LEAN CONSTRUCTION IN GERMANY

Study on the Status Quo of Diffusion and Application

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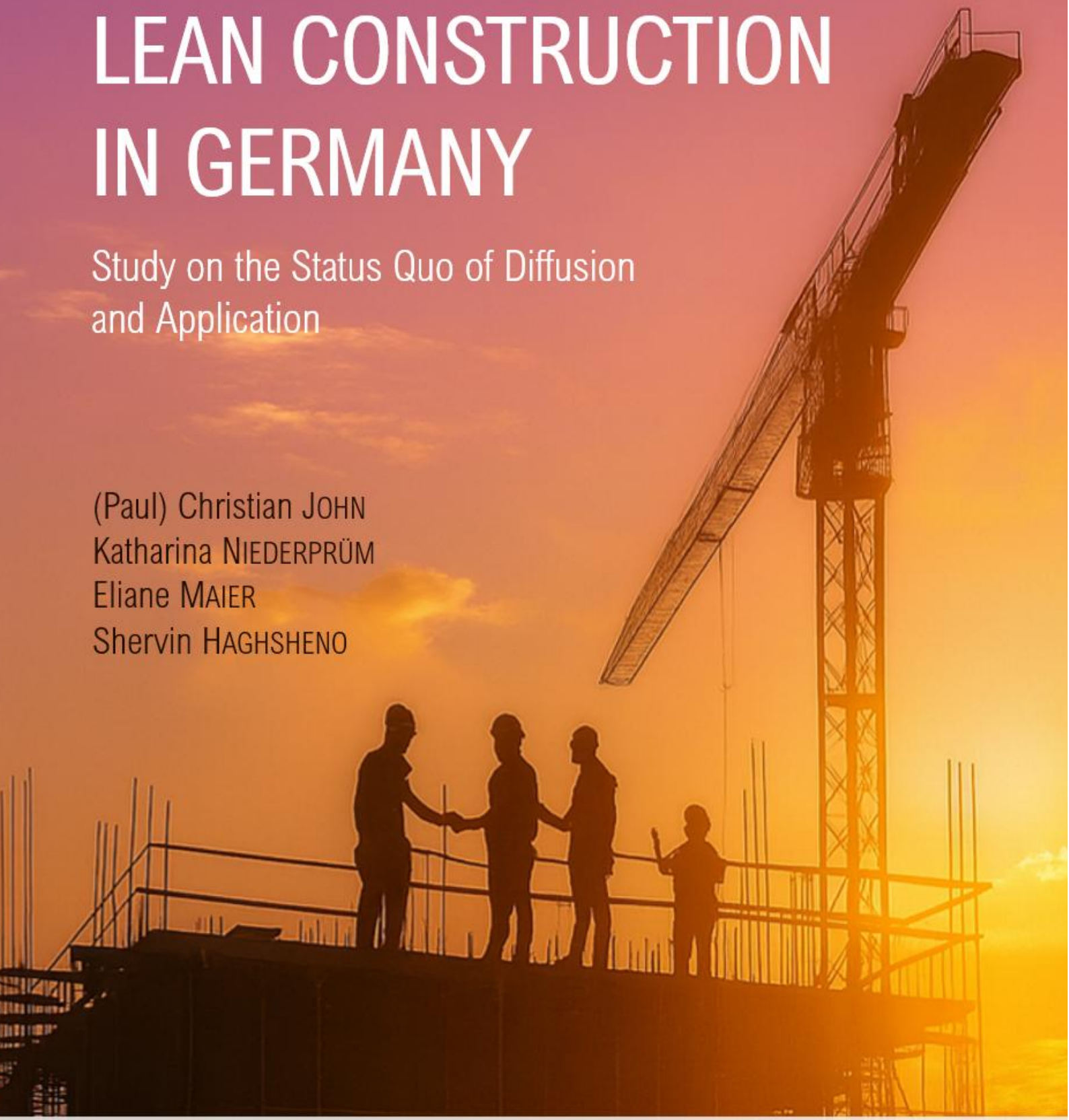

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Foreword

Lean Construction has accompanied the German construction sector for almost two decades now – yet until recently, there has been no robust basis for comprehensively assessing its diffusion, depth of application, and effectiveness. This study now provides a well-founded stocktake: it shows where we stand today, how Lean is being applied, what successes have been achieved, and where there is still room for development.

For us at the German Lean Construction Institute (GLCI), this investigation is of particular importance. Over recent years, we have contributed substantially to the diffusion of Lean Construction, while also knowing that the reality in projects is more complex than the Lean discourse often suggests. The findings presented here confirm more than one intuition – while, at the same time, providing much-needed clarity.

The study makes one thing clear: Lean Construction works. The higher the maturity level, the stronger the perceived effects on schedule, cost, and process reliability, as well as on collaboration among all parties involved. This insight is encouraging and underscores the value of a consistently applied Lean approach. At the same time, it is equally evident that Lean is not yet a standard in Germany. Maturity levels vary widely, and a genuine Lean culture currently exists only in a small segment of the industry. In addition, the authors identify two problematic developments that hinder the anchoring of Lean Construction and put its acceptance at risk – referred to as “Lean light” and “Leanwashing.”

Beyond barriers, the study also highlights concrete potentials: a more consistent integration in the planning phase, stronger involvement of smaller companies, more qualification and capability building, and a more active role of clients / project owners. With its valuable results, the study offers both benchmarking and strategic orientation. It shows what works, what is missing, and how the construction sector can continue its Lean journey.

I am deeply grateful for this study. It sheds light on the situation and provides a solid basis for the further development of Lean Construction. My sincere thanks go to the authors for their initiative, their rigorous execution, and the clear presentation of these important insights.

I wish you an insightful read.

Thomas Bär

Managing Director of the GLCI (German Lean Construction Institute)

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1 Introduction

1.1 Why did we conduct this study?

Lean Construction has accompanied the construction industry for more than three decades. International as well as national projects have provided compelling evidence that the Lean approach can deliver substantial improvements in schedule and cost reliability, quality, occupational safety (in both physical and psychological terms), and the collaboration among all project stakeholders. As a result, professional talks, training programmes, and academic work often present the Lean approach as a promising pathway to address some of the deeply rooted challenges in construction in a sustainable way and to "transform" the industry accordingly.

In Germany, too, a growing Lean Construction community has formed in recent years, largely organised through the German Lean Construction Institute (GLCI). At events such as the annual GLCI Congress, insights into (successful) projects, practical experience reports on the application of Lean Construction, and various best practices are presented and discussed. Many participants perceive the resulting atmosphere as stimulating and inspiring – and, in this way, it can contribute to the diffusion of Lean Construction within the industry. At the same time, it can also quickly create the impression that Lean Construction is already being applied comprehensively within the respective organisations and that the positive effects are already widespread across the German construction sector.[1]

However, the reality of project practice is more complex. While an increasing number of companies in Germany apply Lean Construction – and can demonstrably do so successfully – the construction industry as a whole continues to struggle with schedule and cost problems, conflicts between stakeholders, and insufficient process stability. This contrast raises the question of how far the diffusion of Lean Construction in Germany has actually progressed, and how effective its application is within the respective projects. This is the question addressed by the present study.

[1] The present wording is explicitly not intended as a criticism of the GLCI or of the format of the annual GLCI Congress. On the contrary, the event is a key building block for the diffusion of Lean Construction in Germany: it offers a unique platform for motivation, exchange, and networking, and has made a substantial contribution to increasing the visibility of the topic in both practice and academia. The "risk of a distorted perception" described here rather refers to the fact that participants should not transfer the practical examples presented there to the industry as a whole without appropriate differentiation.

This research report provides, for the first time, an up-to-date and comprehensive stocktake of Lean Construction practice in Germany. The results are relevant at multiple levels. For the construction industry as a whole, they provide a strategic basis for shaping further transformation in a systematic way. For individual companies, they offer orientation and a rough benchmarking reference: Compared to other actors in the industry, what share of our projects do we deliver using Lean Construction? How deeply do we apply methods, and which practices have become established elsewhere? The study also provides concrete guidance for change-management initiatives that should be considered when introducing and applying Lean Construction in practice: What typical challenges and forms of resistance arise? What effects can be expected? Beyond this, the report offers newcomers, experienced practitioners, and researchers in the field a detailed account of how Lean Construction is currently implemented in German construction project practice.

With this study, we aim not only to present a more realistic picture of the current situation, but also to provide a robust basis for advancing the development of the German construction industry through the Lean approach in a more targeted way.

1.2 How was the study carried out, and how is this report structured?

The present study is based on a multi-stage research design. As a starting point, an overview was compiled of the Lean Construction companies operating in Germany. Building on this, the different ways of working and perspectives of some of these organisations were examined. The insights generated were then transferred into a nationwide survey to gain an overall picture of the construction industry. This approach made it possible to consolidate the findings step by step, increase the validity of the results, and ultimately develop a balanced overall picture for Germany. Specifically, the study comprised three consecutive phases:

- **Phase 1: Industry analysis**

  Based on comprehensive desk research, we first identified those companies in Germany that use Lean Construction in project delivery. To this end, we analysed company websites, job postings, and LinkedIn profiles, and also considered the GLCI membership list and conference participants. The result is a database of 451 companies. This provides, for the first time, a robust empirical basis for assessing the actual diffusion of Lean Construction in Germany.

- **Phase 2: Practitioner interviews**

  Building on this database, 15 semi-structured interviews were conducted with experienced practitioners from selected companies. The aim was to understand how Lean Construction is applied in practice across different construction projects, what successes are achieved, where difficulties arise, and how the interviewees assess the overall maturity of the construction industry. The insights gained also formed the substantive basis for designing the questionnaire in Phase 3.

- **Phase 3: Nationwide survey**

  All Lean Construction companies identified in Phase 1 were invited to participate in an extensive online survey. The questionnaire combined items on company characteristics, the scope and quality of Lean Construction application, and statements derived from the interviews. In total, 97 of the 451 invited companies participated – an above-average response rate for this type of study – enabling a robust understanding of Lean Construction practice in the German construction industry.

This results report is therefore structured in line with this phase logic. Following the introduction (Chapter 1), Chapter 2 provides the theoretical foundation required to understand the study results. It sets out our conceptual understanding of Lean Construction and positions the study in an international context: What similar investigations have been conducted in other countries, and what findings have been reported? These insights also informed the design of our study. Chapter 3 then describes the research methodology in detail. In line with the three phases, this chapter outlines the methodological approach, data collection and analysis, and key limitations for each phase. This ensures transparency for readers regarding the empirical basis of the results and the boundaries of their interpretive power. The subsequent results chapter (Chapter 4) is likewise structured around the three phases. It first presents the findings of the industry analysis (Phase 1), followed by the interview results (Phase 2) and finally the results of the nationwide survey (Phase 3). Throughout, results are not only reported but also discussed and contextualised in order to highlight their relevance for research and practice. The report ends with a concluding discussion that summarises the key findings and formulates both an outlook for research and practical implications (Chapter 5). In particular, it addresses how the results can be put to use by companies, institutions such as the GLCI, and the research community. The report is complemented by an appendix, which includes, among other materials, the references and the full questionnaire to support transparency and traceability of the study process.

1.3 What were the overarching findings?

The study results paint a nuanced picture of the diffusion of Lean Construction in Germany. On the one hand, they confirm that the Lean approach has now reached all functional areas of the construction industry. On the other hand, it becomes clear that its broad-based diffusion across the company landscape remains relatively limited. Through the industry analysis (Phase 1), we identified 451 Lean Construction companies across Germany that appear to apply Lean Construction. Against the backdrop of an estimated more than 300,000 companies[2] in the German construction industry, this corresponds to a share well below one percent. Lean Construction is therefore visible in Germany, but by no means established across the industry. Notably, it is primarily larger companies that use the Lean approach, while small and medium-sized enterprises were clearly underrepresented in our research results.[3]

In addition, both the interview findings (Phase 2) and the nationwide survey (Phase 3) indicate that many users perceive the implementation of Lean Construction in the German construction industry as highly effective – the more mature the Lean application, the stronger the perceived benefits. At the same time, the overall view across the industry shows that Lean Construction often does not achieve the level of qualitative depth and breadth within projects (in terms of cross-functional and cross-phase application) that would be necessary to realise the full potential of the approach. While the term “Lean light” refers to a simplified or partial application of Lean practices (often without broader cultural adoption), “Leanwashing” describes the buzzword phenomenon in which projects or companies market Lean Construction externally without making serious efforts to implement it. In both cases, any positive effects remain local and sporadic, at best. This also creates the risk that project participants subsequently perceive the Lean approach as ineffective – or even as additional work – which typically has a negative impact on the acceptance of Lean Construction among those individuals in future construction projects.

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[2] This estimate was generated using an AI-based approach. Reference points included existing figures from different functional areas (see also Chapter 4.1.2).

[3] In this context, the international comparison suggests that Germany is among the leading countries in the practical application of Lean Construction. This became evident when we presented the results of this study at a conference in Kyoto (Japan) in summer 2025 (JOHN et al., 2025a): numerous discussions with international colleagues indicated that, in many other countries, actual implementation in practice is often even considerably lower – despite intensive research activity. In recent years, the work of the GLCI has made an important contribution to the diffusion of Lean Construction in Germany and has significantly increased the visibility of the topic. We have also conducted a separate study that provides a more differentiated analysis of the GLCI’s influence on the diffusion of Lean Construction in Germany: WEINMANN et al. (2025) – *A Decade of Transformation: the Role of the German Lean Construction Institute in the Construction Industry*.

The survey further indicates that, for most companies, Lean Construction application is limited to a small share of the projects they deliver. Only a small proportion of the surveyed companies apply Lean Construction in the majority of their construction projects. Methods such as the *Last Planner System* and *Takt planning / Takt control* are particularly widespread, whereas methods such as *Choosing by Advantages* or *Set-Based Design* are known and applied by only a few companies. The main barriers to expanding the Lean approach to a larger number of a company's construction projects are, in general, a lack of know-how, limited resources[4], insufficient support from top management, and often limited or absent demand on the project owner side.

A detailed presentation and discussion of all results can be found in Chapter 4.

[4] This helps to explain, among other factors, why primarily larger companies visibly apply Lean Construction.

2 Theoretical basis for understanding the study results

2.1 Conceptual understanding of Lean Construction

Lean Construction refers to the application of the Lean approach in the construction industry. The cross-industry Lean approach emerged in the 1990s, building on the Toyota Production System (TPS). Toyota attracted international attention in the 1980s through its distinctive way of managing production, as it clearly outperformed its European and American competitors in the global market (WOMACK et al., 1990). In response, a research team from the Massachusetts Institute of Technology (MIT) travelled to Japan to investigate Toyota's operations (etc.) and to understand the underlying reasons for its success. The findings of this study – led by James Womack and Daniel Jones – form the foundation of what later became known as the Lean approach.

The Lean approach can therefore also be described as a coherent set of practices, working principles, and behaviours (best practices) that have proven successful in practice and that Toyota compiled over time, further developed, and integrated into a consistent system (JOHN et al., 2025b). From an American perspective, this was subsequently captured, systematised, and, over the course of several years, abstracted into a management approach with an overarching philosophy.

Originating in an industrial context, the Lean approach was continuously developed further in subsequent years in collaboration with practice and transferred to many other industries. The first transfer to parts of the construction industry took place in the early 1990s, when researchers such as Lauri Koskela identified fundamental parallels between industrial production systems and construction processes (KOSKELA, 1992). Under the term *Lean Construction*, the principles and methods of the Lean approach were then deliberately adapted to the specific requirements of construction (initially focusing only on building execution processes). A key early milestone in this development was the founding of the International Group for Lean Construction (IGLC) [5], which has since provided the central platform for international exchange on Lean Construction through its conferences (JOHN et al., 2026).

[5] The International Group for Lean Construction (IGLC) is an international research and practice network for Lean Construction that has been active since 1993. Its central forum is the annual IGLC conference, where academic papers and practice reports from around the world are presented and discussed. The IGLC community brings together researchers and practitioners who jointly work on advancing concepts, methods, and fields of application of the Lean approach in the construction industry.

At its core, Lean Construction should therefore be understood not merely as a collection of individual methods, but as a holistic management approach for improving the delivery of construction projects. It is characterised by the interplay of principles, practices, and mindsets. At the level of principles, this includes, among other elements, a consistent focus on waste-free value creation for customers and end users, the creation of process stability and flow, pull-based control, transparency, and continuous improvement. At the methodological level, these principles are manifested in practices such as the *Last Planner System*, *Takt planning and Takt control*, *visual management*, *Choosing by Advantages*, and *Set-Based Design*. Finally, Lean Construction is underpinned by a mindset and culture of learning and of collaborative, respectful cooperation – promoting ownership, trust, and a constructive approach to dealing with errors. Only through the interaction of these elements does Lean Construction realise its full effectiveness.

The introduction of Lean Construction in Germany began with a certain delay compared to global developments. Initial impulses emerged in 2003 through contact between Professor Fritz Gehbauer (Karlsruhe Institute of Technology (KIT)) and Gregory Howell (co-founder of the Lean Construction Institute (LCI) in the United States). In the years that followed, early research projects, university teaching, and pilot projects emerged. With the founding of the German Lean Construction Institute (GLCI) in 2014, the diffusion of Lean Construction in Germany then gained an institutional basis. Since then, through conferences, regional practice groups, education and professional development programmes, and publications, the GLCI has made a substantial contribution to making Lean Construction known in the German-speaking context and to building an active community (WEINMANN et al., 2025).

2.2 Research on the status quo of Lean Construction

2.2.1 National studies

To date, only a limited number of academic studies in Germany have systematically examined the status quo of Lean Construction. Among the few available works are the studies by JOHANSEN and WALTER (2007), DLOUHY et al. (2017), and BACKHAUS and DAHM (2020) (see Table 1).

Table 1: Overview of national construction-related studies[6]

Authors (year)	***Study scope***	***Methodology***	***Respondents***	***Focus***
JOHANSEN and WALTER (2007)	Germany	Survey, interviews	Companies*	Conceptual understanding, trends in Lean development
DLOUHY et al. (2017)	Germany	Interviews	Companies	Degree of integration
BACKHAUS and DAHM (2020)	Germany	Interviews	Companies*	Degree of implementation, development of a maturity model

The study by JOHANSEN and WALTER (2007) is regarded as the first investigation of Lean Construction in Germany. It focused on how Lean principles are understood and perceived, and on which trends can be identified in Lean development. The study considered contractors in the construction industry exclusively. To this end, 61 of the largest German construction companies were invited by email to participate in a questionnaire survey; however, only 17 companies responded. To complement the survey, two expert interviews were subsequently conducted. The results showed that, in the mid-2000s, there was little awareness or application of Lean Construction in Germany. A basic understanding of the improvement potential of the Lean approach was also largely lacking. At the same time, the authors argued that certain established construction practices were already consistent with Lean principles – without companies being consciously aware of this or actively labelling these practices as "Lean Construction". This phenomenon is discussed in the literature under conformity theory, which suggests that organisations can behave in a "Lean-conforming" manner without actively using Lean Construction (ABU DAQAR, 2025; MUKABANA et al., 2015; SWEIS et al., 2016; TEZEL and NIELSEN, 2013).[7]

A further study in the German context was conducted by DLOUHY et al. (2017). Using a targeted sample, the authors carried out interviews with eight German project owner organisations in order to analyse their integration of Lean principles and methods. The results indicated that the project owners examined were at different maturity levels. Only a small share of the available Lean practices was used by these organisations. Overall, the surveyed project owners were therefore classified as being at an early stage of development.

[6] Studies marked with an asterisk (*) indicate an ambiguous or mixed classification (individual- and company-level perspective).

[7] This also aligns with our understanding of the Lean approach and can be explained well by its historical development: the Lean approach integrates many well-known best practices and proven management ideas that had already been applied by other organisations. For example, it is well documented that, after the Second World War, Toyota engineers travelled to Ford and drew inspiration from its production system.

BACKHAUS and DAHM (2020), by contrast, examined the degree of Lean Construction implementation on the contractor side. Their study was based on a maturity model comprising 55 Lean attributes, derived from a literature review and expert interviews. In total, interviews were conducted with 14 contractor representatives as well as staff from a management consultancy and a research institution. The results showed that some companies implement individual Lean attributes, while many others remain entirely unaddressed. Accordingly, the authors assess the surveyed German companies as having an overall low to medium maturity level. Notably, larger and more specialised companies tended to show greater openness towards Lean. As a major barrier to integrating (all) Lean attributes, the authors point to a pronounced culture of mistrust in Germany, which is further reinforced by strict liability regulations.

In addition to the studies described above, the study *"25 Years of Lean Management"* can be considered, which was conducted by Staufen AG and TU Darmstadt in 2016. This study surveyed more than 1,300 executives from various industries on the level of implementation and the impacts of Lean Management in Germany. However, it was cross-industry and not specific to the construction industry. Two thirds of respondents came from mechanical and plant engineering, the automotive industry, and the electrical industry. The results showed that 95% of participants had introduced initial Lean practices. Only seven percent, however, stated that they consistently align their strategy and organisation with the Lean philosophy. This indicates that – even beyond construction – the Lean approach has so far only been embedded to a limited extent in Germany.

Overall, for the German context it can be concluded that only three studies with a direct focus on the construction industry currently exist. At the same time, all three investigations address a narrow segment and are based on small, non-representative samples. Accordingly, they do not allow a comprehensive assessment of the actual status of Lean Construction diffusion and application in Germany.

2.2.2 International studies

In the international context, a substantially larger number of studies is available that examine the status quo of Lean Construction at national level (see Table 2). The studies listed do not constitute an exhaustive overview; nevertheless, they illustrate in particular the range of approaches and thematic emphases found in studies with a similar objective.

Table 2: Overview of international construction-related studies[8]

Authors (year)	***Study scope***	***Methodology***	***Respondents***	***Focus***
COMMON et al. (2000)	United Kingdom	Survey	Companies*	Level of application, degree of penetration of Lean practices
JOHANSEN et al. (2002)	Netherlands	Survey	Companies*	Level of application and development, self-assessment
SARHAN and FOX (2012)	United Kingdom	Survey, interviews	Companies*	Level of implementation, trends in the development of a Lean culture, challenges
EBBS et al. (2015)	Ireland	Literature review, surveys, focus groups, interviews	Individuals	Level of understanding of Lean and LC, comparison of LC theory with current practice
KIFOKERIS and KOCH (2023)	Sweden	Literature review, survey	Individuals	Level of application
MALVIK et al. (2024)	Norway	Survey	Individuals	Awareness; understanding, level of application, knowledge gaps, barriers
Lean Construction Institute (2024)	USA	Survey	Individuals	Status of Lean implementation
PÁEZ et al. (2013)	Colombia	Document analysis, interviews	Individuals	Level of diffusion
SALVATIERRA et al. (2015)	Chile	Interviews, workshops, observation, survey	Companies*	Implementation status barriers, success factors
AYARKWA et al. (2011)	Ghana	Survey	Companies	Perceptions and level of knowledge, benefits, measures
BAJJOU and CHAFI (2018)	Morocco	Survey, Interviews	Individuals	Level of awareness of LC practices, benefits, barriers
MAKONDO and CHIROMO (2020)	South Africa	Literaturreview	Project level (limited)	Level of implementation
SHAQUOR (2022)	Egypt	Survey	Individuals	Implementation status, causes of waste, level of knowledge, benefits
IKUABE et al. (2024)	South Africa	Survey	Individuals	Level of familiarity with Lean techniques

[8] Studies marked with an asterisk (*) indicate an ambiguous or mixed classification (individual- and company-level perspective).

Authors (year)	*Study scope*	*Methodology*	*Respondents*	*Focus*
AL-AOMAR (2012)	Abu Dhabi	Survey	Companies	Types of waste, level of familiarity, use of Lean practices, barriers, measurement of Lean performance
PAN and PAN (2016)	China	Interviews	Individuals	Extent of use of practices, benefits, challenges, future development
SARHAN et al. (2017)	Saudi Arabia	Survey	Individuals	Types of waste, use of Lean practices, phases of application, benefits
AHMED and WONG (2018)	Malaysia	Survey, interviews	Individuals	Level of awareness and acceptance of the need for Lean practices
AHMED et al. (2020)	Bangladesh	Survey	Individuals	Level of awareness, benefits, challenges
BINU and GUPTA (2024)	UAE	Literature review, survey, case study	Individuals	Level of familiarity, relationship between awareness and education level, barriers
CHESWORTH et al. (2011)	Australia	Survey	Companies*	Level of awareness and understanding

The studies listed above mostly examine the level of application, awareness, and understanding of Lean Construction. Methodologically, they employ a wide range of approaches, including surveys, interviews, case studies, and mixed-methods designs. Standardised questionnaires are used most frequently. However, the quantitative scope, scientific rigour, and substantive focus of these investigations vary considerably.

In addition, some academic publications address more specific topics, such as the prerequisites for successful implementation (e.g., DULAIMI and TANAMAS, 2001), implementation barriers and obstacles (AL BALKHY et al., 2021; ALINAITWE, 2009; SINGH et al., 2024), the assessment of effectiveness and benefits of Lean practices (AHMED et al., 2021; OGUNTONA et al., 2018; AYARKWA et al., 2011), or the identification and analysis of types and causes of waste (AL-AOMAR, 2012; SENARATNE and WIJESIRI, 2008).

Notably, many of these studies are limited to specific subdomains of the construction industry rather than examining national construction activity as a whole. For example, SWAIN and MARTIN (2000) studied roofing and facade construction in the United Kingdom, SMITH and NGO (2017) investigated interior fit-out in the United States, and LORIA-ARCILA et al. (2003) examined affordable housing construction in Mexico. Other studies focus exclusively on individual Lean practices such as the *Last Planner System* – for instance in Chile (ALARCÓN et al., 2002), Nigeria (AHIAKWO et al., 2012), or Mexico (CERVERÓ-ROMERO et al., 2013). In some cases, only specific regions within a country are considered (e.g., IKUABE et al., 2024; AHMED and WONG, 2018).

Overall, the literature review reveals a highly heterogeneous picture across comparable studies. Many are limited to specific aspects – for example, particular subdomains of the construction industry, restricted respondent groups, individual methods, specific questions such as the identification of implementation barriers, or only certain regions. To date, there is no study that presents the overarching national status quo (the “big picture”) for an entire country.

In terms of methodological quality, it also becomes apparent that the comparability of results is hindered by the wide range of different research approaches. In addition, many studies rely on surveys of individual practitioners without capturing the organisations they belong to or checking whether multiple responses from the same company may have occurred. This may distort the overall impression. It also often remains unclear whether the respondents were actually in a position to make informed statements about Lean application in their organisation. Moreover, none of the studies reviewed identified the population of Lean Construction companies in advance, which would be required as a robust reference base. As a result, many studies lack a differentiated view of the company landscape. At best, they allow statements about the behaviour of larger or smaller companies, but they do not support robust conclusions about the frequency or diffusion of Lean Construction.

In summary, the literature suggests that, in most countries, Lean Construction is still at an early stage of development. However, none of the available studies has been able to demonstrate broad-based diffusion and deep implementation. In many countries, authors observe a growing awareness of Lean Construction, yet such statements are often difficult to interpret because a clear reference to the size of the construction industry is missing. At the same time, insufficient understanding of the Lean approach in practice is frequently reported.

2.2.3 Measuring maturity and conformity

To structure the assessment of the Lean Construction status quo within companies, research draws on different types of models, which can be grouped into two overarching categories: maturity models and conformity models.

Maturity models capture the development stage of an organisation or a project on its individual “Lean journey”. Their purpose is to provide orientation for change and improvement strategies (Nesensohn et al., 2014). In general, maturity is measured at the level of individual projects or organisations, rather than at the level of the construction industry.

Outside the construction industry, a wide range of established models exists—for example, the *Lean Enterprise Self-Assessment Tool* (LESAT) from 2001, developed by the Massachusetts Institute of Technology (MIT), the University of Warwick, and members of the British and US Lean Aerospace Initiative. Within construction, the *Lean Construction Maturity Model* (LCMM) by NESENSOHN et al. (2014) is widely used. It enables organisations to determine their level of maturity – particularly when they are introducing Lean Construction or seeking to embed it more firmly. Further models include, for example, the *Highways England Lean Maturity Assessment Toolkit* (HELMA), developed specifically for infrastructure projects in the United Kingdom; the *Institute for Lean Construction Excellence Lean Maturity Model* (ILMM) by VAIDYANATHAN et al. (2024), which supports measuring and improving Lean maturity in the Indian construction context; and the *LCI Lean Assessment Tool*, which is available on the Lean Construction Institute's website as a self-test for individuals, teams, or organisations.

What all maturity models share is that they divide the development process from initial introduction to full "Lean maturity" into qualitative stages. For each stage, a theoretical optimum state is defined and positioned based on experience with preceding stages. Companies or projects can thus assess how advanced their Lean Construction implementation already is. In addition, the maturity level is inferred from the completeness and consistency with which different Lean aspects are applied.

In the present research design, we adopted both the principle of positioning organisations within a development process and the approach of considering the completeness and consistency of application – see Chapter 4.3.

Alongside maturity models, conformity theory has coexisted in this context for many years. It is based on the assumption that applying the Lean approach is, in a sense, "old wine in new bottles", and that companies may act in line with Lean principles even without consciously introducing or actively applying the Lean approach. The central question is the extent to which a company's practices and ways of working conform to the core principles of the Lean approach. A key starting point for many studies is the *Lean Assessment Tool* by DIEKMANN et al. (2003). Designed as a questionnaire, it captures the degree of conformity of organisational practices along a spectrum from "Lean" to "non-Lean". Using this instrument, MUKABANA et al. (2015) in Kenya and TEZEL and NIELSEN (2013) in Turkey found relatively high Lean conformity in some cases, even though – within the companies studied in both countries – there was no well-founded understanding of Lean Construction.

3 Research methodology

3.1 Overview of the research design

To investigate the current status quo of Lean Construction diffusion and application in Germany, we developed a three-stage, sequential research design (see Figure 1). The three phases build systematically on one another and combine different methodological approaches in order to capture both the breadth and the depth of the topic.

Figure 1: Schematic illustration of the research design

In **Phase 1**, the focus was on identifying companies in Germany that apply Lean Construction. Throughout this report, we refer to these organisations as Lean Construction companies. To identify them, we conducted a comprehensive analysis of the German construction industry and systematically evaluated multiple data sources. The aim was to establish an overview that is as complete as possible of the relevant companies active in Germany. The results of this phase provide a robust empirical foundation and at least an approximately representative reference base for the subsequent phases.

Building on Phase 1, **Phase 2** consisted of semi-structured interviews with practitioners. In total, 15 individuals were invited who have several years of experience with Lean Construction and in-depth knowledge of the German construction industry.

The interviewees were selected from the group of Lean Construction companies identified in Phase 1. The purpose of this phase was to gain deeper insights into the practical application of Lean Construction, to capture typical success factors and barriers, and to develop a better understanding of the perceived maturity of the German construction industry with regard to Lean Construction. The interview results also served as the substantive basis for designing the questionnaire in Phase 3.

In **Phase 3**, a standardised online survey was conducted. All companies identified in Phase 1 were invited to participate. The survey aimed to develop a more comprehensive picture of the implementation status of Lean Construction among applying companies in Germany. Responses were analysed statistically, discussed, and reported in this research report.

Some key findings were already presented in an international conference contribution (JOHN et al., 2025a). However, this research report presents all results in full, and in expanded form, for the first time.

3.2 Methodology in Phase 1: Industry analysis

The aim of Phase 1 was to identify, as comprehensively as possible, all companies in the German construction industry that apply Lean Construction. This stocktake was intended to provide a reliable basis for systematically examining the diffusion of Lean Construction and, building on this, for conducting more in-depth and (approximately) representative analyses of the nature of its application.

The Phase 1 approach was guided by the study of HAGHSHENO and JOHN (2024), which identified providers of project management services on the project owner side in Germany through an extensive market analysis. In an analogous manner, the present study conducted a desk-based search relying on publicly available sources. In addition, internal information from the GLCI was analysed.

The methodological starting point for this phase was a design-thinking workshop (BROWN, 2008), which addressed the central guiding question: *How can systematic research be used to identify, as comprehensively as possible, all companies that apply Lean Construction in Germany?*

The workshop resulted in four search strategies (see Table 3 and the explanations below):

Table 3: Search strategies for the industry analysis

Search strategy	***Companies identified***	***Search scope***
(1) GLCI register	162	Member database + participant lists from the past five congress years
(2) Company websites	168	Entering 1,230 keyword combinations + screening 6,543 Google results pages
(3) Job postings	62	Screening 30,944 job postings
(4) LinkedIn search	59	Screening 5,246 LinkedIn profiles

(1) German Lean Construction Institute (GLCI) register + congress participation:

As a starting point, we used the membership register of the GLCI, which serves as the central platform of the Lean community in the German-speaking region. In addition to member companies, we also captured the participant lists from recent GLCI congresses. Both membership and congress participation at least suggest a basic interest in the topic. To ensure actual application of Lean Construction, we additionally analysed the respective company websites – particularly service portfolios, company descriptions, and reference projects. Only companies with explicit indications of Lean Construction application were included in the database.

(2) Company websites (via Google):

The central search strategy for identifying Lean Construction companies with no direct connection to the GLCI was a systematic keyword search via Google. This search builds on the observation that companies often present their Lean Construction application on their websites.

For this research, nine (German) Lean-related keywords were first defined in the design-thinking workshop: *Lean Construction*, *Lean Bauwesen* (Lean construction industry), *Lean Management Bau* (Lean Management construction), *Lean Bauunternehmen* (Lean construction companies), *Lean Construction Bauunternehmen* (Lean Construction Construction companies), *Lean Design*, *Lean Architekt* (Lean Architect), *Last Planner*, *Taktplanung* (Takt planning).

The subsequent research was then carried out in several steps:

a. First, the nine keywords were applied nationwide in Germany:

   `„(Lean Construction OR Lean Bauwesen OR […]) AND Germany“`

b. Next, a geographic grid was applied to systematically increase the hit rate and to ensure that companies with a primarily regional focus were captured. For this purpose, each of the nine keywords was combined with all 16 federal states, e.g.:

`„(Lean Construction OR Lean Bauwesen OR […]) AND Bavaria“`

c. Building on this, we analysed Germany's largest cities. This was based on the classification of *bulwiengesa AG*, which groups cities into four categories (A–D) according to their significance for the real-estate market. The search covered all 7 A cities, 14 B cities, and 22 C cities[9].

Overall, this resulted in 1,230 keyword-location combinations. For each combination, we reviewed at least the first 15 pages of Google results (where available). Where further relevant indications emerged, we also considered later results pages. In total, 6,543 Google results pages were analysed. Companies were included in the database if their websites contained clear evidence of Lean Construction activities; otherwise, they were not considered.

(3) Job postings (via job portals):

Because some companies do not promote their Lean Construction application on their websites, we applied an additional search strategy: analysing job postings on two of the most widely used job portals in Germany – Indeed (www.indeed.com) and StepStone (www.stepstone.de). The underlying assumption was that companies posting vacancies with an explicit Lean Construction focus either already apply the Lean approach or are at least in concrete preparation to introduce it in the near future.

We used the same nine keywords as in the Google search, supplemented by *Lean Construction Manager* and *Lean Bauingenieur* (Lean civil engineer). In total, 30,944 job postings were screened. Companies were recorded if the posting either used a Lean-specific job title (e.g., "Lean Manager") or explicitly required experience with Lean Construction.

(4) Job role descriptions (via LinkedIn):

Because not all companies make their Lean Construction activities visible on their own websites, and not all are recruiting via online job advertisements at any given time, we additionally included the career and business platform LinkedIn (www.linkedin.com) in the search. Here, the assumption was that, where Lean Construction is actually applied, indications would be visible in job titles, in role descriptions, or in clearly stated certifications within profiles.

[9] In addition, for the federal states of Hesse and Rhineland-Palatinate, the search was extended to include D cities as well as all rural districts ("Landkreise") and independent cities ("kreisfreie Städte"). This resulted in 674 additional keyword combinations. As analysing this level yielded only very limited additional results (+3 companies), this step was not extended to further federal states.

Using the search operators already applied, we conducted targeted searches for profiles with a Lean Construction reference by combining the defined keywords with location terms, for example:

`„(Lean Construction OR Lean Bauwesen OR […]) AND Hamburg“`

As location terms, we used all A, B, C, and D cities in Germany (a total of 127 cities). In total, 5,246 profiles were screened. Particular attention was paid to job titles, role descriptions, and listed skills. If a profile indicated a clear link between Lean Construction and a specific company, that company was added to the database.

The results of all four search strategies were consolidated and categorised in a single database. For each company, we documented the company name, legal form, website, headquarters, number of locations, and (where available) a contact person with a Lean Construction reference.

During the searches, many higher-education institutions also appeared in the results. As the extent to which Lean Construction is reflected in the curricula of German higher education is likewise an indicator of the approach's diffusion, we separately reviewed all 422 higher-education institutions in Germany to determine whether they offer programmes related to construction and real estate. Where this was the case, we analysed the respective module handbooks to assess how frequently and to what extent Lean Construction is taught (as a dedicated module, as part of a module, or as a component within a course).

Training and professional development providers as well as software providers were also added to the database, as these actors likewise provide important indications of the diffusion of Lean Construction in Germany. However, they were not searched for systematically; therefore, we make no claim of completeness for these categories.

Methodological limitations

Despite the extensive methodological approach, completeness of the data collection cannot be guaranteed. The analysis relied largely on publicly available information. Companies that apply Lean Construction but do not communicate this externally in any of the forms examined could therefore not be captured. Conversely, it is also possible that some companies promote Lean Construction externally but do not (or no longer) practise it and were therefore included in the database incorrectly.

In addition, paid job portals such as StepStone and Indeed are typically used more frequently by larger companies; smaller firms may therefore be underrepresented in the results of this search strategy. Similar limitations apply to visibility via professional company websites and LinkedIn profiles. Moreover, the Google and LinkedIn searches were limited to larger cities and the federal-state level; companies located in rural areas may therefore have been captured less frequently, despite sample-based test

runs. On LinkedIn, only public profiles could be considered – private profiles were not accessible.

When incorporating project references, another challenge was distinguishing between the active application of Lean Construction and mere participation in projects where Lean was applied by others. Here, we sought to include only those companies that apply Lean Construction on their own initiative wherever possible.

Despite these limitations, given the breadth of sources considered, the large number of records screened, and the diversity of search strategies used, it can be assumed that Phase 1 captured a largely comprehensive picture of the Lean Construction company landscape in Germany.

3.3 Methodology in Phase 2: Practitioner interviews

In Phase 2, the focus was on developing a deeper understanding of how Lean Construction is actually implemented in practice. While Phase 1 provides a systematic stocktake of Lean Construction companies, this phase aimed to capture, in greater depth, the specific forms of application, typical challenges, limitations, and perceived effects of Lean Construction in day-to-day project delivery.

To this end, 15 semi-structured interviews were conducted with experienced practitioners. All interviewees came from the companies identified in Phase 1. Interview partners were selected using a convenience sampling approach. Only individuals who met two core criteria were included:

1. Extensive experience with Lean Construction, measured by the duration and number of projects in which they have applied Lean practices.
2. Comprehensive construction industry knowledge, supported by many years of professional experience, enabling them to interpret both internal developments and broader industry-wide trends.

These criteria were intended to ensure that respondents could, on the one hand, provide in-depth insights into the concrete application of Lean Construction within their company (depth perspective) and, on the other hand, offer more overarching assessments of the construction industry's overall stage of development (breadth perspective) – see Table 4.

Table 4: Profiles of the interviewed practitioners

Primary functional area	***Experience in the construction industry*** *(years)*	***Experience with Lean Construction*** *(years)*	***Number of Lean projects supported*** *(self-assessment)*
Project owner	10	10	65
Project owner	19	11	300
External project owner representative	10	10	10
External project owner representative	12	10	100
Design + construction company	11	8	50
Design + construction company	13	9	90
Design + construction company	28	12	200
Construction company	13	13	300
Construction company	28	9	100
Lean consultancy	7	7	50
Lean consultancy	26	9	10
Lean consultancy	15	7	50
Lean consultancy	26	15	220
Lean consultancy	15	14	60
Association	24	5	-

The interviews followed a semi-structured approach. They were based on an interview guide that included both open-ended questions and pre-formulated statements ("perceptions") for assessment. These were informed by the authors' experience as well as insights from the literature. At the beginning, participants were asked to describe the Lean practices used in their company, to share both positive and negative experiences, and (where relevant) to reflect on exchanges with other companies (e.g., whether they encountered curiosity or resistance). They were then asked to provide an assessment of the overall status of Lean application in the construction industry – a subjective "look over the garden fence" intended to complement the respondents' internal perspective with a broader external perspective.

Each interview lasted approximately 60 minutes on average and was conducted by the first author via videoconference. All conversations were recorded and complemented by written notes. Additional interviews were conducted until no new insights emerged and responses began to repeat. On this basis, theoretical saturation was assumed.

The interviews were subsequently analysed qualitatively. The analysis was based on the written notes as well as the review of the audio recordings. The statements collected were thematically categorised and organised. In this way, initial patterns and

trends could be identified. On the one hand, this provided an overview of different forms of Lean Construction application in the construction industry and of the (subjectively perceived) stage of industry development. On the other hand, the findings formed the basis for the standardised online survey used in Phase 3: statements from the interviews were translated into specific questions and pre-formulated statements and integrated into the questionnaire.

Methodological limitations

As is typical for qualitative studies, the results of this phase are subject to certain limitations. The findings are fundamentally based on the subjective assessments of the interviewed practitioners, shaped by their personal experiences and organisational contexts. They therefore do not allow representative statements about the construction industry as a whole; rather, they provide informed insights into the perceptions of experienced industry participants. The sample of 15 interviews is also limited. While the theoretical saturation achieved ensures a high informational value, the findings remain exploratory in nature.

3.4 Methodology in Phase 3: Company survey

After Phase 1 identified Lean Construction companies in Germany and Phase 2 provided deeper insights into their ways of working through practitioner interviews, Phase 3 served to validate and quantify these insights through a broad-based survey. The aim was to obtain as comprehensive a picture as possible of the current status quo of Lean Construction practice in Germany.

For this purpose, a standardised online survey was conducted. The questionnaire content was developed based on the statements of the interviewees in Phase 2 as well as relevant academic and professional literature. In designing the questions and response options, we followed established recommendations from the methodological literature (DILLMAN, 1978; BRAUNECKER, 2023, p. 122 ff.).

Importantly, the survey explicitly targeted companies, not individuals. This distinction was crucial for developing a differentiated view of the German construction industry. Accordingly, the approach to participants had to be designed carefully. Wherever possible, the invitation was addressed to a person within each company who was likely to have an overview of the company's Lean Construction activities. The invitation text also specified that the survey should be completed only once per company. Each response therefore represents one company in Germany.

Before launching the survey, several pretests were conducted in which ten participants from academia and practice completed the questionnaire one after another. Following each completion, an interview was conducted to check completeness, clarity,

completion time, and technical functionality. After each pretest, the questionnaire was revised and refined until the final version was established (see Appendix 1).

The questionnaire comprised 15 questions (single choice, multiple choice, and matrix items) and 15 statements, structured into three sections to make participation clearer and easier to navigate:

- **Section 1: Profiling the companies**

  Five questions on basic characteristics of the participating company: functional areas, number of employees, number of locations in Germany, international presence, and duration of Lean Construction application. The aim was to capture structural differences that could be considered in subsequent analyses.

- **Section 2: Application of Lean Construction**

  Questions addressing different facets of application, including: the share of projects in which Lean Construction is applied; the quality of application based on a five-level maturity model; how application is organised; frequency of use across different functional areas; the project phases in which Lean Construction is applied; the practices used; targeted measures to promote application within the company; effects on cost, schedule, and quality objectives; and reasons why application is not implemented across all projects.

- **Section 3: Assessment of statements**

  Fifteen statements (general perceptions) derived from the Phase 2 interviews. Participants assessed these on a four-point scale (“Fully agree” to “Do not agree at all”), with an additional “No statement” option. The statements covered a broad range of topics, including: modes of application; understanding and interpretation; reasons for use; different fields of use; effects on project outcomes; challenges and reservations; the role of digitalisation; consideration of project owner and end-user needs; and the suitability of Lean for different project sizes and types of project owners.

The survey was addressed to all 451 companies that had been identified in Phase 1 as Lean Construction companies. In addition, the questionnaire was promoted again at the GLCI Congress 2024: in a presentation by the first author, (Paul) Christian John, initial interim results were shared. Participants could use a QR code to provide their email address and company affiliation, enabling further invitations to be sent in a more targeted manner. In this second outreach round, we also indicated which person from the respective company had already been invited in the first round, and asked companies to ensure that no duplicate participation occurred.

The survey was conducted anonymously in order to increase willingness to participate and to encourage respondents to provide as open and honest answers as possible. This was intended to reduce socially desirable response behaviour.

Of the 451 invited companies, 97 completed the survey in full. The response rate therefore amounts to 22%. This is substantially higher than the 13% response rate achieved by HAGHSHENO and JOHN (2024) in a comparable study and is considered above average for company surveys.

Methodological limitations

The company survey is also subject to methodological limitations. Although all identified Lean Construction companies were approached, the exact structure of the underlying population is not fully known, meaning that full representativeness cannot be claimed. Nevertheless, given the high response rate and the breadth of the respondent group, the results can be regarded as a robust approximation of the status quo. Content validity was supported by the careful development of the questionnaire and the preceding pretests, which helped ensure that the questions were clear, complete, and well targeted (TÖPFER, 2012, p. 234 ff.).

Due to the anonymisation of participation, it was also not possible to verify whether more than one person from the same company responded. The deliberate decision not to implement such controls was made in order to promote openness and honesty in the responses. For quality assurance, however, participants were explicitly asked to check whether the survey had already been completed by their company.

4 Results

4.1 Phase 1: Industry analysis

4.1.1 Overview of the institutional landscape

The central outcome of Phase 1 is a database of 578 organisations in Germany that are connected to Lean Construction in different ways. These organisations can be grouped into four categories: 451 companies that apply Lean Construction in construction projects, 44 training and professional development providers offering Lean Construction-related courses and seminars, 47 higher-education institutions that have integrated Lean Construction into their curricula, and 37 software providers offering products specifically designed for Lean Construction. Figure 2 provides an overview of the Lean Construction institutional landscape in the German-speaking region.

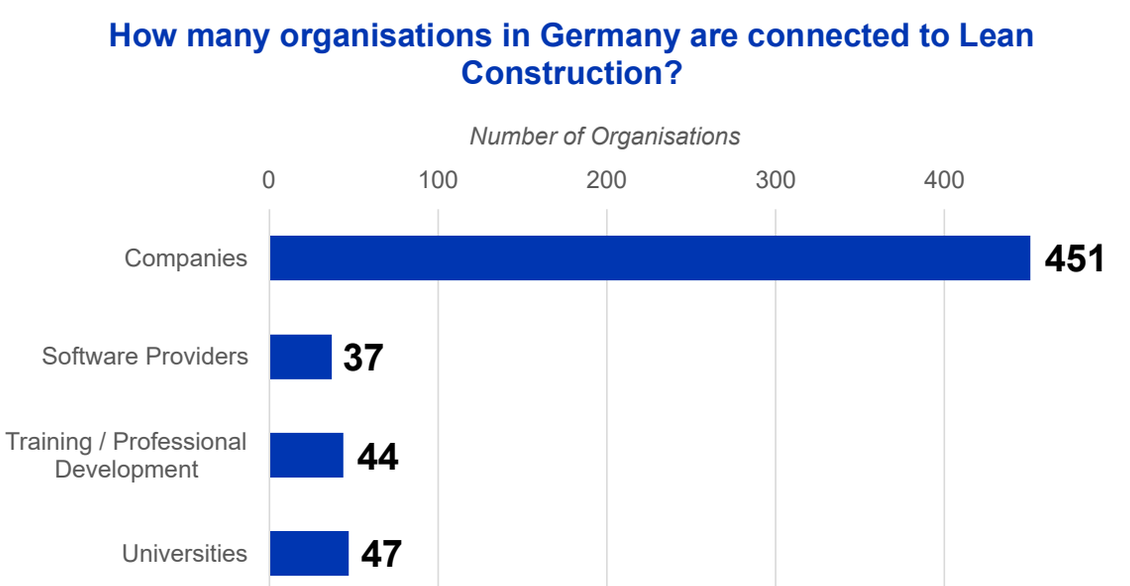

Figure 1: Overview of the institutional Lean Construction landscape in Germany

4.1.2 Companies

The largest group within the dataset comprises companies that actively apply Lean Construction in their project practice. In light of the methodology described in Chapter 3, it can be assumed that the 451 identified Lean Construction companies capture the substantial share of relevant Lean Construction application in Germany. This figure is

therefore meaningful in that it provides an approximately representative overview of the current diffusion of Lean Construction within the German construction industry.

However, determining Lean Construction diffusion relative to the overall industry is difficult with precision, as Germany does not provide robust statistics on the total number of actors in the construction industry. Based on various partial statistics[10] that were consolidated using AI-based analyses, an overall order of magnitude of more than 300,000 construction companies can be assumed.

Against this backdrop, the 451 Lean Construction companies represent less than one percent of the German construction industry. This, in turn, clearly indicates that Lean Construction is still far from being established across Germany – despite its growing relevance since the mid-2000s and the institutional support provided by the German Lean Construction Institute (GLCI), founded in 2014. The low relative penetration in relation to the size of the construction industry therefore highlights substantial potential for broader Lean Construction application.

To better understand the role of the identified companies, we analysed their primary fields of activity / functional areas. Classification followed the roles typically assumed in construction projects:

- Project owner / client (non-core business), project owner as project developer, external project owner representative / project management (PM)
- Architecture, design coordination, specialist design / engineering
- Construction management, construction execution, construction logistics, supplier
- Consultancy

The basis for assigning companies to these functional areas was the information available on their websites, such as company descriptions, service portfolios, and project references. A company could be assigned to more than one functional area.

The results of this analysis (see Figure 3) first illustrate that Lean Construction is now applied across all parts of the value chain in the German construction industry.

[10] The order of magnitude is based on a synthesised estimate derived from several publicly available partial statistics: (1) figures from the Federal Statistical Office (Destatis) on the number of companies in the main construction sector and the finishing trades, (2) industry statistics from the German Social Accident Insurance for the Construction Industry (BG BAU), and (3) company counts in adjacent construction-related service domains (e.g., architectural, engineering, and design offices). These individual statistics were consolidated within the study using AI-supported data matching and clustering procedures to derive a consolidated order of magnitude. Due to differing delineation logics across the sources, the reported figure represents a conservative estimate of the total number of construction-related companies operating in Germany.

In which functional areas are Lean Construction companies primarily active? (n = 451; multiple assignments possible)

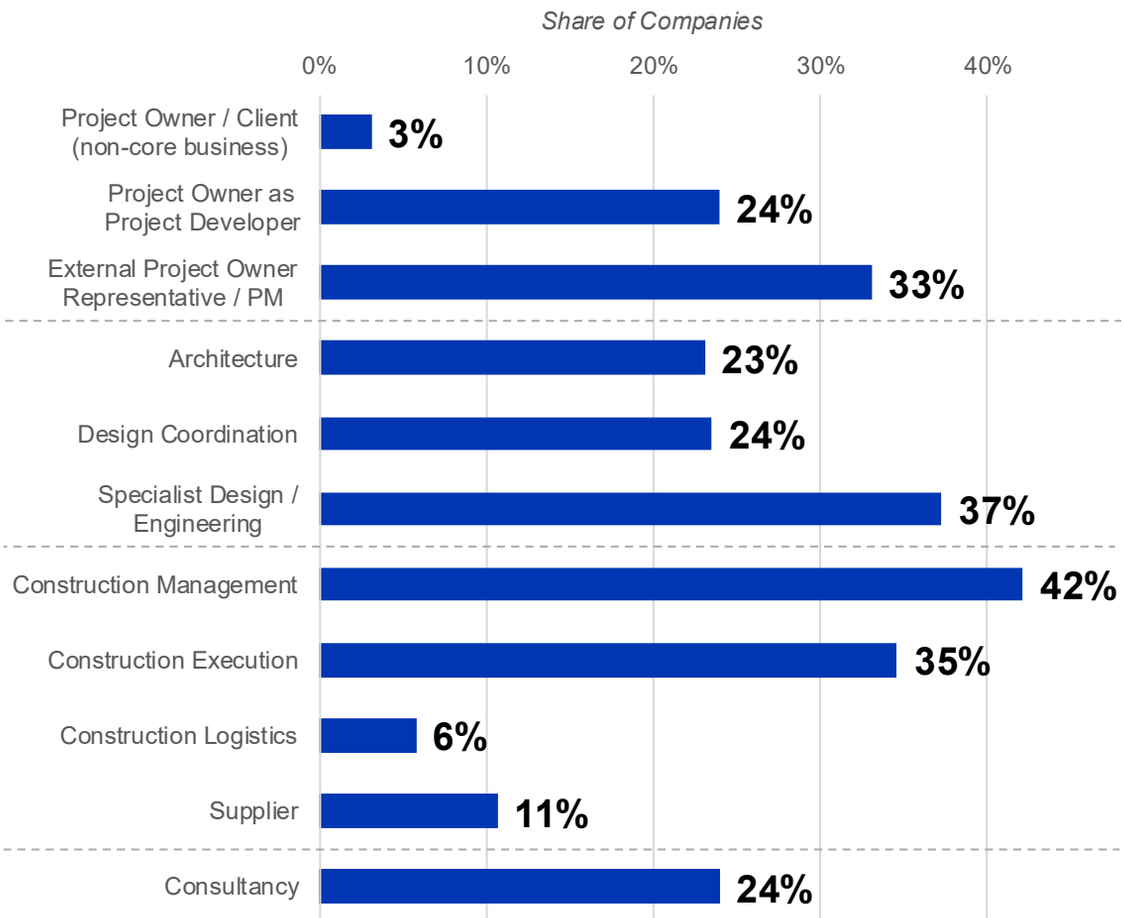

Figure 2: Core functional areas of Lean Construction companies

The most strongly represented functional areas are construction management (42%), specialist design / engineering (37%), construction execution (35%), and external project owner representation / project management (33%). By contrast, Lean Construction is much less prevalent among project owners / clients (non-core business) (3%)[11], in construction logistics (6%), or among suppliers (11%).

This distribution illustrates clearly that Lean Construction is primarily present in those areas that are directly linked to project coordination and control. Another notable finding is the consistent presence of actors within the design domain. While Lean Construction was originally applied mainly during construction execution, it is now increasingly embedded within design-related companies as well – sometimes under the

[11] The limited representation of project owners (non-core) business can also be explained by the fact that these organisations typically do not make detailed information about their construction projects publicly available.

term “Lean Design”. At the same time, the subsequent analyses (see Chapters 4.2 and 4.3) show that Lean Construction application remains strongest in the construction execution phase.

However, the statistics presented on the distribution of functional areas should be interpreted with caution. The figures are not directly comparable, as no robust statistics are available on the total number of companies within each functional area. A numerically small share therefore does not necessarily mean that Lean Construction is used less frequently in that area; it may simply reflect a smaller underlying population of companies in that domain. Conversely, a high share does not automatically indicate stronger or more frequent application either – it merely shows that the companies applying Lean Construction are (also) primarily active in these areas. The analysis therefore primarily depicts the composition of the Lean Construction company landscape in Germany, rather than its relative penetration within individual functional areas. At most, it provides indications of possible focal areas or gaps.

To further characterise the identified companies, we also examined the number of their locations as an indicator of company size[12] (see Figure 4). The results show that around 45% of Lean Construction companies have only one location, while 55% operate multiple locations. Nearly one third (32%) even maintain more than five locations.

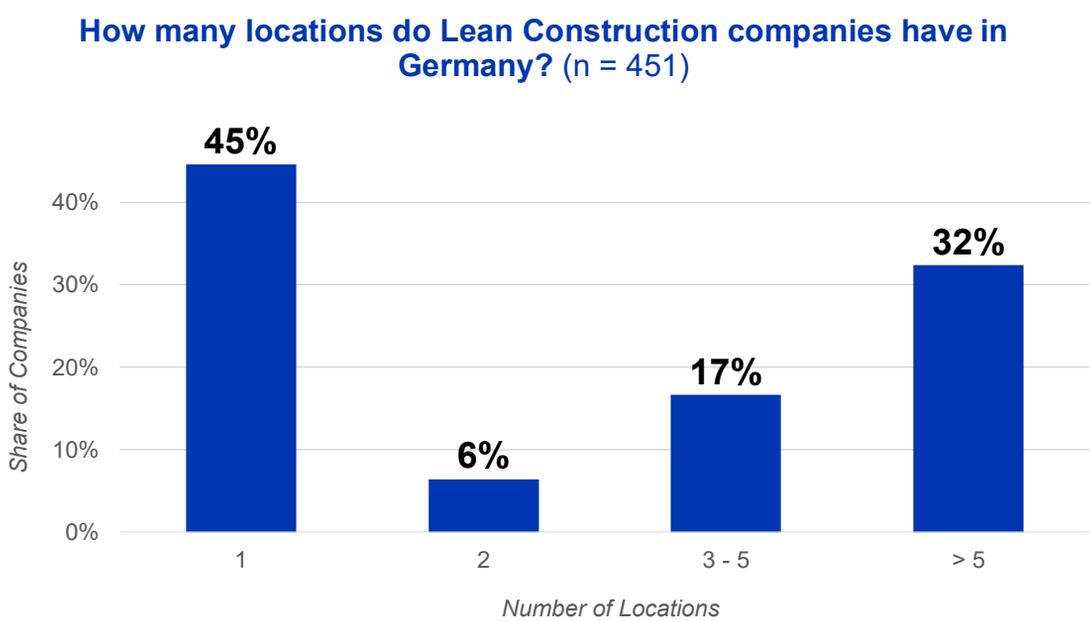

Figure 3: Number of German locations of Lean Construction companies

[12] Information on employee numbers or revenues is not publicly available for most companies.

The company landscape in the German construction industry is dominated by smaller companies, which typically operate from only one location (80–95%; KRAUS and WEITZ, 2024; HAGHSHENO and JOHN, 2024). Among Lean Construction companies, however, a different picture emerges: the approach appears to be used disproportionately by larger organisations. This may, on the one hand, be explained by the fact that larger organisations tend to have more resources for development and are more dependent on continuous process improvement and standardisation. On the other hand, it could also be a methodological effect of the data collection, as smaller companies may have been less visible in the search process. It is nevertheless noteworthy that several practitioners interviewed in Phase 2 of our study consistently pointed out that Lean Construction is still used primarily by larger industry participants.

To further examine these observations, we conducted an additional in-depth analysis of the largest actors in the German construction industry. We considered the 50[13] largest organisations in each of three central project stakeholder categories:

(1) External project owner representation

(2) Design and planning companies

(3) Construction companies

First, we checked whether these companies were already included in the database created in Phase 1. For those companies for which no clear information could be identified in this way, we additionally conducted follow-up phone calls to clarify whether there had been any points of contact with Lean Construction (see Figure 5).

[13] For external project owner representation, 62 companies were considered. The “Top 50” list is based on the number of locations in Germany (after HAGHSHENO and JOHN, 2024). As several companies have the same number of locations, the resulting list comprises more than 50 organisations – see Appendix 2.

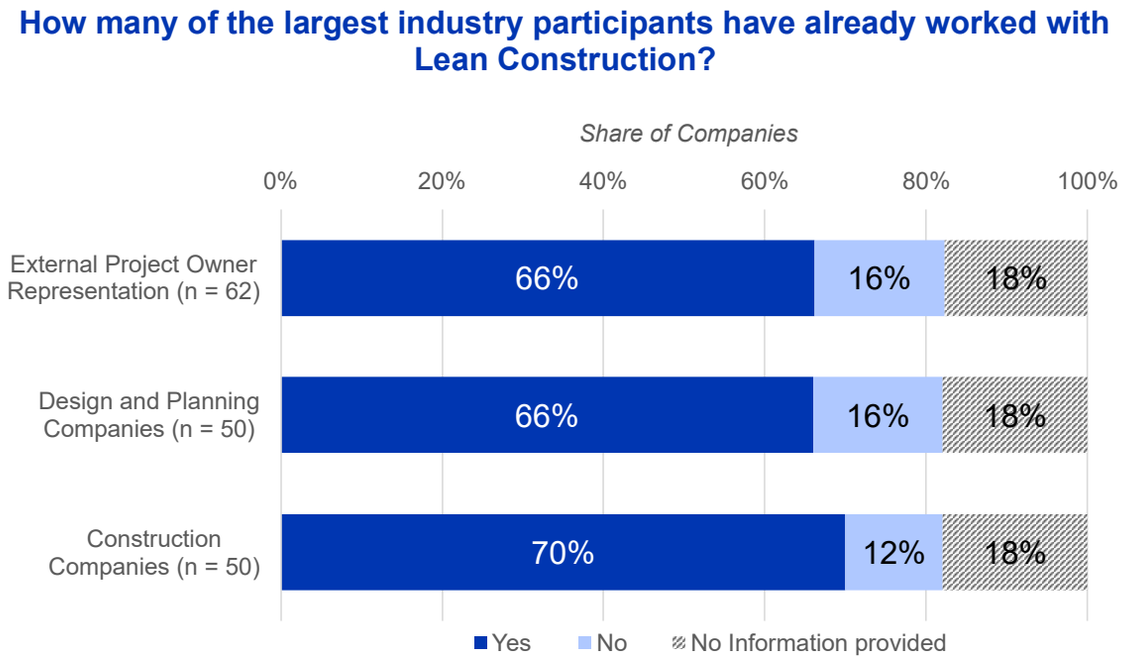

Figure 4: Lean Construction share among the Top 50 companies across three categories

The results of this additional validation show that a substantial share of the largest market actors in the German construction industry have already gained experience with Lean Construction. Among external project owner representatives, nearly two thirds (66%) stated that they apply Lean Construction and/or have relevant experience with it. For design and planning companies, the share was likewise 66%, and for construction companies it was 70%. These findings align with the assessments expressed by practitioners in Phase 2 and support the observation that Lean Construction has (at least) become established among larger companies. At the same time, for some companies no information could be obtained – even after follow-up phone calls (no information provided). The reported shares should therefore be interpreted as minimum values. The complete three Top 50 lists – including the classification of whether each company applies Lean Construction or whether no indications have been identified to date – are documented in the appendix (Appendices 2–4) of this publication.

An analysis of the headquarters locations of these companies also shows a nationwide distribution without any apparent regional clustering. Only 19 of the 451 companies (~4%) are headquartered outside Germany, predominantly in neighbouring countries such as Austria, Switzerland, and the Netherlands.

4.1.3 Software providers

In addition to active Lean Construction companies, we identified 37 companies that have developed specific software solutions for Lean Construction and market them in Germany. Of these, 33 are headquartered in Germany, three in Austria, and one in Denmark. A list of these companies is provided in Appendix 5.

As the systematic identification of software providers was not a primary objective of the search, we do not claim completeness. Nevertheless, a substantial share of the relevant providers is likely captured.

4.1.4 Training and professional development providers

The category “training and professional development providers” comprises 44 organisations, including chambers of engineers and skilled crafts, chambers of architects, as well as other associations, professional bodies, and specialised institutions. A list of the identified providers is presented in Appendix 6. These organisations offer seminars, training courses, and certification programmes related to Lean Construction. Their locations are concentrated in Germany’s major metropolitan areas such as the Rhine–Ruhr region, the Frankfurt area, the Stuttgart / Karlsruhe region, Berlin, Munich, and Hamburg, while overall a nationwide distribution can still be observed.

4.1.5 Universities

The first lecture on Lean Construction in Germany was delivered by Professor Fritz Gehbauer at Karlsruhe Institute of Technology (KIT) in 2006 (WEINMANN et al., 2025). Since then, Lean Construction has become increasingly established in the higher-education context.

Germany has a total of 422 higher-education institutions (Federal Statistical Office (Destatis), 2025). Of these, 98 (23%) offer degree programmes related to construction and/or real estate. However, among these 98 universities, only 47 (48%) explicitly include Lean Construction in their curricula (see Figure 6). An analysis of all module handbooks (and direct contact where these were not available online) showed that only two universities[14] offer Lean Construction as a dedicated programme profile. In total, 13 universities (28%) include Lean Construction as a standalone module; at 6 universities (13%), Lean Construction is addressed as a module component / course; and at 37 universities (79%), Lean Construction is at least covered within modules or courses under different titles. A complete list of higher-education institutions offering Lean Construction is provided in Appendix 7.

[14] Karlsruhe Institute of Technology (KIT) and Leuphana University of Lüneburg.

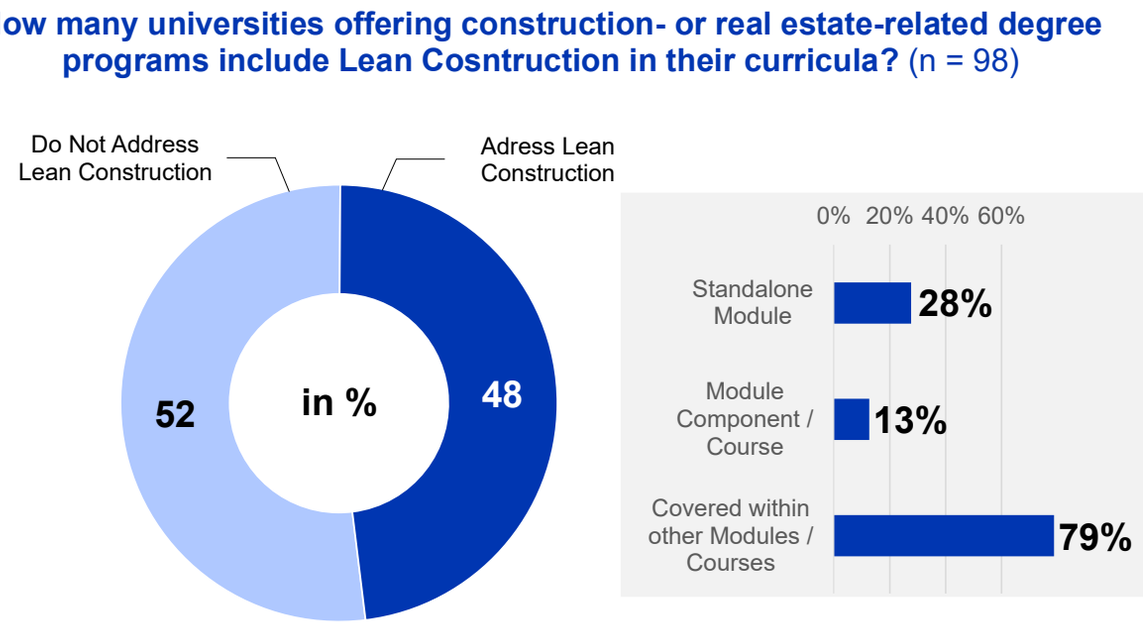

Figure 5: Lean Construction in the German higher-education landscape

4.2 Phase 2: Practitioner interviews

4.2.1 Diffusion of Lean Construction in Germany

The institutional landscape presented in Phase 1 shows that Lean Construction is now represented across all areas of the German construction industry – yet, in quantitative terms, still at a low level. Complementing this, Phase 2 of our study provides qualitative insights into the perceived diffusion and application practice from the perspective of experienced practitioners.

With regard to diffusion, the interviewees likewise emphasised that, despite growing attention in recent years, Lean Construction is still far from having reached the construction industry as a whole – or all individuals within it. One practitioner put it as follows: *"I am repeatedly surprised by how many people have never heard of Lean, or at least cannot really picture what it means, especially given that I deal with it every day."* This perception aligns with the Phase 1 findings, according to which the identified Lean Construction companies represent only a small fraction of the overall construction industry.

Several respondents also noted that the diffusion of Lean Construction – and the associated (and often necessary) cultural change within the industry – frequently fails due to deeply entrenched routines, structures, and power dynamics in construction (see also BACKHAUS and DAHM, 2020). At the same time, some interviewees expressed cautious optimism: so-called "Generation Z" (born from 1995 onwards) brings

different expectations regarding collaboration, responsibility, and transparency into companies, which may have a noticeable impact on working life and organisational dynamics. In addition, as Lean Construction is increasingly embedded in higher-education teaching, future entrants to the industry will already be familiar with the approach – potentially supporting both its diffusion and the quality of its application.

4.2.2 Effects and success factors of application

The practitioners also agreed that Lean Construction application has a positive effect on project success – based on their personal experience and perception. However, not every project in which Lean Construction is applied is automatically successful. The interview results illustrate that the success of the approach depends on several factors:

- **External influences:** Even with high-level integration and application of Lean Construction, unforeseen events such as supply shortages or political decisions can significantly affect a project.
- **Degree of implementation in scope (quantity) and over the project lifecycle (duration):** Lean is often not implemented holistically, but only in selected areas – by individual project stakeholders and/or in specific phases of a project (e.g., construction). In particular, the interviewed Lean consultants reported that they are frequently brought in only once problems already exist ("firefighting"), in the middle of an ongoing project that had previously been delivered without a Lean approach, with the expectation that Lean Construction will then resolve the issue.[15]
- **Intensity of use (depth):** Several practitioners emphasised that Lean Construction is fundamentally a matter of mindset and should not be reduced to method application alone. In many projects, however, Lean Construction is applied only selectively – for example, through the use of individual methods such as the Last Planner System. This "Lean light" approach can deliver local improvements (e.g., schedule transparency), but it rarely affects overall project success because the project is otherwise still delivered conventionally.

[15] Such cases entail a high risk for the acceptance of Lean Construction. If Lean Construction is introduced only once projects are already in a critical situation, it often cannot meet the high (or inflated) expectations placed on it and – given the damage already incurred – can at best help to limit further deterioration. In such constellations, those involved not infrequently gain the impression that the Lean approach is merely an "empty promise". There is also a risk that project management retrospectively uses Lean Construction as a scapegoat and attributes the project's failure to it – which can sustainably undermine the credibility and future acceptance of the approach (see also Chapter 4.2.3).

- **Quality of implementation:** Poorly prepared applications, or implementation under emotional resistance within the project team, can hinder adequate execution and thus reduce the quality of application. If Lean Construction is then used only superficially – or even merely labelled for marketing purposes (which we refer to as "Leanwashing") – this not only leads to a lack of effects, but also increases mistrust among the involved project stakeholders.

4.2.3 Acceptance and industry dynamics

The interviews also indicated that the success of a Lean project forms the basis for the acceptance of Lean Construction in future projects. Positive experiences increase the willingness to use the Lean approach again, whereas negative experiences can reinforce resistance – both towards introducing Lean and towards engaging with it in daily work. This therefore represents a substantial risk for acceptance across the construction industry as a whole and, in turn, inhibits further diffusion.

One practitioner commented: *"Lean requires both sufficient time [to understand it and prepare the way of working] and people [who feel responsible for it], as well as the relevant expertise."* For smaller companies in particular, the (at least perceived) financial and staffing effort is therefore often an initial barrier to integrating Lean Construction.

4.2.4 Labelling issues and conformity theory

Another finding concerns the "label question": several practitioners observed that practices consistent with Lean Construction principles are in some cases already applied in projects, but without being labelled as "Lean Construction". This phenomenon is discussed in the literature under conformity theory (see Chapter 2.2.3). In practice, however, it also leads to the Lean approach sometimes being described as "old wine in new bottles" or simply as "common sense".

On the one hand, this comparison is understandable, since Lean integrates many established best practices (which are also used by other management approaches). On the other hand, it is also incomplete: Lean Construction unfolds its (full) effectiveness only through the interplay of principles, practices, and cultural mindset. Several practitioners therefore argued for a stronger demystification of Lean Construction and a clearer distinction from traditional or alternative management practices. Initial steps in this direction have already been taken, for example through the comparison of Lean Management and Agile Management (JOHN et al., 2025b).

4.2.5 Company-specific application

The additional insights from the Phase 2 interviews are not presented explicitly at this point. Their primary value lay in reflecting the varying modes of application and different implementation priorities of Lean Construction, and in using these insights as the basis for the Phase 3 survey. To avoid repetition, we therefore refer to Chapter 4.3, where the qualitative insights from the interview study are complemented by a more informative quantitative basis.

4.3 Phase 3: Company survey

4.3.1 Survey overview

The third phase of the study aimed to capture a broad picture of current Lean Construction practice in Germany. Building on the results of the industry analysis (Phase 1) and the qualitative insights from the practitioner interviews (Phase 2), a nationwide standardised online survey was conducted. All companies identified in Phase 1 as Lean Construction companies were invited to participate (see also Chapter 3.4).

The survey focused on how widely Lean Construction is applied within the participating companies, how it is applied, and which experiences and challenges companies associate with the Lean approach. For this purpose, the questionnaire was structured into three sections:

- **Section 1: Profiling the companies** (Chapter 4.3.2)
- **Section 2: Application of the Lean approach** (Chapter 4.3.3)
- **Section 3: General perceptions of Lean Construction** (Chapter 4.3.4)

This survey provides, for the first time, structured quantitative feedback from a broad spectrum of identified Lean Construction companies in Germany. The results make it possible to reflect on the insights from Phase 2 and to generate a comprehensive picture of current practice in Germany.

4.3.2 Profiling the participating companies

The first section of the questionnaire covered questions on basic structural characteristics of the participating companies. The aim was, first, to better understand the composition of the respondent group and to clarify who participated in the survey. Second, it was intended to enable analyses of differences in the use and assessment of Lean Construction depending on specific company characteristics – particularly company size. In addition, comparing the survey results with the industry structures identified in Phase 1 makes it possible to assess the extent to which the sample reflects the

(provisional) population of Lean Construction companies identified there in structural terms.

In total, 97 of the 451 Lean Construction companies identified in Phase 1 participated in the survey, corresponding to a response rate of 22%. In itself, this rate does not establish statistical representativeness of the results; however, it indicates comparatively strong robustness of the findings and suggests that the results provide a meaningful approximation of the Lean Construction status quo in Germany. At the same time, comparison with the structural data collected in Phase 1 shows that larger companies are overrepresented in the survey sample (see Figure 7). As a result, the findings reflect the behaviour and assessments of this actor group more strongly. Wherever the analyses indicated that the response patterns of smaller companies might systematically differ from those of larger companies, this is explicitly highlighted in the interpretation of results.

One key structural characteristic captured both in Phase 1 and in the survey is the number of locations in Germany as a rough proxy for company size. In the Phase 1 database, 45% of the identified Lean Construction companies have exactly one location, 6% have two locations, 17% have three to five locations, and 32% have more than five locations. By contrast, the survey sample shows a somewhat different distribution: in the survey, companies with only one location account for just 16% of participants, 18% have two locations, 31% have three to five locations, and 35% have more than five locations.

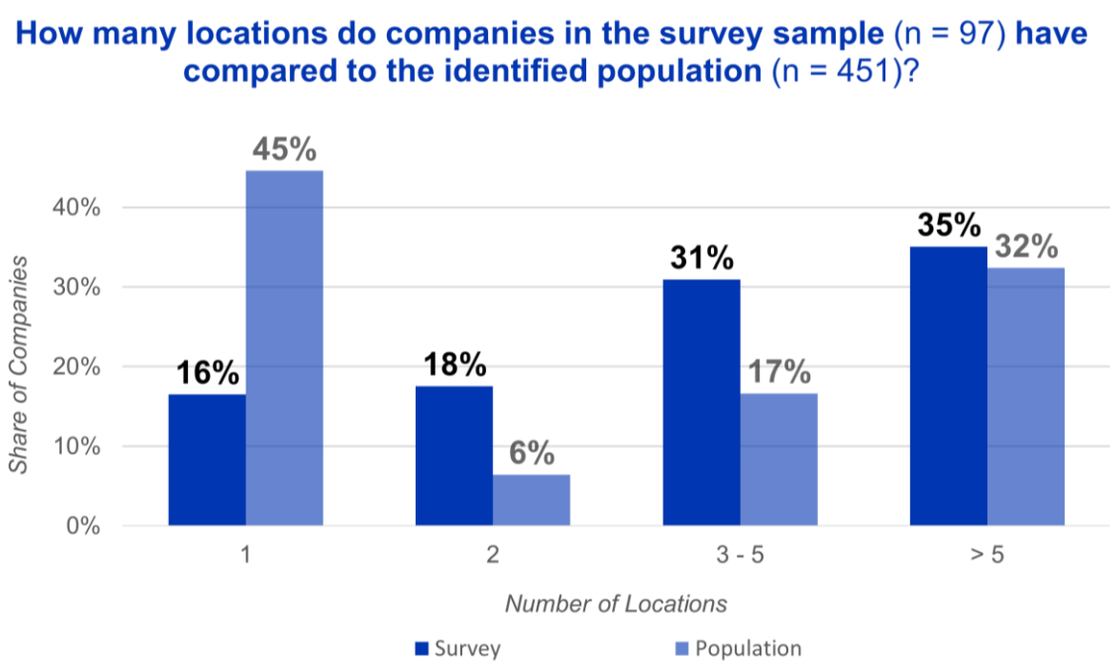

Figure 6: Comparison of the number of locations in Germany (survey vs population)

It therefore becomes clear that, in the present survey, companies with only one location (typically smaller companies) are markedly underrepresented. By contrast, companies with two locations and those with three to five locations are overrepresented relative to the population identified in Phase 1. The group of companies with more than five locations is represented approximately proportionally to the population. For the interpretation of the subsequent results, this means that the findings primarily reflect the perspective of companies that operate multiple locations (i.e., comparatively larger market actors). This shift in the size structure should be taken into account when interpreting the results.

The analysis of employee numbers also supports the assessment that the respondent companies tend to be among the larger market actors in the German construction industry (see Figure 8). The German construction industry is overall highly fragmented and consists predominantly of small companies with fewer than 50 employees (KRAUS and WEITZ, 2024). Against this backdrop, the structure of the respondent group shows a different pattern (as already observed for the Phase 1 population): the sample is dominated by larger companies. This can be interpreted as a further indication that the Lean approach appears to be more prevalent among larger companies.[16] Specifically, 11% of the companies have 1–9 employees, 15% have 10–49 employees, 28% have 50–249 employees, and 45% employ 250 or more people.

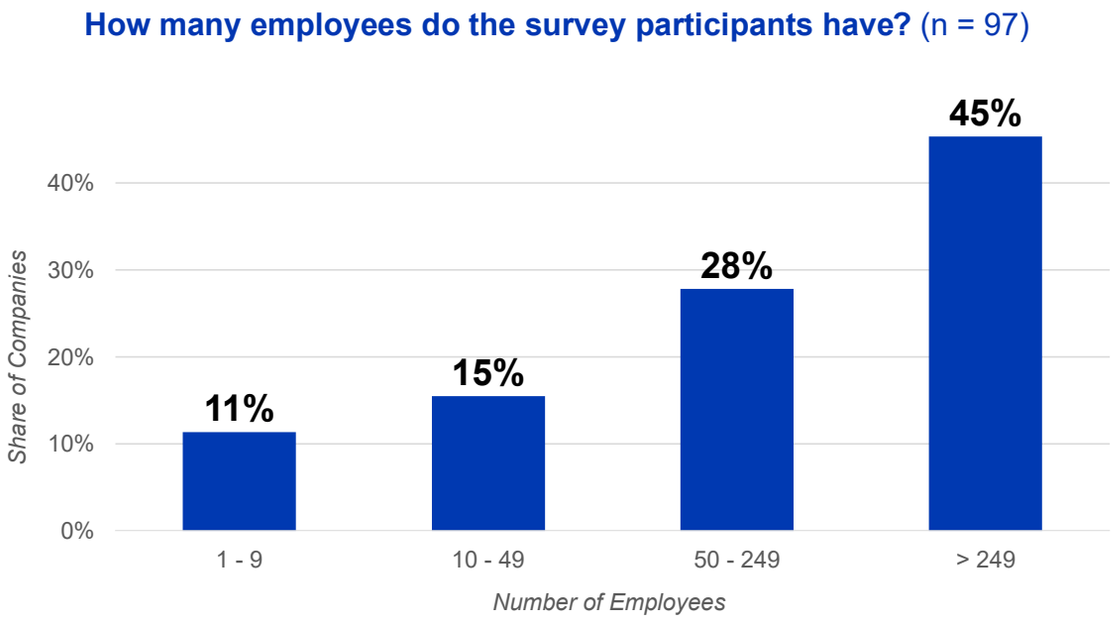

Figure 7: Number of employees of the survey participants

[16] This interpretation should be treated with caution, as no evidence is available on whether smaller companies that did not participate systematically differ in relevant ways ("non-response bias"). It is possible that smaller companies are structurally less likely to respond to surveys, irrespective of whether they apply Lean Construction or not.

Thus, more than 70% of the responses come from companies with at least 50 employees, while micro and small companies (fewer than 50 employees) together account for only 26% of the sample.

With regard to the functional background and primary areas of activity of the participating companies, the survey includes all key functional areas of the construction industry (see Figure 9). In this phase, however, companies self-classified their functional areas – unlike in Phase 1. Multiple selections were also possible in Phase 3, as many companies cover more than one role along the value chain.

For structural comparison, Figure 9 additionally presents the distribution from Phase 1. However, no robust conclusions about structural representativeness can be drawn from this comparison, as the two datasets reflect different perspectives. In Phase 1, classification was conducted by the authors based on publicly available information; in Phase 3, it relied on the self-assessment of company representatives. Despite this methodological difference, the distributions across both datasets are similar in large parts. This may be interpreted as a cautious indication that the survey sample reflects the previously identified population at least approximately – without claiming structural representativeness.

In the survey results, the most strongly represented functional areas are construction execution (45% of respondents), project management / external project owner representation (37%), construction management (30%), and architecture (26%). By contrast, project development (13%), project owners / clients (non-core business) (12%), construction logistics (9%), and suppliers (4%) are represented much less frequently. Overall, the results reflect the tendency already observed in Phase 1: in Germany, Lean Construction is often applied during the construction execution phase and within the project control environment. Companies active in project management frequently use Lean as a support or advisory service for project owners, with a particular focus on the construction phase.

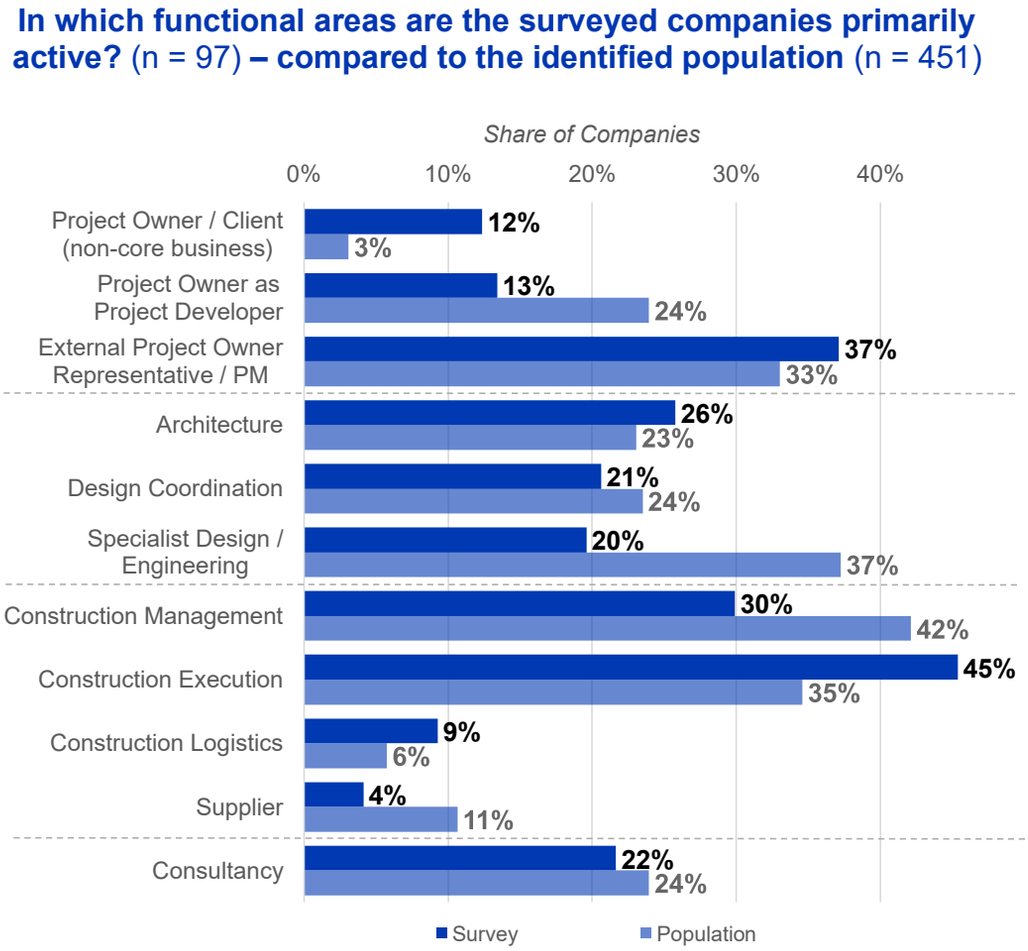

Figure 8: Comparison of core functional areas (survey vs population)

At the end of the first section of the questionnaire, we asked how long the participating companies have been actively applying Lean Construction. This information provides an initial indication of how far companies have progressed on their "Lean journey" and to what extent experiential knowledge is reflected in the survey responses (see Figure 10).

The results show a heterogeneous but overall experience-rich picture: 42% of the companies stated that they have been working with Lean Construction for at least five years, and 16% for more than ten years. A further 27% have used the approach for two to five years, and 13% for one to two years. In addition, 15% of respondents described themselves as newcomers who have been working with Lean Construction for less than one year, while 2% reported that they don't (no longer) use Lean Construction.

Taken together, around two fifths of the participating companies already have "solid" experience in applying Lean Construction – an important indication for the robustness of the subsequent assessments of the approach's effectiveness and its challenges. At

the same time, the responses from “younger” adopters provide valuable insights into the current starting conditions under which companies introduce Lean Construction today.

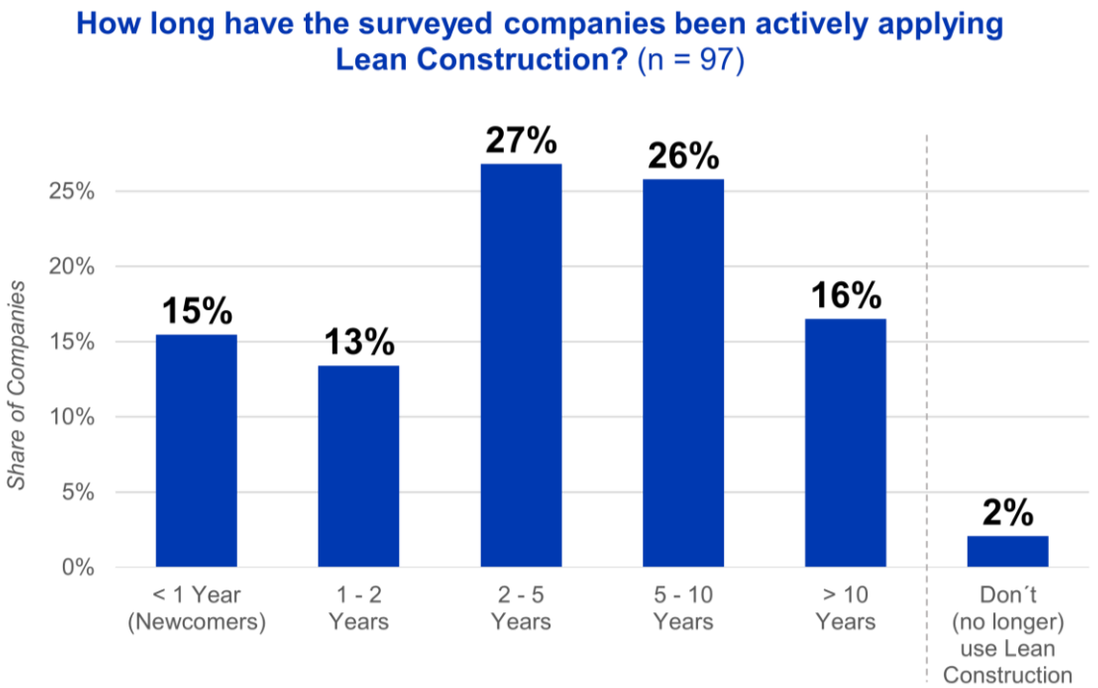

Figure 9: Duration of Lean Construction application

The results should also be interpreted in light of the historical context of Lean development in Germany. The German Lean Construction Institute (GLCI) was founded in 2015 and has since contributed substantially to the diffusion of the approach (WEINMANN et al., 2025). The data suggest that some of the participating companies came into contact with Lean Construction already before, or directly around, the establishment of the GLCI. Around ten years earlier, Professor Fritz Gehbauer (KIT) had introduced Lean Construction in the German-speaking region, thereby laying an early foundation for initial application projects. While it cannot be ruled out that individual companies used Lean practices even earlier, no established applications from that period are documented. Overall, the analysis indicates that both early pioneers and many companies that entered the field only after the institutional establishment of the GLCI participated in the survey.

4.3.3 Application of the Lean approach

Maturity

The second section of the questionnaire focused on the concrete application of the Lean approach. The aim was to understand how Lean Construction is implemented in practice, which effects companies observe, and which challenges emerge. The section begins with a self-assessment of Lean maturity (see Figure 11). This was deliberately

considered separately from the question of how long companies have been applying Lean Construction, as longer exposure does not necessarily correspond to a higher level of development.

For orientation, participating companies were provided with a five-stage classification, drawing on established maturity models in the Lean literature (see Chapter 2.2.3):

- **Stage 1:** Companies that have informed themselves about Lean Construction and/or developed their capabilities, but have not implemented any concrete measures in practice.
- **Stage 2:** Initial integration of Lean practices in a few construction projects.
- **Stage 3:** Standard application of Lean practices in some projects, but without company-wide use.
- **Stage 4:** Standard application of Lean practices in the majority of the company's construction projects.
- **Stage 5:** Beyond standard application in project delivery, the Lean approach is embedded in the company's strategy, structure, and culture.

Which Lean Construction maturity stage do the surveyed companies assign to themselves? (n = 97)

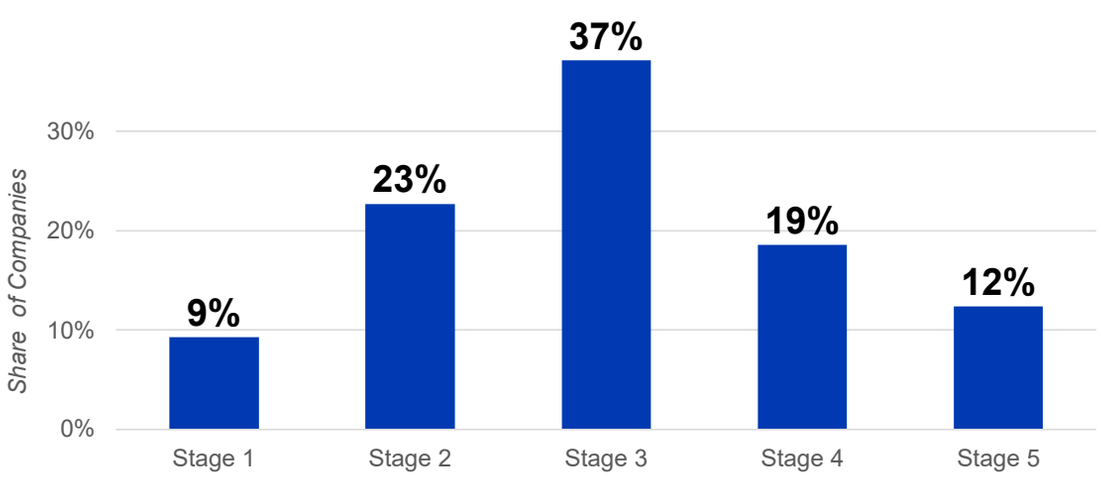

Figure 10: Maturity stages

The results show that around one third of the participating companies have already reached a high level of Lean application (at least Stage 4). At the same time, more than two thirds do not apply Lean Construction across their company, and some are still at the beginning of their "Lean journey". This underlines that, while the broader diffusion of the approach in Germany is visible, its qualitative depth of integration still leaves room for further development.

Overall, 19% of companies place themselves in Stage 4, while 12% report that they have already embedded Lean Construction holistically and strategically within the company (Stage 5). At the same time, the findings also show that even companies that have been applying Lean Construction for many years do not necessarily reach the highest stage—indicating that organisation-wide integration of the Lean approach beyond project delivery is a demanding transformation process. The largest group consists of companies in Stage 3 (37%). These companies already apply Lean Construction in a meaningful share of their projects, but not yet across the board. A further 23% report that they have so far only piloted Lean in a few projects (Stage 2). The smallest share is represented by companies in Stage 1 (9%), which have so far only gathered information and/or provided training, without implementing concrete measures in practice.

Figure 12 additionally illustrates the relationship between the duration of Lean Construction application within a company and its self-assessed maturity stage. As expected, a positive relationship emerges: the longer companies have been working with Lean Construction, the more advanced their application tends to be and the more extensively it is applied (in terms of the share of the company's projects).

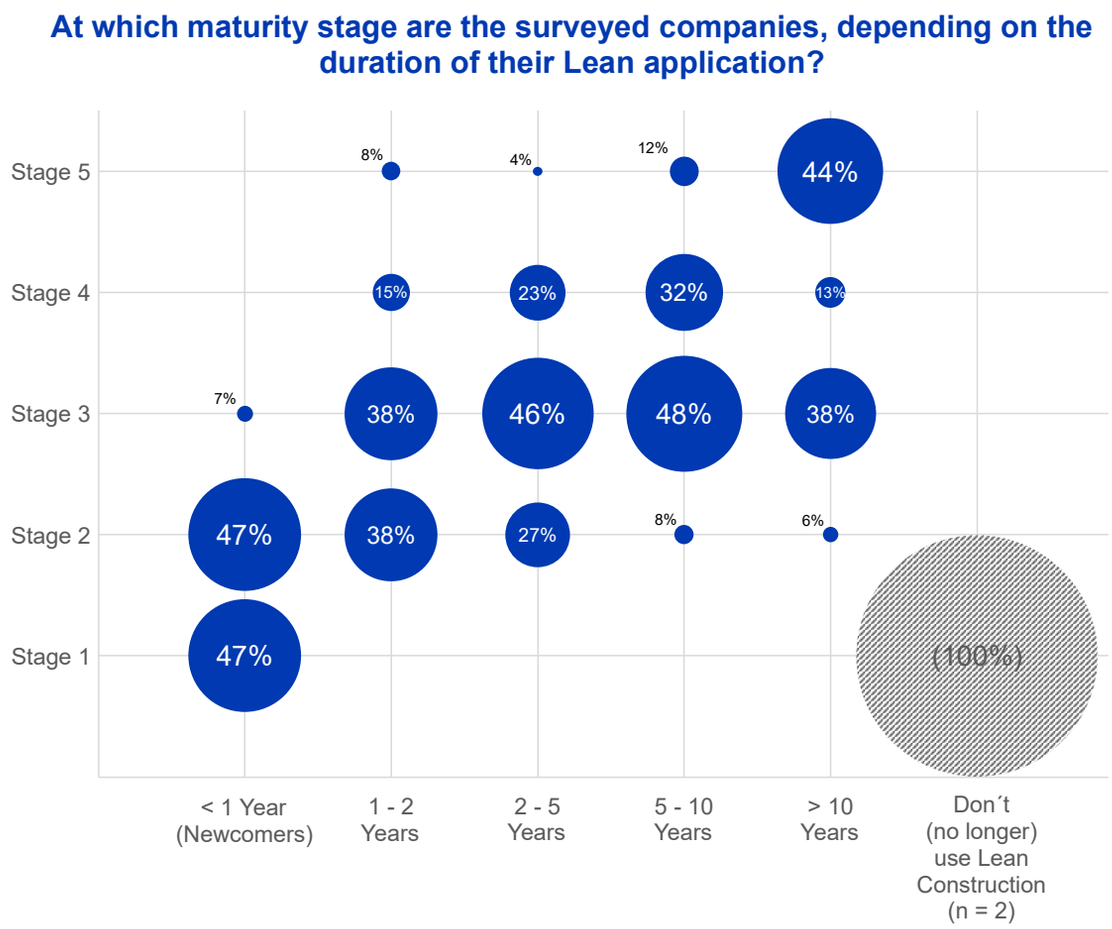

Figure 11: Maturity stages in relation to duration of application

While, during the first two years after introducing the Lean approach, a large share of companies remains at Stage 1 or 2, the distribution shifts increasingly towards Stage 3 as application duration increases. In particular, from an application period of five years onwards, the share of companies at Stage 4 rises noticeably, and among companies with more than ten years of experience, meaningful shares at Stage 5 appear for the first time.

This distribution indicates that maturity in the sense of company-wide and holistic application requires time. At the same time, it becomes evident that a longer period of engagement with Lean Construction does not automatically translate into a high maturity stage: even after ten years, some companies still operate primarily at Stage 3. This suggests that development over time depends not only on duration of application, but also on internal company factors such as resources, management support, and the implementation strategy (see challenges in implementation, pp. 56–57).

An additional analysis by company size also indicates that companies at Stage 5 are disproportionately likely to be smaller organisations. This can be explained, among other factors, by the fact that embedding the Lean approach across the organisation is typically easier to achieve within more manageable structures. Larger companies, by contrast, are more frequently represented in Stages 3 and 4. In such organisations, company-wide rollout usually requires more time due to more complex structures, larger workforces, higher numbers of projects, and in some cases more strongly segmented organisational units.

Against this backdrop, the Lean Construction status quo in Germany needs to be interpreted accordingly: a Lean Construction company (see Phase 1) is not automatically a “mature” Lean Construction company. This has important implications for interpreting diffusion – particularly with respect to the qualitative depth at which Lean Construction is actually implemented in Germany.

Share of projects with Lean Construction in the project portfolio

A further perspective for analysing the implementation status of Lean Construction in practice is the share of construction projects in which companies actually apply the Lean approach. The purpose of this question was to complement the qualitative self-assessment via the maturity model with a quantitative picture of actual Lean Construction use. The results confirm the impressions gained in Phase 2: in many companies, Lean Construction is not applied across the board.

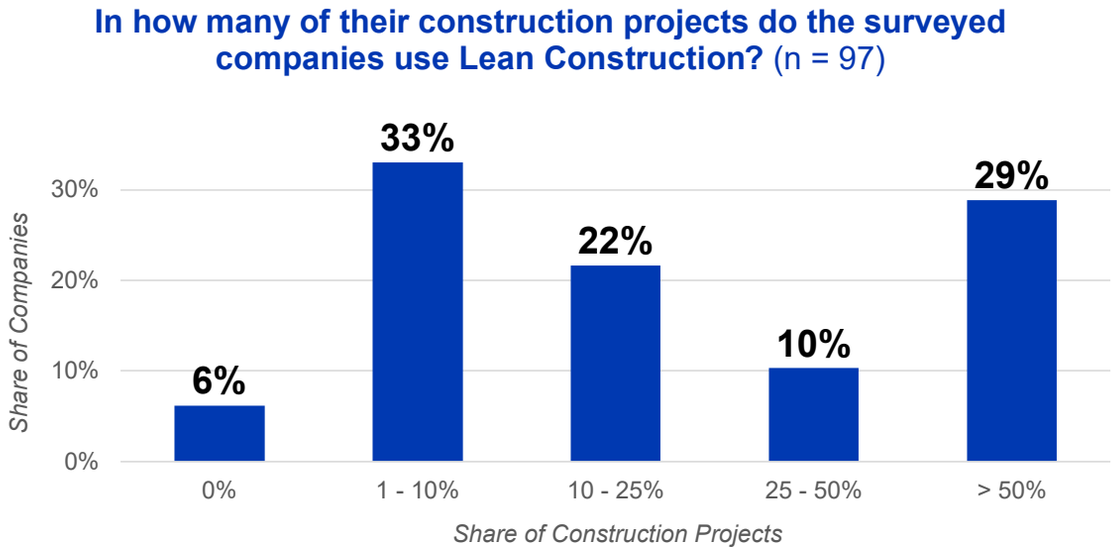

Figure 12: Share of construction projects using Lean Construction

Figure 13 shows that 71% of the participating companies have so far applied Lean Construction in less than half of their projects. Within this group, 6% report that they have not yet implemented Lean in any of their projects. These companies can therefore be assigned to Stage 1 of the maturity model: they are already engaging with Lean Construction, but have not yet put it into practice. One third of the surveyed companies apply Lean Construction in no more than one out of ten projects. Only 29% of the respondent companies use Lean Construction in more than half of their projects. This group consists predominantly of companies that have been working with Lean Construction for several years and place themselves in Stages 4 and 5 of the maturity model. Nevertheless, a cross-analysis with the duration of Lean engagement shows that a long period of involvement with the approach does not automatically result in broad application: even among companies that have used Lean Construction for more than ten years, there are cases where Lean is still applied in only a limited share of projects.

The finding that the majority of companies do not apply Lean Construction across the board inevitably raises the question of why an approach that many users describe as effective is not used in all projects. Indications are provided by the following results on application quality, perceived challenges, and the structural and project-related conditions that influence comprehensive use.

Organisation of Lean application

A key aspect in understanding Lean Construction application concerns how the Lean approach is integrated into day-to-day operations. The interviewees in Phase 2 described that companies generally pursue three pathways. First, they can build internal responsibility – for example through a dedicated point of contact, a Lean working group, or even a dedicated Lean department that acts as internal coaches and

supports operational project teams in applying the approach. Second, companies can provide targeted training to the employees directly responsible for application, for instance through programmes offered by the GLCI Academy or through the VDI certification programme (Chapter 4.1.4). Third, especially companies engaging with Lean Construction for the first time often rely on external Lean coaches, who are brought in on a project basis and support the introduction and/or delivery of the approach.

The survey results (see Figure 14) reflect these three pathways and show that organisational embedding of Lean Construction is predominantly internal. 60% of participating companies have an explicit Lean responsibility in the form of a point of contact, a group, or a dedicated organisational unit. 58% focus on directly training the employees who apply Lean Construction in projects. By contrast, external Lean coaches are used (any longer) by only 25% of companies. As multiple selections were possible, some companies combine these approaches – for example, building an internal Lean department while simultaneously drawing on external coaches for project-specific support.[17]

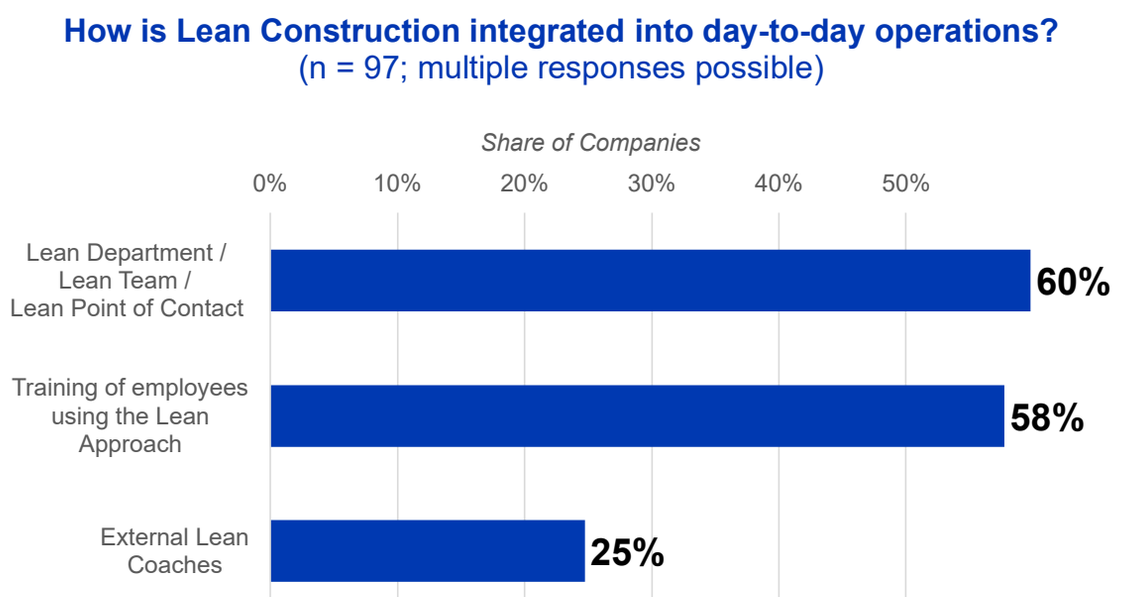

Figure 13: Mode of integration of Lean Construction

An analysis by company size shows clear differences between companies: larger companies in particular tend to have the capacity and structural resources to establish internal Lean coaches and to finance corresponding training programmes for operational staff. The use of external coaches, by contrast, differs only marginally between small, medium-sized, and large companies. This suggests that this form of support is used largely independently of company size – either as an entry point or as a project-specific complement.

[17] Companies that themselves offer Lean coaching classified themselves under the category "Lean department / Lean team / Lean point of contact", or were assigned to this category by us.

Lean Construction application across functional areas

Another aspect of our analysis concerns the question in which functional areas companies actually apply Lean Construction (independent of their primary functional areas, which were intended to indicate the company's "background"). While the previous analyses primarily show *who* applies Lean Construction, the following perspective provides indications of *where* along the value chain the Lean approach is used. For methodological reasons, it is not possible to determine precisely in how many projects within each functional area Lean Construction is applied overall. Nevertheless, the analysis offers a first indication of the areas in which application occurs frequently (see Figure 15).

The results initially confirm the overall impression from the previous chapters: in Germany, Lean Construction application continues to be clearly concentrated in construction execution. In this area, not only are most companies active, but Lean Construction is also applied comparatively consistently. Half of the companies primarily active in construction execution report that they often apply Lean Construction in this functional area, and almost three quarters (74%) use Lean Construction there at least occasionally. External project owner representation / project owner-side project management is also relevant; according to the interviewed practitioners, it likewise integrates Lean Construction predominantly in the construction phase. In this functional area, 31% use Lean Construction often and 73% at least occasionally. A similar pattern is observed in construction management: 45% apply Lean often, and 77% use it at least occasionally. Consultancy also shows a relatively high frequency of application (50% often, 64% at least occasionally), which can be explained by the continued strong focus of many consultancy services on the construction phase.

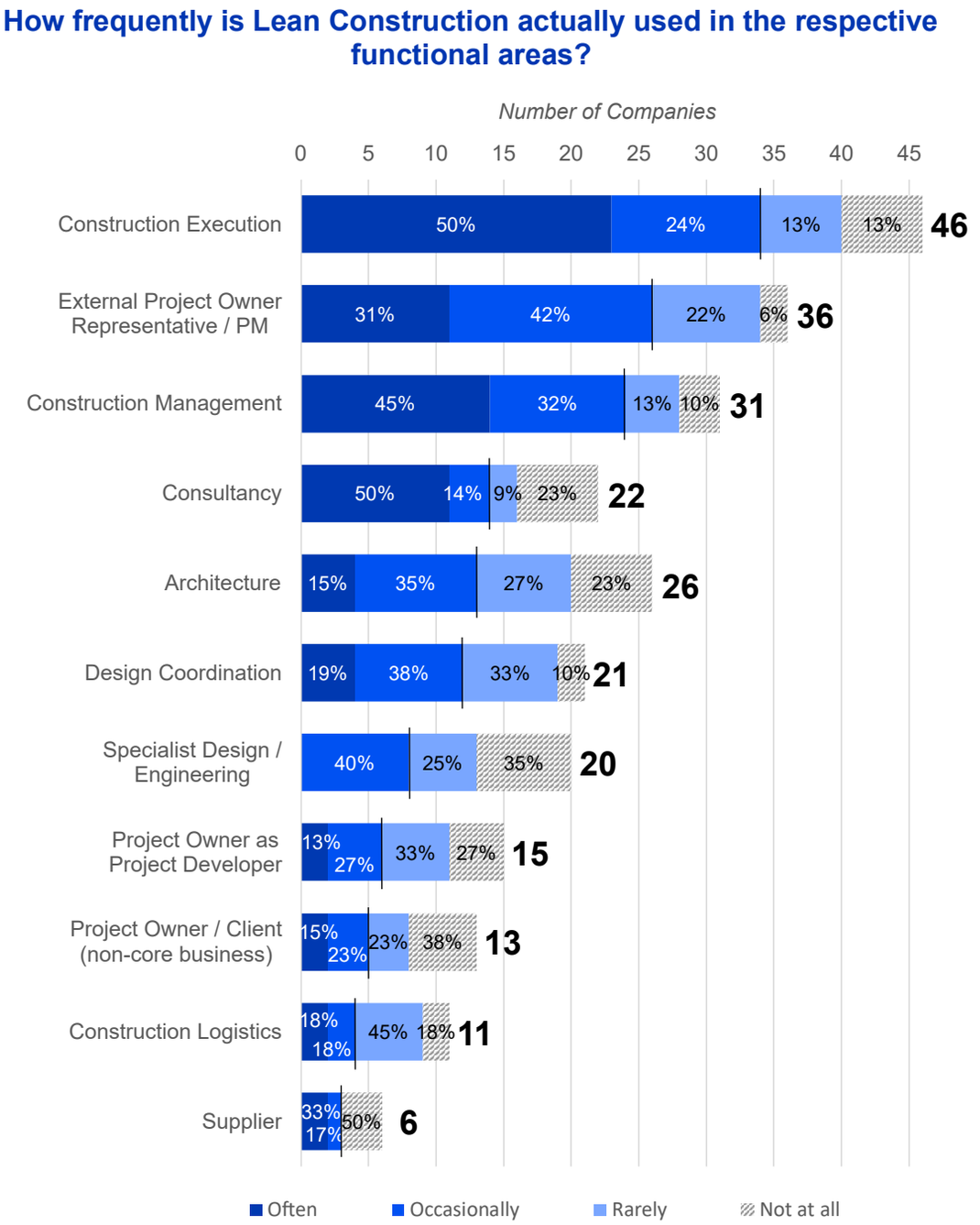

Figure 14: Frequency of Lean application by functional area

Overall, the analysis shows that, in Germany, Lean Construction is currently most prevalent in areas associated with the construction phase or with operational project control. In design, Lean Construction is visible, but applied less frequently. These findings therefore complement the insights from Chapters 4.1 and 4.2.

Application across the project lifecycle

In addition to examining the companies' functional areas, the questionnaire also asked in which project phases Lean Construction is actually applied. The purpose of this

analysis was to test – using a second perspective – the assumption derived from Phases 1 and 2 that Lean is predominantly used during construction execution. We deliberately asked only *whether* Lean is applied in the respective phase, not with what intensity. Indications of application intensity can be interpreted only in combination with the previous results on usage across functional areas.

The results (see Figure 16) first show that Lean Construction is, in principle, applied across the entire project lifecycle. Nevertheless, clear differences between project phases emerge. 88% of companies apply Lean Construction during the construction execution phase, making this phase the clear frontrunner. This confirms the earlier assessment from another perspective: in Germany, Lean Construction currently has its main focus in construction execution.

In the design phase, 55% of companies report applying Lean Construction. This indicates that the Lean approach is increasingly gaining traction in design, but is not yet embedded as broadly as it is in execution. Use is even lower in upstream and downstream phases: in both concept development / project definition and commissioning, only about a quarter of companies apply Lean Construction.

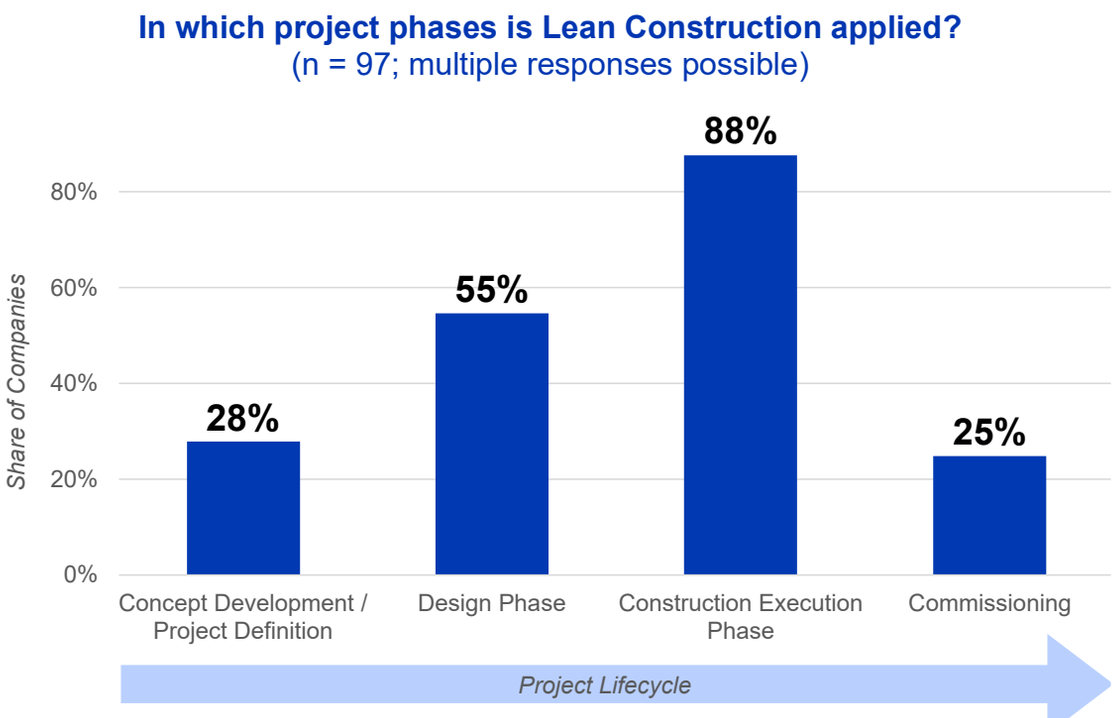

Figure 15: Application of Lean Construction across project phases

Lean practices

After outlining in the previous sections who applies Lean Construction, to what extent, and in which project phases, the next step was to examine how the approach is used in concrete terms. This analysis builds on an observation repeatedly emphasised in the Phase 2 interviews: Lean Construction application is strongly method-driven. Lean Construction is often introduced into projects through specific practices, meaning that the selection and diffusion of these practices is a key indicator of both the depth of implementation and the mode of Lean Construction application.

Which Lean Construction practices are used by the surveyed companies and how frequently? (n = 97)

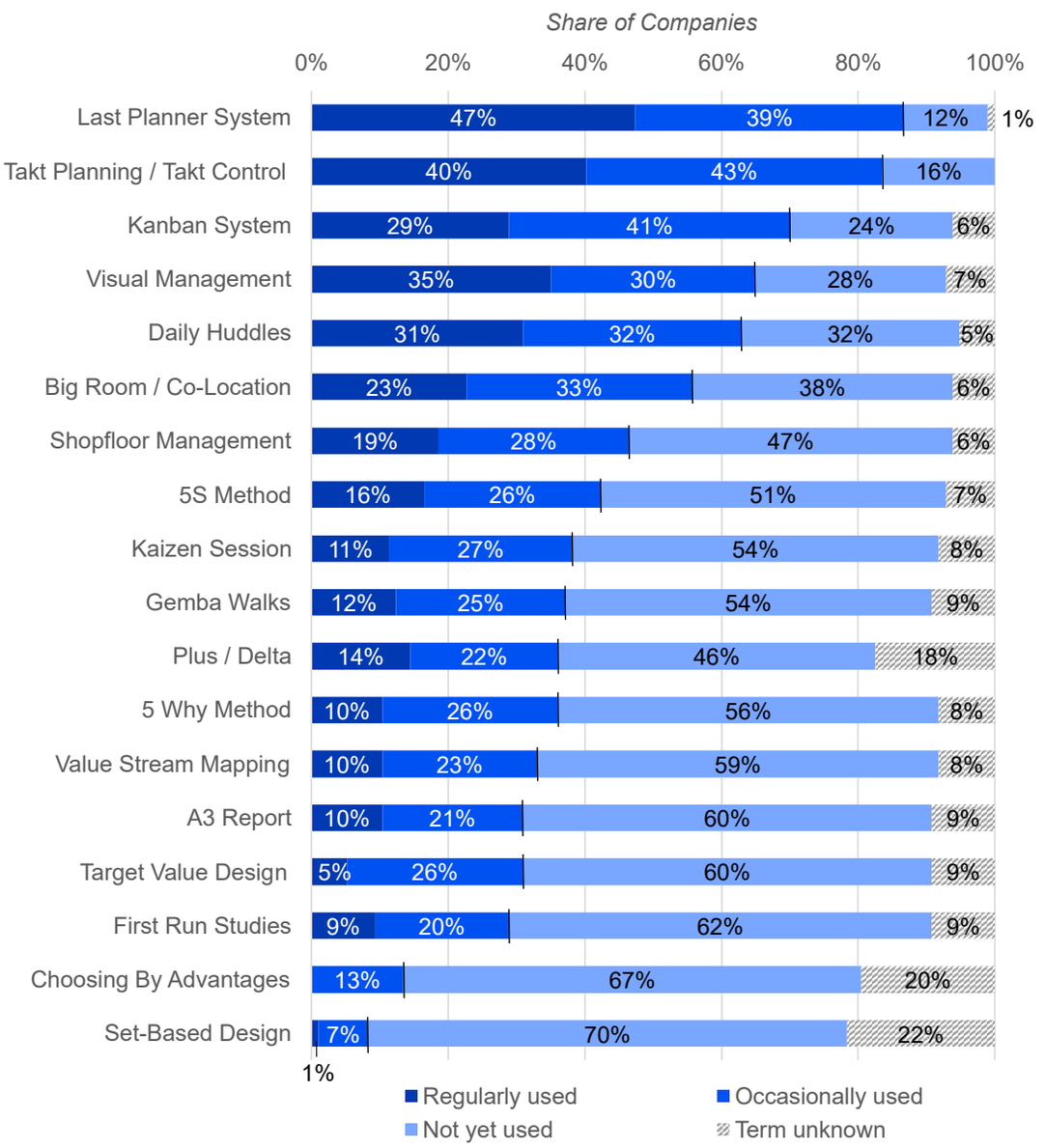

Figure 16: Application of Lean practices

To obtain a clearer picture of application practice in Germany, the questionnaire therefore included a list of widely used Lean practices. Companies were asked to indicate whether and how frequently they use these methods. The results are presented in Figure 17 and show substantial differences in the diffusion of individual practices.

The most frequently applied practices are the *Last Planner System* (LPS) and *takt planning / takt control* (TPTS). Both are used by a large share of the surveyed companies and also show the highest values for regular use. 86% of companies use LPS, with 47% using it regularly. TPTS is applied by 83% of companies, and 40% use it regularly. Moreover, LPS and TPTS are the only methods that were known to (almost) all survey participants. For all other practices included in the survey, between 5% and 20% of companies reported that they were not familiar with the respective practice / method.

In addition, several other Lean practices are used by a majority of companies—though usually less regularly. These include, in particular, the *Kanban system* (70%; 29% regularly), *visual management* (65%; 35% regularly), *daily huddles* (63%; 31% regularly), and *Big Rooms / co-location* (56%; 23% regularly). These practices therefore also appear to have an established – albeit varying – role in Lean Construction application among German companies. The least frequently used methods are *Choosing by Advantages* (CBA) and *Set-Based Design* (SBD). CBA is used only occasionally by 13% of companies. SBD shows the lowest values overall: only 1% of companies apply it regularly, while 7% use it at least occasionally.

Implementation of Lean principles

Beyond the application of specific Lean practices, the next step was to examine which underlying principles companies consciously take into account. By principles, we refer to overarching conceptual guiding ideas that – according to common Lean understanding – should underpin Lean Construction application, regardless of which operational methods are used.

Figure 18 shows which of these principles the surveyed companies report proactively addressing. The most frequently mentioned principle is “creating transparency”, which is consciously promoted by 80% of companies. About half of the companies additionally report systematically identifying and avoiding waste (47%), promoting standardisation and process thinking (47%), or visualising processes and decisions (46%). Other core Lean principles are actively addressed by a smaller share of companies. These include continuous pursuit of improvement (42%) and fostering a constructive and collaborative working culture (40%). Principles related to customer orientation are applied considerably less often – that is, deliberately aligning the project with the needs of the project owner or the later end user (31%). Even fewer companies report placing a targeted focus on employee enablement and well-being (24%).

When these results are considered in relation to the previously presented patterns of Lean practice application, a consistent picture emerges: many companies are still strongly oriented towards the methodological level of the Lean approach. Application is often realised through specific practices such as the Last Planner System or takt planning / takt control, while the overarching principles – particularly those related to culture, behaviour, and leadership – are addressed less systematically. This suggests that the current day-to-day practice of many companies in Germany is still driven primarily by operational methods, and that the deeper, principle-led orientation of Lean Construction still holds considerable potential for further development.

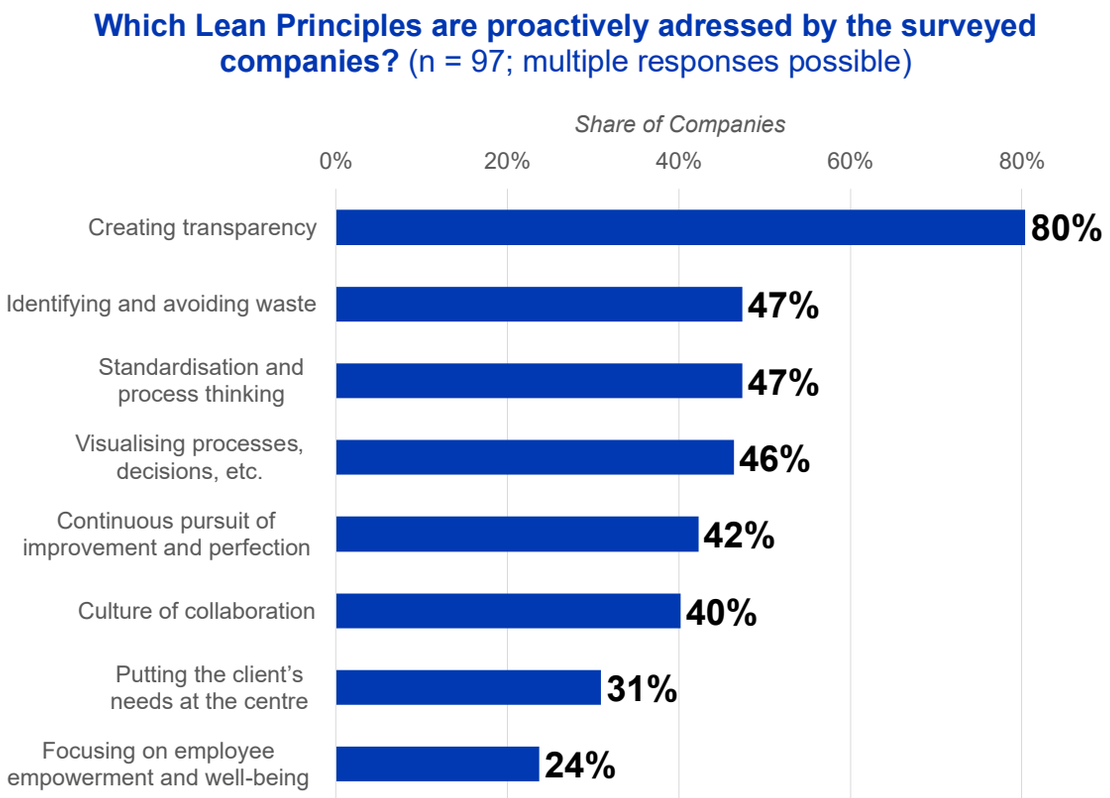

Figure 17: Implementation of Lean principles

A differentiated analysis by the maturity stages presented earlier shows that companies at the highest stage (Stage 5) take all examined principles into account significantly more frequently – each principle is integrated by at least 60% of companies in this stage. Particularly pronounced are the principles related to customer orientation and employee enablement – principles that are comparatively weakly developed in Stages 1 to 4.

Overall, a consistent trend emerges: as maturity increases, so does the share of companies that consciously apply and promote the respective Lean principles. This pattern is to be expected, yet it also confirms the maturity classification used and illustrates that advanced Lean Construction application typically goes hand in hand with a broader and increasingly holistic, principle-led orientation.

Impact of Lean Construction on project outcomes

A fundamental motivation for integrating Lean Construction is its positive impact on project outcomes. To explore this key aspect, we asked the participating companies how, in their experience, Lean application generally affects project outcomes. While the positive contribution of the Lean approach to project and business performance has been documented internationally – both anecdotally and empirically – no comparable evaluation has so far been available for Germany. The following analysis therefore provides, for the first time, a systematic snapshot of perceptions from a company perspective (see Figure 19). At the same time, it must be emphasised that these are subjective assessments which – despite being collected quantitatively – are based more on experience and respondents' perceptions than on verified causal relationships. The results should therefore be interpreted with the necessary caution.

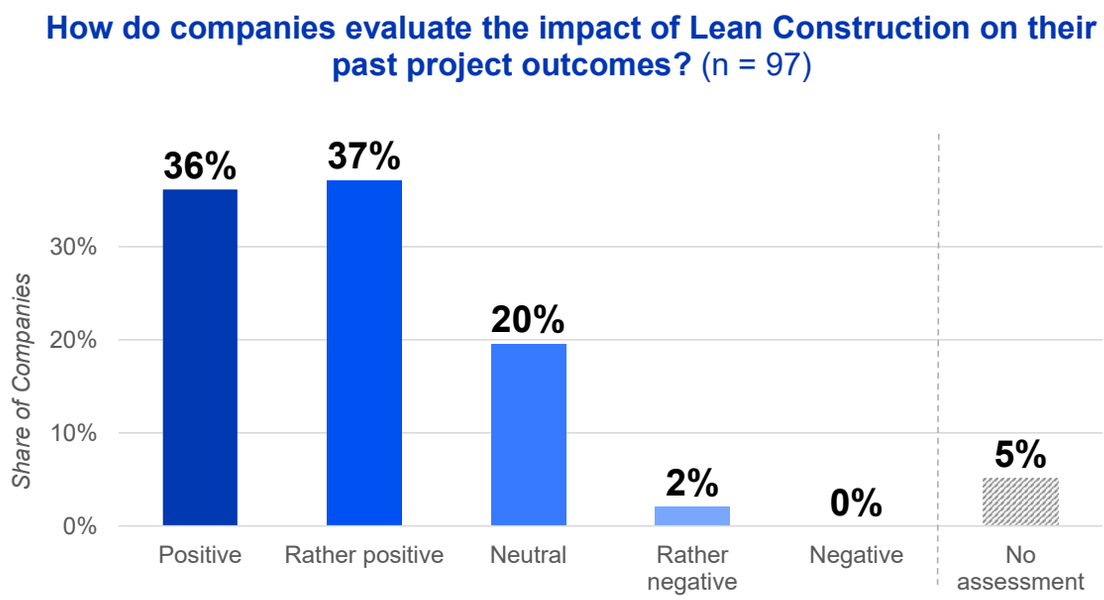

Figure 18: Assessment of the perceived impact of Lean Construction on project outcomes

The responses presented overall paint a predominantly positive picture. Around one third of companies rate the impact of Lean Construction on their project outcomes as positive (36%), and a further 37% as rather positive. Negative assessments were virtually not expressed: only 2% report rather negative experiences, and no company reports negative experiences. At the same time, 20% of respondents indicate that the effects to date have been neutral or mixed. This may suggest that Lean Construction

has either not yet been implemented comprehensively in these companies, that the effectiveness of measures is difficult to isolate, or that perceived improvements are offset by other project-specific factors. Around 5% did not provide an answer; these are exclusively companies that have not yet gained practical experience with Lean Construction application.

Overall, the results indicate that, from the perspective of the surveyed companies, Lean Construction has predominantly had positive effects on project outcomes. However, when interpreting these findings it must be taken into account that the assessment was collected exclusively from current Lean Construction users. For a more balanced assessment, it would be necessary to also survey companies that used Lean Construction in the past but subsequently discontinued it. This perspective is missing in the present study, because such companies could not be systematically identified in Phase 1. Accordingly, the result – an overall positive perception of Lean Construction's impact – should not be understood as representing an industry-wide opinion. Nevertheless, one robust conclusion can be drawn: among active Lean Construction users, most companies report positive effects on their project outcomes. This suggests that Lean Construction can generate positive impact where it is applied.

A differentiated analysis of impact ratings by maturity stage also reveals clear relationships (see Figure 20). The results suggest that the perceived impact of Lean Construction becomes more positive as application becomes more "mature". This aligns with the expectation that Lean Construction can only unfold its full effect when practices and principles are applied not merely selectively, but systematically and across multiple projects. At the same time, the analysis illustrates that early stages of application are naturally characterised by more limited impact.

In Stage 1, a neutral rating dominates (44%), accompanied by an equally high share of companies that could not or did not wish to provide an assessment (44%). This can be explained by the fact that companies at this early stage have either not yet applied Lean Construction in practice, or have gained too little experience to assess impacts on project outcomes in a valid manner. Only 11% of companies at this stage report rather positive effects. In Stage 2, a noticeably more positive tendency emerges: 27% perceive the impact as rather positive and a further 18% as positive. The share of those unable to provide an assessment decreases to 5%. Notably, all companies reporting a "rather negative" impact fall into this stage – suggesting that selective or unsystematic application of individual methods ("Lean light") is insufficient to achieve stable positive effects and may even lead to disappointment.

From Stage 3 onwards, positive assessments clearly dominate: 53% of companies rate the impact as rather positive and 33% as positive, while only 14% provide a neutral rating. This shift indicates that, beyond a certain level of implementation, Lean Construction can contribute consistently to improved project outcomes. In Stage 5 – i.e., among companies that have embedded Lean Construction beyond project delivery into their organisational structure and culture – all respondents report positive effects. This finding underlines that Lean Construction tends to realise its full effectiveness only when it is integrated holistically and across the organisation.

Overall, this analysis suggests that the perceived impact of Lean Construction depends strongly on the maturity of application. Incomplete, selective, or purely method-focused implementations are unlikely to unlock the potential associated with a mature Lean Construction application that is embedded culturally and organisationally.

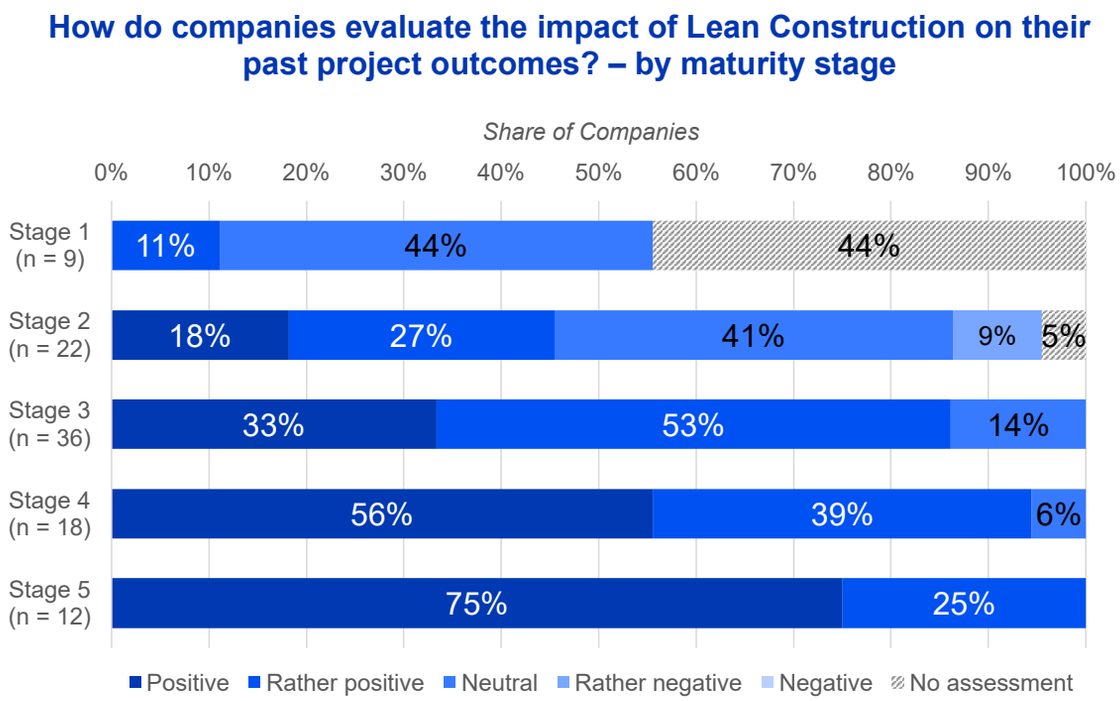

Figure 19: Assessment of the perceived impact of Lean Construction on project outcomes by maturity stage

Areas of impact of Lean Construction

To better understand how Lean Construction influences project outcomes, the companies were also asked to assess in which areas of a construction project the impact is particularly noticeable. Figure 21 shows the distribution of these assessments across different performance dimensions.

To what extent does the application of Lean Construction have a positive impact on the listed areas of a construction project? (n = 97)

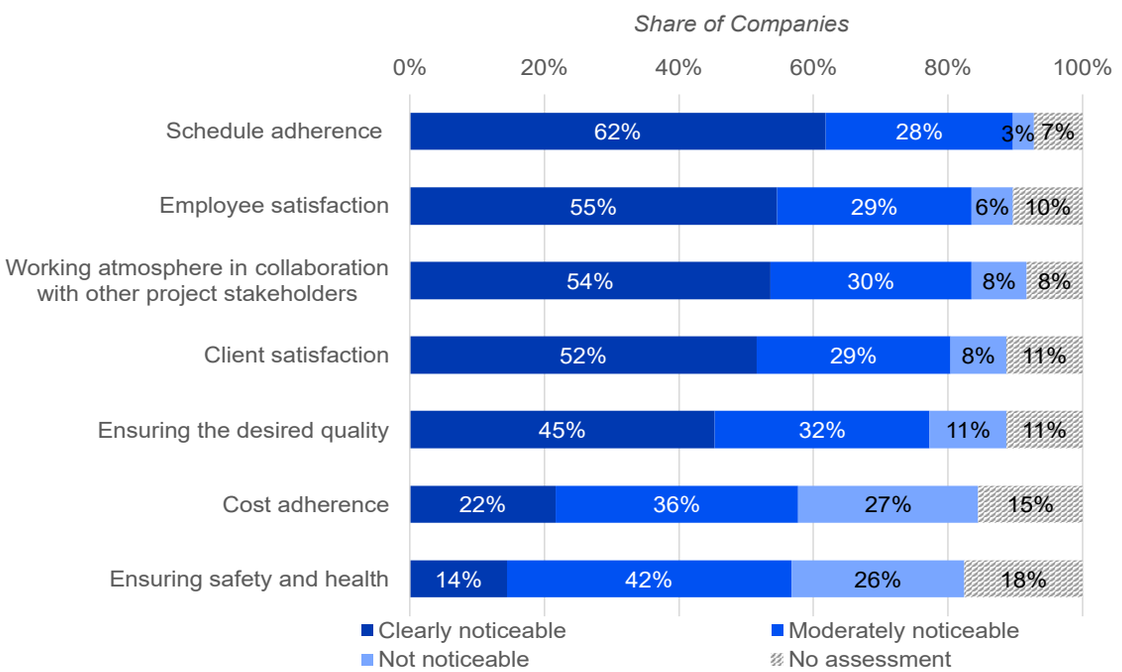

Figure 20: Perceived impact of Lean Construction on target dimensions

The perceived impact of Lean Construction is strongest in schedule adherence: 62% of companies report a clearly noticeable positive effect, and a further 28% perceive at least moderately noticeable improvements. Only 3% see no effect in this area, while 7% did not provide an assessment. A similar pattern emerges for employee satisfaction (55% clearly noticeable, 29% moderately noticeable), the working atmosphere in collaboration with other project stakeholders (54% clearly noticeable, 30% moderately noticeable), project owner satisfaction (52% clearly noticeable, 29% moderately noticeable), and quality (45% clearly noticeable, 32% moderately noticeable). These responses confirm that many companies perceive Lean Construction as a helpful approach to improving key project performance dimensions.

Assessments are more cautious for cost adherence and safety and health. For cost adherence, 22% report a clearly noticeable effect and 36% report moderate improvements, while 27% do not perceive an impact. A similar pattern is observed for safety and health: while some companies perceive improvements (14% clearly noticeable,

42% moderately noticeable), a comparatively high share report no noticeable effects (26%) or indicate that they cannot provide an assessment (18%). These results suggest that companies perceive the impact of Lean Construction on cost and on safety and health aspects more heterogeneously.

Challenges in integrating Lean Construction

To follow up on the assessment expressed in the Phase 2 interviews – that Lean Construction is still applied only in selected areas in many companies, and that the majority of projects continue to be delivered conventionally (which is also reflected in the survey results presented above) – we asked why Lean Construction is not applied in all of the companies' projects. Figure 22 presents the results.

Why is Lean Construction not applied in all of the companies´ projects? (n = 97; multiple responses possible)

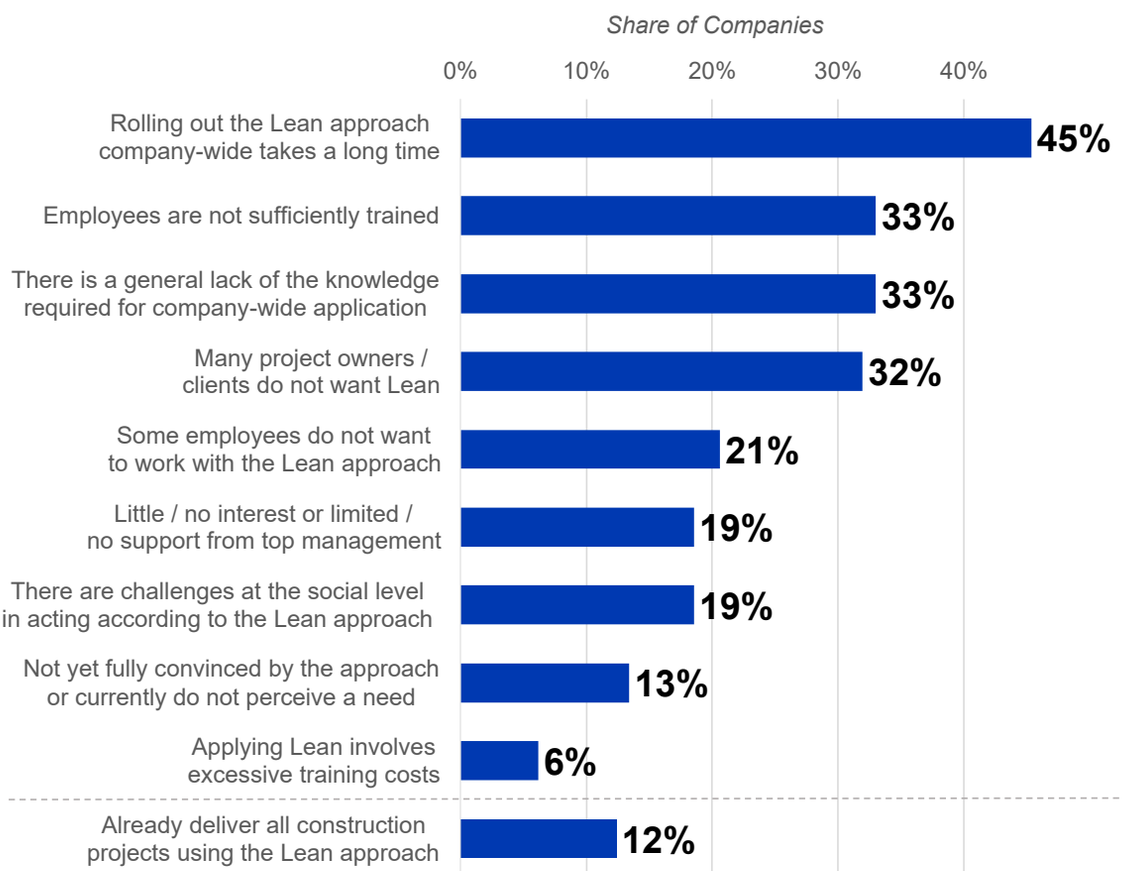

Figure 21: Barriers to organisation-wide implementation of Lean Construction

First, 12% of respondents report that they already apply Lean Construction in all of their projects. These companies fall within maturity Stages 4 and 5 and therefore exhibit a comparatively advanced integration of the approach. Among the remaining 88% of companies, 45% state that a company-wide rollout of the Lean approach requires a great deal of time. This aligns with numerous interview statements indicating that Lean Construction cannot be implemented “overnight”, but requires structural adjustments, capability building, and cultural change. Other frequently cited reasons are insufficient employee qualifications (33%) and a general lack of knowledge regarding comprehensive application of the Lean approach (33%). Around one third of respondents also mention insufficient demand from project owners / clients – a finding that was also discussed in Chapter 4.2.

In addition, several internal barriers are confirmed: 21% report resistance within the workforce, and 19% point to low or missing interest and/or insufficient support from top management. Another 19% indicate that social factors – such as difficulties in working collaboratively or transparently – make application more difficult, pointing to challenges of cultural fit. A further share of companies attribute limited rollout to the fact that they are not yet fully convinced by the approach or currently do not perceive a need (13%). A smaller group (6%) refers to what they consider to be the high financial effort required for training associated with introducing Lean Construction.

Overall, the results illustrate that the reasons for not applying Lean Construction across the board are diverse and encompass structural, cultural, and knowledge-related aspects. These factors help explain why, despite positive assessments of its impact, the Lean approach is still applied only selectively in many companies.

4.3.4 General perceptions of Lean Construction

To develop a more nuanced picture of how Lean Construction is actually understood, applied, and experienced in practice, we presented the participating company representatives with 15 statements reflecting common perceptions, stereotypes, or recurring experiences related to Lean Construction. Representatives were asked to rate each statement on a five-point Likert scale in order to assess the extent to which it aligns with their day-to-day practice. This section therefore complements the preceding results with an evaluative and reflective perspective, offering additional insights that support interpretation of the Lean Construction landscape.

Statement 1 (n = 97):
Under Lean, we primarily understand the application of methods – Lean principles beyond method application are not or hardly a focus of our work.

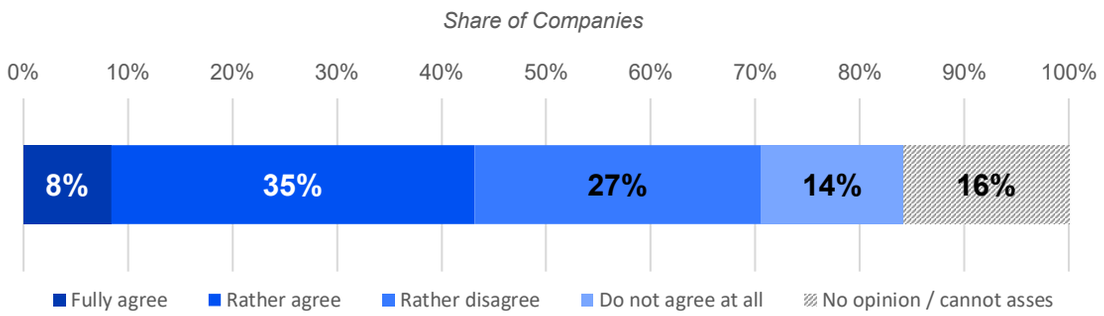

Figure 22: Perception of method orientation

For a substantial share of applying companies (41%), Lean Construction is currently perceived primarily as a toolbox of methods (see Figure 23) – a finding that is consistent with the earlier results on the use of practices and principles. As shown in Chapter 4.3.3, application is dominated by specific practices such as the Last Planner System or takt planning / takt control, while core Lean principles such as customer orientation, employee enablement, and cultural development are addressed systematically far less often. At the same time, the almost equally large share of companies (43%) that do not agree with the statement points to a group of more advanced users that already understands Lean Construction more strongly as a principle-based management approach. This aligns with the observation that, at higher maturity stages, substantially more Lean principles are consciously implemented and the Lean approach is embedded beyond operational method application into strategy, structure, and culture. 16% did not provide an answer.

Statement 2 (n = 97):
For us, Lean mainly means optimising processes.

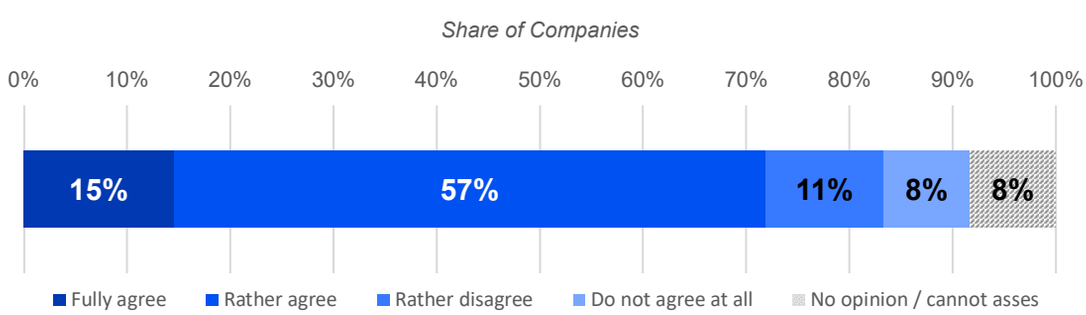

Figure 23: Perceptions of process orientation

The second statement suggests that, in the surveyed companies, Lean Construction is predominantly equated with process optimisation. Overall, 72% of companies agree with this statement (15% “fully agree”, 57% “rather agree”), while only 19% disagree and 8% did not provide an answer (see Figure 24). This indicates that the focus is often placed on increasing efficiency in processes, whereas the cultural dimension of the approach is addressed far less frequently – consistent with the results on Lean principles.

Statement 3 (n = 97):
In the construction projects in which we work with Lean, we are predominantly supported by (external or internal) “Lean coaches”.

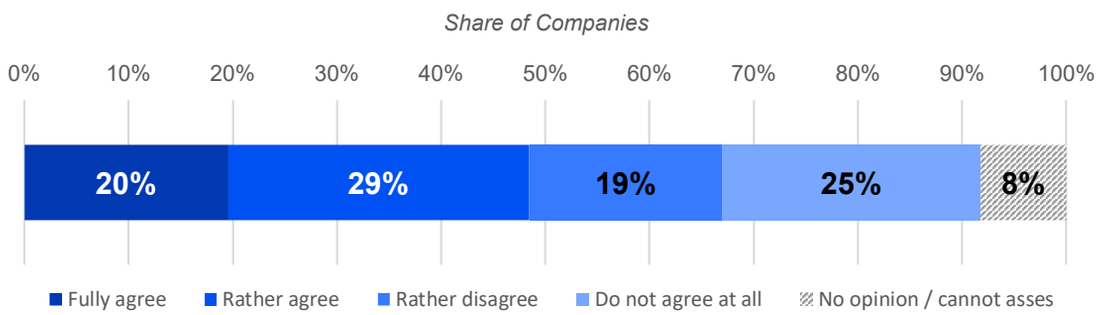

Figure 24: Perceptions of reliance on coaches

Lean Construction in many companies is still strongly supported by external or internal Lean coaches. Overall, 49% of companies (rather) agree with the statement that Lean Construction projects are predominantly accompanied by coaches (20% “fully agree”, 29% “rather agree”), while 44% (rather) disagree and 8% did not provide an answer (see Figure 25). This again points to a highly heterogeneous picture – while also confirming a key pattern from the preceding analyses: particularly in early stages or lower maturity levels, companies often rely on coaching structures because method knowledge, experience, and cultural routines are not yet sufficiently established within the organisation at an operational level. At higher maturity stages, this dependence tends to shift towards more direct ownership and responsibility within the project teams.

Statement 4 (n = 97):
When we work with Lean, this is usually explicitly requested or specified by the project owner / client.

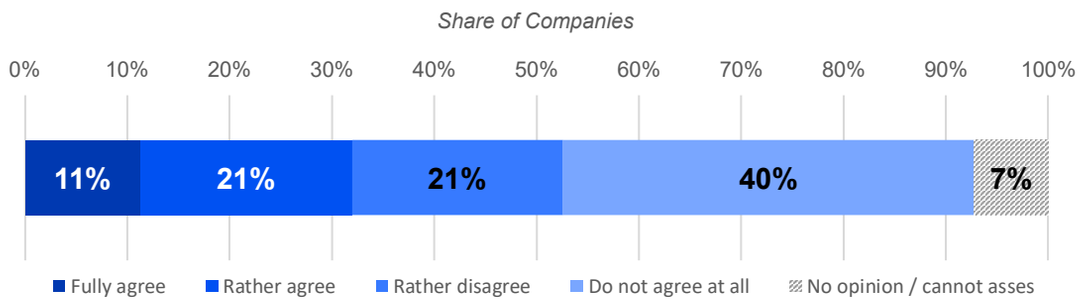

Figure 25: Perceptions of the initiation of Lean Construction in projects

In roughly one third of companies (31%), Lean Construction is (tended to be) applied at the request of, or mandated by, the project owner / client. In almost twice as many companies (61%), however, it is applied on the company's own initiative. 40% clearly disagree with this statement, and 7% did not provide an answer (see Figure 26). This again paints a clear picture that complements the findings from the preceding analyses: on the one hand, project owners are partly perceived as a barrier (i.e., insufficient demand), while on the other hand there appears to be a relevant group of companies in which Lean Construction is explicitly required by the project owner. Overall, however, the majority of Lean applications are not initiated by project owners but are driven by the companies themselves. This provides at least an indication that Lean Construction to date has had (also) positive effects primarily on the companies' own delivery of their assignments within projects (see p. 52).

Statement 5 (n = 97):
Lean is usually applied only in project delivery and not to other internal activities within the company.

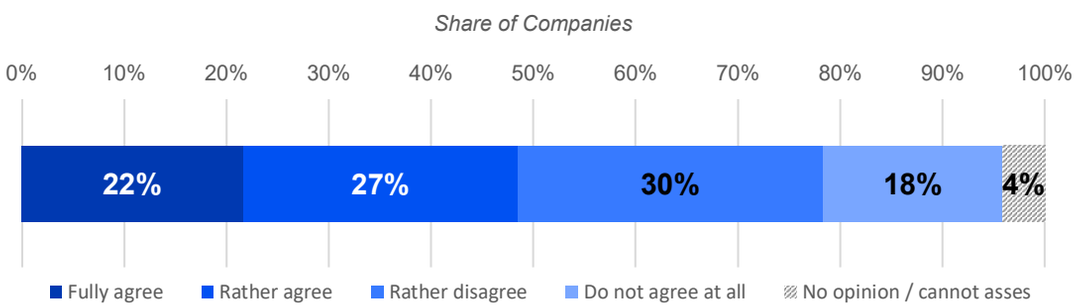

Figure 26: Perceptions of project orientation

Figure 27 addresses the statement that, in many companies, Lean Construction is (rather) limited to project work. Almost half of the respondents agree with the statement (22% “fully agree”, 27% “rather agree”), while 48% tend to disagree. Only 4% did not provide an answer. This again confirms a broader impression: in Germany, many companies understand Lean Construction primarily as a project-based approach, and accordingly have limited experience with integrating it into non-project, organisation-wide work. This aligns with the maturity distribution, which show that most companies fall into Stages 2 or 3 and therefore apply Lean Construction mainly in selected projects, rarely embedding it across the organisation. The analysis of Lean principles likewise indicated that cultural and strategic elements are still less developed in many Lean Construction companies.

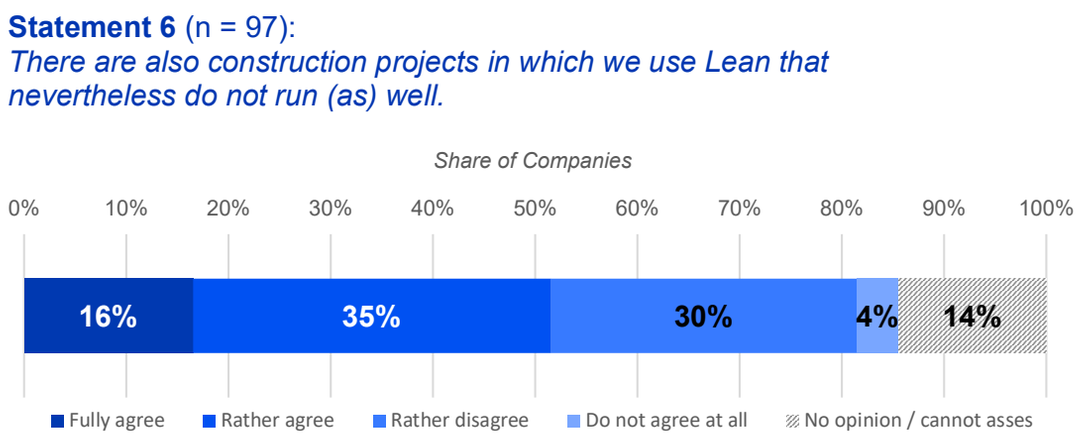

Figure 27: Perceptions of the effectiveness of Lean Construction

The results for Statement 6 (see Figure 28) reinforce a key insight from the preceding chapters: Lean Construction is not a guarantee of project success – especially not when the approach is applied only selectively, late, or incompletely. Overall, 51% of companies agree with the statement that there are Lean projects that still do not run (as) well (16% “fully agree”, 35% “rather agree”). Just under one third (30% + 4%) disagree, and 14% did not provide an answer.

This pattern is consistent with the qualitative findings from Phase 2 and with the impact analysis results. Many practitioners emphasised that Lean Construction can only unfold its benefits when it is implemented early, broadly, consistently, and with sufficient depth. If Lean is instead used merely as a “firefighting” measure, applied selectively in certain areas, or introduced without a supporting cultural foundation, positive effects remain limited – or frustration may even emerge within the project team. The fact that a substantial share of companies confirms that Lean projects can still fail therefore points less to any inherent ineffectiveness of the approach and more to variations in maturity, depth of application, and contextual conditions. At the same time, the finding aligns with the impact analyses in Chapter 4.3.3: higher maturity increases

the likelihood that Lean Construction contributes consistently to positive project outcomes.

Statement 7 (n = 97):
In most cases, we apply Lean only to certain aspects of a construction project and/or only temporarily.

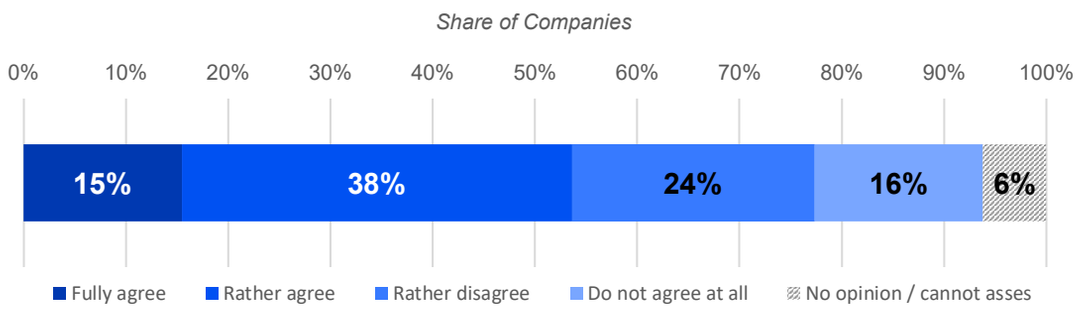

Figure 28: Perceptions of consistency of application

The responses to Statement 7 confirm very clearly a key pattern that has already run through several of the previous analyses: in many companies, Lean Construction is applied only selectively – either only in certain aspects of a construction project or only temporarily. Overall, 53% of companies agree with this statement (15% "fully agree", 38% "rather agree") (see Figure 29). Around a quarter (24%) disagree, a further 16% clearly disagree, and 6% did not provide an answer.

Statement 8 (n = 97):
Lean is often applied only once negative deviations from the project objectives become foreseeable.

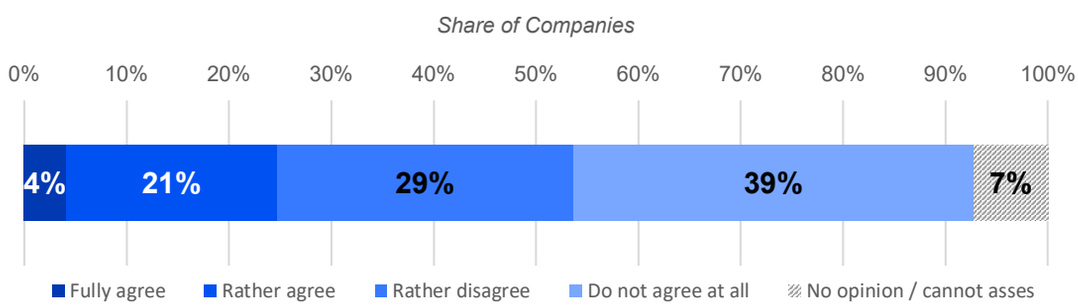

Figure 29: Perceptions of Lean "firefighting" deployments

Lean Construction is still applied reactively rather than proactively in some German companies (see Figure 30). One quarter of companies (4% "fully agree", 21% "rather agree") confirm that the Lean approach is often introduced only once negative deviations from project objectives become foreseeable. In contrast, more than two thirds

(68%) disagree with this statement, including 39% who clearly disagree. 7% did not provide an answer. Overall, while the majority of companies now embed Lean Construction in a more deliberate and planned manner, there remains a relevant share that primarily uses the approach as a problem-solving instrument – rather than as an approach for proactively shaping projects.

Statement 9 (n = 97):
When we use the term Lean in construction projects or within the company, we often encounter reservations or resistance.

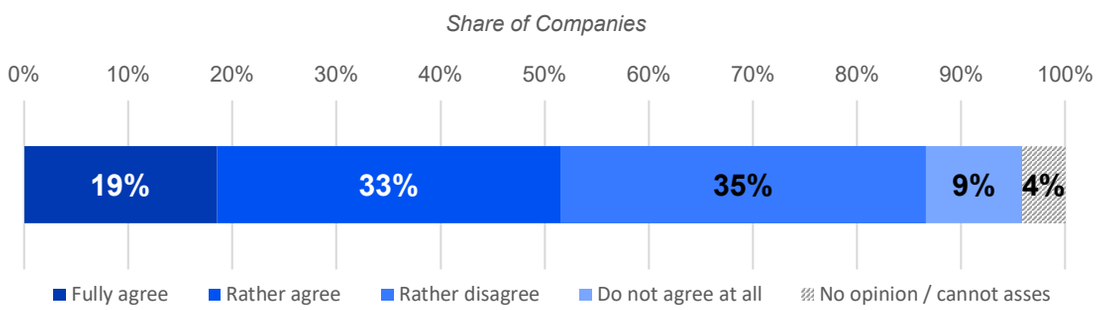

Figure 30: Perceptions of the acceptance problem

The results for Statement 9 (see Figure 31) indicate that Lean Construction is still associated with noticeable reservations in many companies and in collaboration with many project partners. More than half of respondents (52%) confirm that the term "Lean" frequently triggers scepticism or resistance in day-to-day project work or within the company, while 44% (rather) disagree with this assessment.

This divided picture fits seamlessly with the findings to date. The Phase 2 interviews already showed that Lean Construction often faces an acceptance problem – frequently being perceived as a buzzword, as "old wine in new bottles", or merely as a theoretical concept. One reason lies in how Lean Construction is implemented in many organisations. As the previous statements and analyses have shown, practice is often dominated by a selective, method-focused, and sometimes even reactive application. In such cases, the expected impact often falls short of expectations – thereby reinforcing scepticism and resistance. At the same time, the results on maturity and perceived impact clearly show that where Lean Construction is applied consistently, early, and holistically, not only does acceptance increase, but so does the enjoyment of delivering construction projects (at least according to the experience reported by some practitioners).

Statement 10 (n = 97):
Ongoing digitalisation (e.g., through BIM) supports the integration of Lean in construction projects.

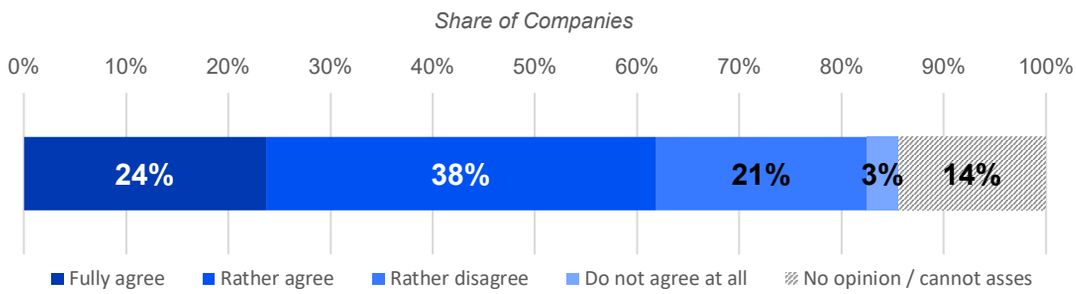

Figure 31: Perceptions of synergy with digitalisation

Most companies perceive ongoing digitalisation as a tangible enabler for embedding Lean Construction (see Figure 32). Overall, 62% agree with the statement, while only 24% (rather) disagree; 14% did not provide an answer. This also mirrors the views expressed in the interviews, where Lean Construction and BIM were increasingly described as being considered in tandem within many organisations. Both approaches address similar themes: greater transparency, improved information flows, and stronger collaboration. Where digital models, common data environments, or automated analyses are in place, the operational implementation of Lean practices is often easier – and conversely, Lean Construction promotes clear structures, responsibilities, and processes that in turn support digital ways of working. Where Lean Construction and digitalisation are combined, a mutually reinforcing effect can therefore often emerge.

Statement 11 (n = 97):
Through Lean, at the start of a construction project or assignment, we engage more intensively with the project owner's / client's needs.

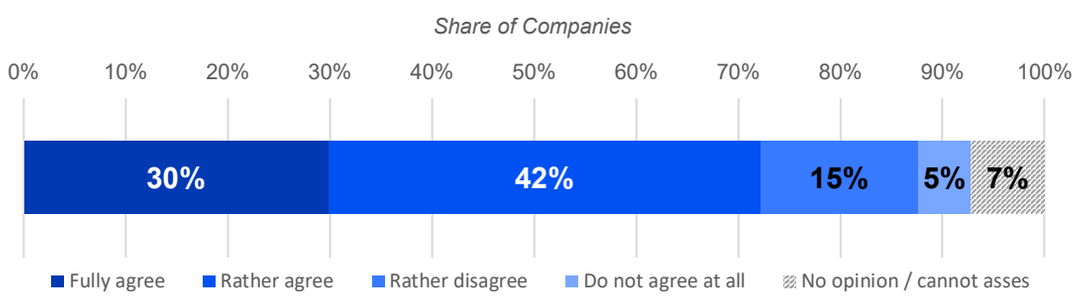

Figure 32: Perceptions of awareness of project owner needs

72% of company representatives agree that Lean Construction in their organisation leads to a more intensive engagement with project owner / client needs at the start of a project (30% “fully agree”, 42% “rather agree”). Only 20% disagree with the statement that Lean Construction has such an effect, while 7% did not provide an answer (see Figure 33).

In this regard, the analysis of Lean principles showed that customer-centred aspects have so far been systematically prioritised by only around one third of companies. The interviews likewise suggest that Lean practices such as early collaboration formats, structured project kick-off workshops, or visual planning help to make expectations more transparent at an early stage and thus clarify project owner needs. At the same time, the 20% of dissenting responses indicate that this effect does not occur automatically with Lean Construction. In companies where the approach is, for example, introduced only later in the project timeline, its potential influence at the project or assignment outset cannot naturally materialise.

Statement 12 (n = 97):
Through the application of Lean, we also engage with the needs of the building’s future users.

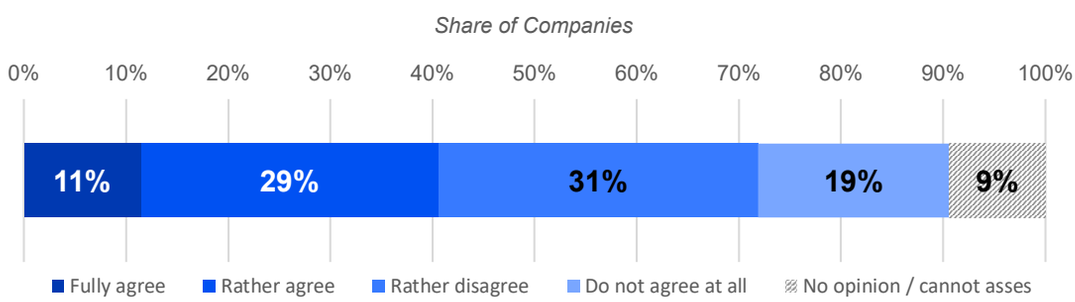

Figure 33: Perceptions of awareness of end-user needs

Looking in the other direction – towards the later end users – yields a noticeably more cautious picture (see Figure 34). While overall two fifths of companies (40%) agree that Lean Construction leads them to engage more intensively with the future users of the building (11% “fully agree”, 29% “rather agree”), half of the companies state that this is (rather) not the case for them (31% “rather disagree”, 19% “fully disagree”). 9% did not provide an answer.

This can be interpreted as an indication that had already emerged in the analysis of Lean principles: end-user orientation – one of the core elements in Lean thinking, particularly in terms of value from the end user’s / customer’s perspective – has so far been embedded only to a limited extent in German Lean Construction practice. Here, the notion of “value” still appears to be interpreted primarily in terms of project objectives (from the project owner’s perspective), rather than from the perspective of the later end users.

Statement 13 (n = 97):
For us, Lean also means empowering our employees more strongly to make decisions themselves and solve problems on their own.

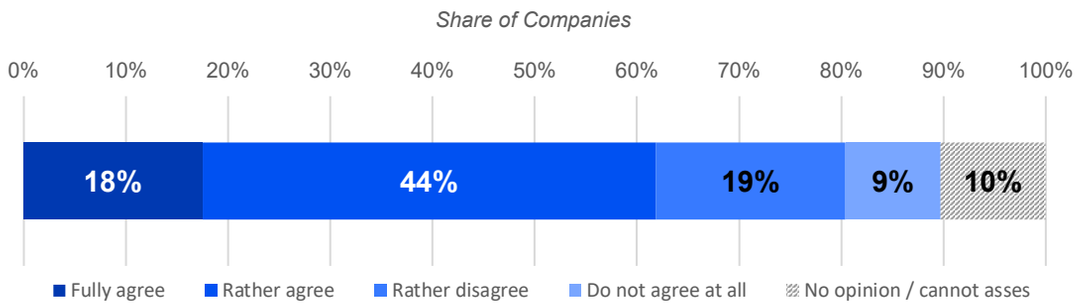

Figure 34: Perceptions of employee enablement

Looking "inwards", the results show a positive, but not yet fully developed, picture regarding employee enablement in the context of Lean Construction (see Figure 35). A majority of 62% of companies agree that the Lean approach helps to empower employees to make independent decisions and solve problems with greater personal responsibility (18% "fully agree", 44% "rather agree"). At the same time, 28% state that this is (rather) not the case for their company.

This relatively high share is consistent with the earlier results on Lean principles, where a focus on employee enablement and well-being was among the least frequently and deliberately embedded principles (only 24%). The strong method-oriented emphasis in many companies may also help explain why cultural and leadership-related aspects have not yet been realised to the same extent in practice.

Statement 14 (n = 97):
Lean is more suitable for large construction projects than for small ones.

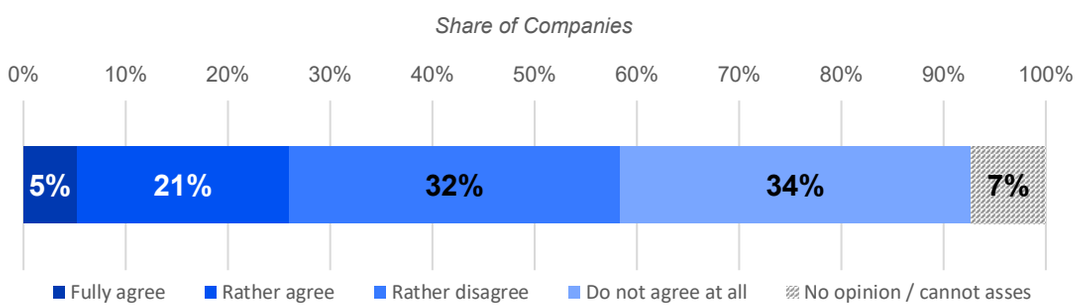

Figure 35: Perceptions of project size

The majority of companies (around two thirds) do not see Lean Construction as a question of project size, but rather as an approach that is fundamentally applicable across project types. The common assumption that Lean Construction only pays off in complex large-scale projects is therefore not supported by the data; instead, the results suggest that the Lean approach is also perceived as meaningful and practicable for smaller projects.

While 26% of companies agree with Statement 14 in Figure 36 (5% “fully agree”, 21% “rather agree”), 66% disagree (32% “rather disagree”, 34% “fully disagree”). 7% did not provide an answer.

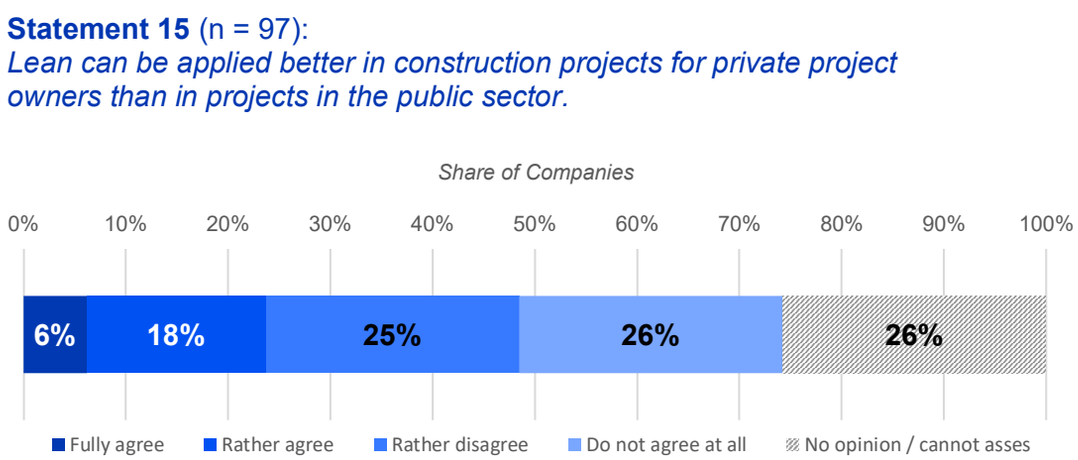

Figure 36: Perceptions of project owner type

With regard to whether Lean Construction can be applied more effectively in projects for private project owners / clients than in projects for the public sector, the data likewise show relatively limited agreement. While 24% of companies tend to agree with this statement (6% “fully agree”, 18% “rather agree”), 51% reject it (25% “rather disagree”, 26% “fully disagree”) – see Figure 37.

Notably, 26% of companies did not provide an assessment, which is substantially higher than for any other statement. This uncertainty may indicate that many companies either lack sufficient comparative experience between public and private projects or do not feel confident generalising across both contexts. Overall, the results argue against the assumption that Lean Construction is primarily “an approach for private project owners” and instead suggest that applicability depends less on the project owner type than on the specific project conditions and context.

5 Concluding discussion

5.1 4E4D modell

As part of this study, we developed an analytical model that allows the insights gained on the status quo of Lean Construction in Germany to be systematically and clearly assigned to different levels of analysis and dimensions. We refer to this as the 4L4D model: four levels, four dimensions.

The starting point is the distinction between four analytical levels. At the highest level is the German construction industry (L1) as an overall system (*Where does the construction industry stand overall in its development with regard to Lean Construction?*). The second level focuses on construction projects (L2) that take place within this system (*How far has Lean Construction application progressed within construction projects?*). The third level concerns the companies (L3) involved in these projects (*Where are companies on their Lean journey?*). Finally, the fourth level addresses the operational (individual) assignment delivery (L4) of these companies within the projects (*How advanced is Lean Construction application in day-to-day assignment execution?*).

Note: In the meantime, we have added a fifth level (L5 – Operational practitioner). This additional level will be introduced and discussed in more detail in future publications – see also Figure 38).

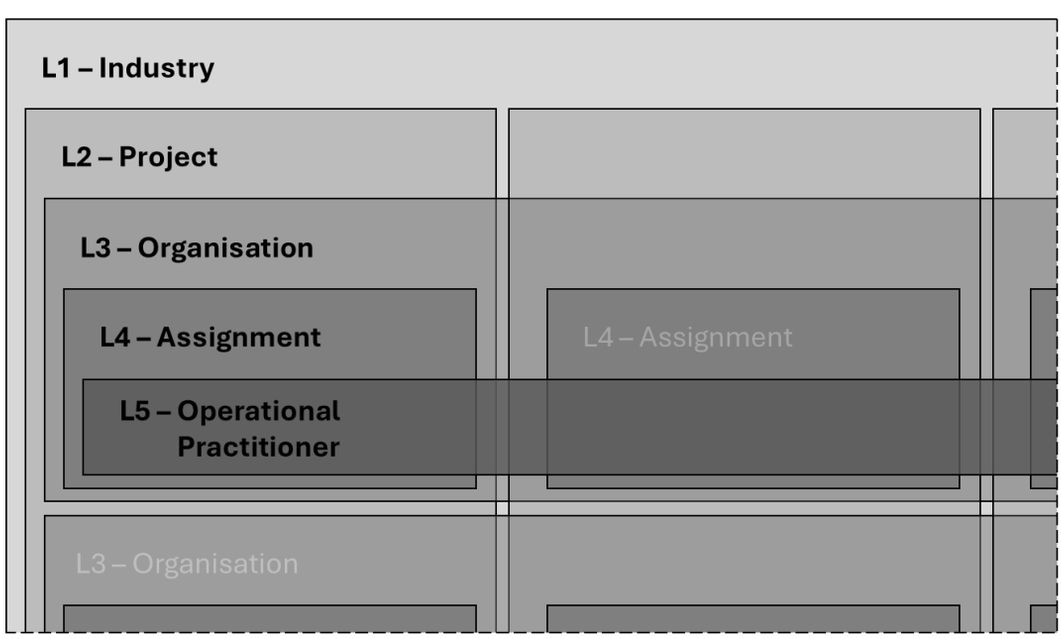

Figure 37: Levels of the 4L4D model

In addition, the model distinguishes four dimensions that are relevant at each level. Breadth (D1) refers to the purely quantitative aspect of application – i.e., diffusion. Depth (D2) captures the qualitative aspect of application and thus reflects the maturity of application. Duration (D3) addresses the temporal aspect of application, and Size (D4) represents the outcome-oriented aspect – i.e., the extent to which Lean Construction generates positive effects at the respective level.

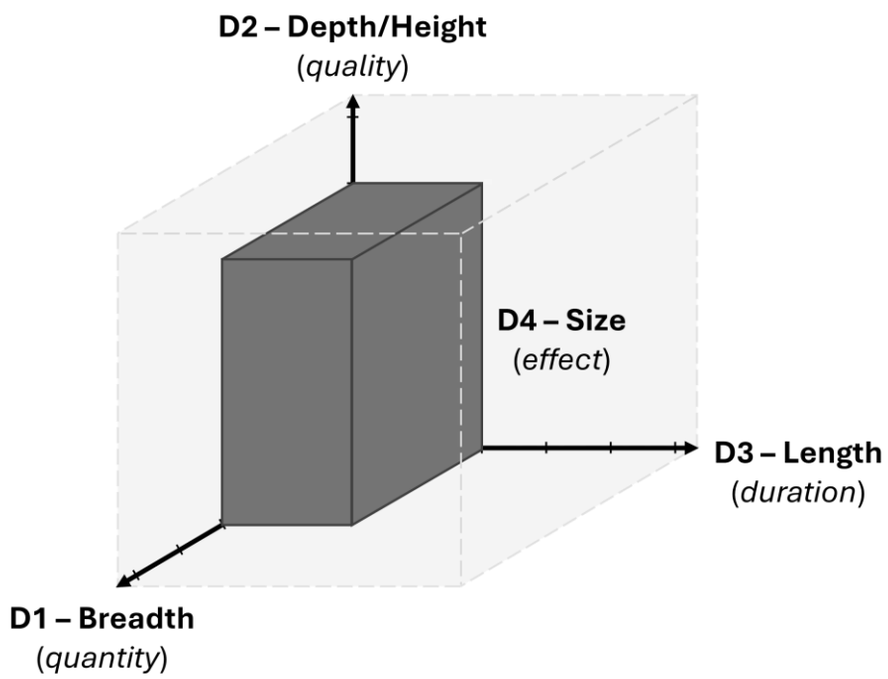

Figure 38: Dimensions of the 4E4D model

By combining these four levels and four dimensions, the model forms a coherent analytical framework that structures the wide range of findings collected in this study, relates them to one another, and makes them interpretable.

For the implications, we differentiate below – based on the insights gained – between three overarching responsibility groups:

1. **Companies** (project owners / project owner representatives as commissioning parties, and the remaining project participants as contractors in the narrower sense)
    a. Top management level
    b. Employee level
2. **GLCI** as an overarching institution
3. **Research**

5.2 Findings and implications at industry level

D1 – Breadth: ***Lean Construction is visible in Germany, but still scarcely represented in quantitative terms.***

In terms of breadth, Lean Construction appears in Germany as a visible but still quantitatively marginal phenomenon. Our systematic industry analysis identified 451 companies nationwide that apply Lean Construction – well below one percent when set against an estimated total of more than 300,000 companies in the German construction industry.

At the same time, discussions with international researchers suggested that many countries likely do not reach a comparable absolute number of Lean Construction adopters. From an anecdotal perspective, Germany could therefore be described as a frontrunner in international practical application. However, this has not yet been empirically demonstrated, as comparable industry-wide analyses from other countries are currently not available.

D2 – Depth: ***Lean Construction still suffers from limited awareness across many parts of the industry, frequently insufficient understanding – even among Lean companies – and an acceptance problem.***

There are still many people in the German construction industry who have not yet heard of Lean Construction or cannot clearly articulate what it entails. In addition, the understanding of the Lean approach varies substantially across the industry – including among Lean companies themselves. Many interpret Lean primarily as a toolbox of methods that can be used selectively when needed. Others view it as “old wine in new bottles” or equate it with “common sense.” Only a minority explicitly considers the cultural and principle-based layer and applies Lean Construction as a continuous management approach that extends beyond the use of methods.

At the same time, most practitioners are familiar with the fact that Lean Construction can face substantial resistance. One interviewee described it as feeling like a “war of belief” (conventional vs. Lean). This acceptance problem occurs not only in projects, but demonstrably also within Lean companies themselves. Some reasons – such as negative experiences caused by *Lean light* or *Leanwashing* – are objectively understandable; other forms of resistance appear to be driven more by emotional dynamics.

D3 – Length: ***Lean entered construction more than 30 years ago, and reached Germany almost 20 years ago – yet broader uptake in the industry has only been observable for about a decade.***

From a temporal perspective, Lean Construction can draw on more than three decades of international development. In Germany, however, its visible anchoring in the construction industry is comparatively recent. While the approach was first introduced to a broader German-speaking audience around 2006, its application remained limited for a long time to isolated pilot projects and small professional circles. Broader awareness and application emerged only gradually – particularly since the establishment of the German Lean Construction Institute (GLCI) in 2014. Still, it appears that a long path remains before Lean Construction ideas and principles are perceived as "self-evident" in construction projects.

D4 – Size: ***Lean Construction has not (yet) transformed the construction industry – there is no observable effect on industry-level performance.***

With regard to the effect at the industry level, Lean Construction is still too limited in its diffusion across projects and companies, and often too superficial in application, for changes to be observable. At present, it is therefore not possible to claim a measurable effect on the overall performance of the German construction industry – although within parts of the Lean community, individual mindsets and perspectives may be shifting in noticeable ways.

Practical implications at industry level:

At industry level, the primary lever – and thus the leading responsibility – for a broader and higher-quality anchoring of Lean Construction does not lie with individual companies or individuals. Rather, it sits above all with overarching institutions such as the German Lean Construction Institute (GLCI).

1. A first starting point is to make the actual application of Lean Construction in Germany more visible and tangible. Practical, traceable examples can provide orientation, reduce fear of failure, and lower the threshold for companies to get started – for instance through a "Lean Germany map" where projects can be entered online with a small set of information (e.g., project KPIs, applied practices and principles, experiences, lessons learned, and a Lean contact person).
2. At the same time, the GLCI should continue to build awareness across the broader construction industry – beyond the Lean community and explicitly also among smaller companies. A more proactive approach, for example through stronger presence at industry-relevant events, targeted information sessions, or company visits (e.g., via representatives of the regional groups acting as Lean ambassadors), could increase local and regional visibility of Lean Construction and facilitate access to knowledge.
3. A central field of action also concerns the understanding of Lean Construction. This study shows that the approach is often perceived in a reduced way as a set of methods. Here, the GLCI can contribute by publishing clear, accessible, non-

over-academic materials, practically usable guidance, and shorter media contributions – for example a "What is Lean Construction?" video series on YouTube – to support a more consistent and accurate understanding.

4. Finally, fostering acceptance is one of the most critical tasks at industry level. The Lean community should be a place for open, honest, and directly practice-relevant exchange – not for self-presentation. Transparent handling of successes as well as failures (e.g., through formats such as "Lean fuckup nights") can systematise learning and help counteract Leanwashing. If experiences and lessons learned are documented by the GLCI, regularly updated, and made publicly accessible, the construction industry as a whole can learn. This would also send an important signal beyond the Lean community – consistent with this study's findings: Lean Construction works, but it must be applied correctly; before that, it must be understood correctly.[18]
5. In addition, research support (by initiating and funding small and large research projects, by serving as a research partner, and by sharing information) can make a substantial contribution in the field of Lean Construction. Many of the challenges identified in this study – especially acceptance issues, insufficient understanding, heterogeneous implementation depth, or the occurrence of "Lean light" and "Leanwashing" – have hardly been addressed scientifically so far. Research could investigate these aspects in greater depth and provide the GLCI and other industry stakeholders with robust evidence. Such empirically grounded insights would be valuable to support transformation more purposefully, derive more effective measures, and advance the development of the approach in Germany in a concrete way.

[18] A useful impulse for a future GLCI acceptance-building strategy could be the following quote attributed to the behavioural researcher and Nobel laureate Konrad Lorenz: "*Thought does not always mean said; said does not always mean correctly heard; correctly heard does not always mean correctly understood; correctly understood does not always mean agreed; agreed does not always mean correctly applied; correctly applied is still far from being sustained*."

5.3 Findings and implications at the project level

D1 – Breadth: ***Lean Construction is now, in principle, used across all disciplines in German construction projects – most frequently by construction execution and larger companies.***

Lean Construction has, in principle, reached all functional disciplines in German construction projects. Our study also shows, however, that the extent of application varies considerably: while construction execution, construction management, and consulting use Lean Construction comparatively often and intensively, other areas are much less active in practice. In addition, Lean Construction is often applied by only one or a few parties within a project, without being integrated across disciplines. This "silo use" may still generate benefits, but typically primarily for the individual company applying it. The potential that Lean Construction can create at overall project level – particularly with regard to collaboration – therefore remains largely untapped.

We also found that Lean Construction tends to be used by larger companies. One plausible explanation is that its application is frequently associated with substantial resource requirements (both financial and time-related), which can lead smaller companies to perceive that they "cannot afford it" or "do not have the time" for it, as several practitioners explicitly stated.

D2 – Depth: ***Lean Construction application in Germany is strongly method-focused; even core Lean principles are not considered by many users.***

In terms of depth, Lean Construction in German construction projects is still implemented in a predominantly method-driven way. The use of individual practices – above all the Last Planner System and takt planning / takt control – shapes practice far more than a holistic, principle-based way of working. Our results show that central Lean principles such as customer orientation, employee enablement, continuous improvement, or a collaborative culture are not consciously or explicitly addressed by many companies. As a consequence, application in many projects remains relatively superficial.

D3 – Length: ***Lean Construction is mainly used during the execution phase, while increasing activity can be observed in design and planning.***

Looking across the project timeline, Lean Construction in Germany is still used predominantly in the execution phase. At the same time, many practitioners report a growing development in the design and planning phase, where more and more companies are engaging with Lean Construction. Our analyses also show that design and planning companies are clearly represented among Lean Construction companies, and that some companies already use Lean Construction explicitly in the planning phase. By contrast, early project phases and late phases are addressed only to a limited extent. A holistic, consistent Lean Project Delivery approach spanning all project phases has not yet been observed by us in Germany.

With regard to the time dimension at project level, the point in time at which Lean Construction is introduced also varies substantially. A non-trivial number of companies (and practitioners) report "firefighting deployments", where Lean Construction is brought into a project on short notice only when major deviations from project targets have already become foreseeable.

D4 – Size: ***A measurable contribution to overall project success is so far evident only in isolated cases, due to fragmented application across parties as well as limitations in quality and duration.***

In terms of impact on overall project success, Lean Construction has so far only been able to unfold limited effectiveness in German construction projects. Because application is fragmented – across breadth (isolated within individual disciplines), quality (strongly method-oriented and weakly anchored in culture), and duration over the project lifecycle (execution-focused, rarely spanning the entire project) – its contribution to core project success dimensions remains constrained. While companies report positive effects in specific instances, a consistent, overarching contribution to project success cannot, given current project-level practice, be observed by us in general, and only rarely at present.

Practical implications at project level:

The central leverage point at project level lies with the project initiator – the project owner / client – and, where applicable, the project owner's external project management (project owner representative / project controller). Only if these actors integrate Lean Construction early can the approach unfold its full potential at project level beyond individual practices both structurally and culturally.

1. A first point of action for project owners is to anchor Lean Construction already in the initial project set-up – for example in the project delivery model, the project processes, or the rules of collaboration within the project team.

2. Project owners or their representatives can also pay explicit attention, when selecting contractors, to Lean competence – or at least to a fundamental openness towards the Lean approach.
3. It may also be appropriate to include the application of Lean Construction as a binding requirement in contract documents and/or to integrate evidence of Lean experience into tendering, for instance through minimum qualifications or training certificates.
4. Other project participants – especially those entering the project early, such as architects, consultants, or specialist designers – can also make an important contribution to the integration of Lean Construction. They can proactively point project owners to potential benefits and advocate for early Lean integration.
5. The GLCI can, to some extent, also support implementation at project level – particularly through tangible and informative offerings for project owners and project owner representatives. With the establishment of the "Lean Project Management" working group jointly with the DVP (German Association for Project Management in the Construction and Real Estate Industry), an initial institutional initiative has already been launched in this direction.

Overall, a realistic set of expectations is required: a step-by-step introduction (starting small, making early successes visible, and then scaling systematically) can help reduce barriers and build acceptance. However, integration at project level does not begin with applying individual practices; it begins with the conscious decision to treat Lean Construction as a fixed component of project delivery – and that requires project owners who trust in the effectiveness of this approach.

5.4 Findings and implications at organisational level

D1 – Breite: ***Lean Construction is mostly applied to only a small share of projects/assignments within Lean Construction companies.***

At organisational level, Lean Construction is still used quite selectively in terms of breadth. Most Lean Construction companies apply the approach only to a small portion of their project assignments. Our survey shows that 71% of companies use Lean Construction in less than half of their projects, and one third apply it in no more than every tenth project. Even long-standing adopters often do not roll Lean Construction out across their full project portfolio. Accordingly, in many organisations Lean Construction is not yet a standard; it is frequently deployed case-by-case and tailored to individual projects.

D2 – Depth: ***Lean Construction is still used predominantly on a project basis, not as a general management approach applied across the company.***

With regard to maturity, the results indicate that Lean Construction is mostly implemented as a project-specific approach rather than as a comprehensive management system that shapes the organisation as a whole. This is also reflected in the fact that – even after several years of engagement – many companies remain at mid-level maturity stages. In practice, Lean Construction often remains an optional add-on rather than an integrated element of corporate management and leadership.

D3 – Length: ***Most Lean Construction companies have only been engaging with Lean Construction for a few years.***

From a time perspective, most Lean Construction companies in Germany appear to be at an early stage of their Lean journey. Around 85% of participating companies have been applying Lean Construction for less than ten years; about 60% for no more than five years, and just under 30% for less than two years. These figures underline that, for many organisations, Lean Construction is still a relatively new field of development in which experience, routines, and stable organisational structures are only gradually emerging. Expectations of a comprehensive or deeply embedded implementation are therefore unrealistic – most companies are still in early phases of adoption, which is consistent with multiple findings from this study.

D4 – Size: ***A substantial improvement in company performance is observed only among a few Lean pioneers; it is not the norm – because Lean is applied too little, too narrowly, and too superficially in most companies.***

A clearly positive influence of Lean Construction on company performance can only be observed among a small number of Lean pioneers in Germany that have embedded the approach deeply and organisation-wide. The prominent overall positive benchmark remains Toyota – a company that has demonstrably achieved outstanding results through a consistent Lean application developed over decades. For the vast majority of German Lean Construction companies, however, this effect remains limited. Implementation is often too selective, too project-bound, or too superficial to generate substantial improvements at company level.

Implications for practice at organisational level:

At company level, the decisive lever for effective and increasing Lean application lies in strategic choices and a consistently lived culture. Among other things, our study shows that missing support or indecisiveness at top-management level is one of the key barriers to effective implementation within organisations. This leads to several action points:

1. Top management should explicitly commit to Lean Construction and not only permit its application, but actively promote and role-model it. An explicit strategic decision, combined with clear communication, is the foundation of any successful organisational transformation.
2. In management research, the guiding principle applies: "*Culture beats strategy – and structure follows strategy.*" Company-level Lean Construction should therefore start with depth (as in projects). The organisational culture must fit the Lean approach[19]; without that cultural foundation, Lean is effectively "built on sand." As with any transformation, the rule is: tailoring (i.e., deliberately making it your own) rather than copying. The Lean approach must be adapted to the organisation's specific context, project types, structures, and people.
3. At employee level, companies can begin by making small Lean successes visible – internally and to management. When Lean works well in initial projects, it creates convincing effects. Early success experiences can thus become a driver for scaling Lean across the organisation.
4. The GLCI, as a recognised institution in this field, could use its voice to draw more attention to the fact that Lean Construction does not unfold its full potential through methods alone, but above all through the underlying cultural foundation and the corresponding mindset.

5.5 Findings and implications at assignment level

D1 – Breadth: ***In Germany, Lean Construction is often not "self-sustained" at the operational level, but introduced into projects by internal or external coaches.***

In terms of breadth at the operational delivery level, Lean Construction in Germany often depends on the involvement of internal or external Lean coaches. In many companies, the required operational knowledge and competencies are still limited.

With regard to the range of Lean practices actively applied, the focus is typically on the Last Planner System or takt planning / takt control. Other Lean practices are used by fewer companies and applied less frequently.

[19] Further ideas and practical approaches for shaping (project) culture are provided by JOHN and SCHILLING MIGUEL (2023).

D2 – Depth: ***"Lean light" (superficial, selective use of methods) and "Leanwashing" (Lean primarily as a marketing label) are observable phenomena in German practice.***

In terms of depth, our study clearly indicates that Lean Construction in many projects is implemented in a reduced form. Two phenomena characterize practice in Germany: "Lean light" (the superficial, selective use of individual methods without embedding the underlying principles) and "Leanwashing" (Lean Construction is used primarily as a label or marketing instrument without substantial changes in culture, collaboration, or leadership behavior). Both patterns are symptomatic of insufficient implementation quality – particularly a lack of principle orientation and cultural integration.

D3 – Length: ***Lean Construction is still rarely applied consistently from tendering/request to completion of delivery.***

From a temporal perspective, our investigation shows that Lean Construction in Germany still rarely spans the full life cycle of a project delivery – from initial tendering / request through to completion. As outlined above, application often concentrates on a limited set of practices. At the same time, Lean Construction can also be applied independent of specific named methods.

D4 – Size: ***Lean Construction works – the higher the maturity, the stronger the perceived effect on project outcomes.***

Lean Construction creates impact most clearly where it is applied "maturely" and consistently. Companies at higher maturity levels report almost uniformly positive effects on project outcomes – particularly regarding schedule performance, collaboration, quality, and the satisfaction of both clients and employees. At lower maturity levels, these effects tend to be weaker or less consistently observed.

Implications for practice at assignment level:

The study shows that Lean Construction to date is applied primarily at the level of operational project delivery. At this level, every employee can contribute to further development:

1. Building the competencies of operational staff is the foundation for better and more motivating application in day-to-day delivery. Importantly, this must not be limited to method skills alone, but also include adopting and embodying the underlying mindset.
2. An open approach to mistakes is essential. Phenomena such as “Lean light” or “Leanwashing” can lead to disappointment and resistance among other parties already during project execution. Transparency about challenges, failures, and learning processes, by contrast, strengthens trust and acceptance within the project team.

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Appendix

Appendix 1: Questionnaire (Phase 3)

I – Profiling the companies (1/5)	
Question:	**1. In which functional areas is your company primarily active?**
Note:	Multiple responses possible
Answer:	☐ Project owner / client ☐ Project development ☐ Project management / project owner representation ☐ Architecture / building design ☐ Design coordination ☐ Specialist design (engineering) ☐ Construction management ☐ Construction execution ☐ Construction logistics ☐ Supplier ☐ Consultancy ☐ Other: *(free text)*

I – Profiling the companies (2/5)	
Question:	**2. How many employees does your company have?**
Note:	-
Answer:	☐ 1-9 ☐ 10-19 ☐ 20-49 ☐ 50-99 ☐ 100-249 ☐ 250-499 ☐ ≥ 500

I – Profiling the companies (3/5)	
Question:	**3. How many locations does your company have in Germany?**
Note:	-
Answer:	☐ 1 ☐ 2 ☐ 3-5 ☐ 6-10 ☐ > 10

I – Profiling the companies (4/5)	
Question:	**4. Does your company also have locations outside Germany?**
Note:	-
Answer:	☐ 1 ☐ 2 ☐ 3-5 ☐ 6-10 ☐ > 10

I – Profiling the companies (5/5)	
Question:	**5. Approximately since when has your company been working with Lean (in the construction industry)?**
Note:	-
Answer:	☐ We are currently in the implementation phase / piloting ☐ < 1 year ☐ 1-2 years ☐ 2-5 years ☐ 5-10 years ☐ > 10 years ☐ We do not (no longer) use the Lean approach

II – Application of Lean Construction (1/10)	
Question:	**6. Approximately in how many construction projects across your company is Lean applied?**
Note:	-
Answer:	☐ So far, in none of our construction projects ☐ In 1-10 % ☐ In 10-25 % ☐ In 25-50 % ☐ In > 50 %

II – Application of Lean Construction (2/10)	
Question:	**7. How advanced is Lean application in your company?**
Note:	-
Answer:	☐ **Stage 1:** We have informed ourselves about Lean / built capabilities (e.g., through training or presentations), but have not yet implemented any concrete measures in practice. ☐ **Stage 2:** We have piloted Lean methods and/or Lean elements in a few construction projects. ☐ **Stage 3:** We apply Lean methods and/or Lean elements as standard practice in some construction projects, but not across the board. ☐ **Stage 4:** We apply Lean methods and/or Lean elements as standard practice in most construction projects. ☐ **Stage 5:** Beyond advanced application of methods in project delivery, Lean is also embedded in the company's strategy, structure, and culture.

II – Application of Lean Construction (3/10)	
Question:	**8. How is Lean application organised within your company?**
Note:	Multiple responses possible
Answer:	☐ There is a Lean department, Lean team, or Lean point of contact that is consulted (in an advisory capacity) for the respective construction projects. ☐ The employees who use the Lean approach in projects receive dedicated training for this purpose and/or have developed their competencies independently. ☐ We work with external Lean coaches in our projects. ☐ Other: *(free text)*

II – Application of Lean Construction (4/10)	
Question:	**9. How frequently does your company use Lean in the respective functional areas?**
Note:	Only the functional areas you selected in Question 1 are shown here.
Answer:	☐ Not at all ☐ Rarely ☐ Occasionally ☐ Often

II – Application of Lean Construction (5/10)	
Question:	**10. In which project phases is your company predominantly involved with Lean?**
Note:	Multiple responses possible
Answer:	☐ Concept development / project definition ☐ Design ☐ Construction ☐ Commissioning

II – Application of Lean Construction (6/10)					
Question:	**11. Which Lean methods and/or practices have already been used in your company?**				
Note:	-				
Answer:		*Not used so far*	*Used occasionally*	*Used regularly*	*(Name unknown)*
	Last Planner System (LPS)	☐	☐	☐	☐
	Takt planning / control	☐	☐	☐	☐
	Target Value Design (TVD)	☐	☐	☐	☐
	Value Stream Mapping	☐	☐	☐	☐
	Kanban system	☐	☐	☐	☐
	Gemba walks	☐	☐	☐	☐
	Daily huddels / stand-ups	☐	☐	☐	☐
	First Run Studies / PDCA	☐	☐	☐	☐
	Visual management	☐	☐	☐	☐
	Shopfloor management	☐	☐	☐	☐
	Big Room / co-location	☐	☐	☐	☐
	5S method	☐	☐	☐	☐
	A3 report	☐	☐	☐	☐
	5 Whys	☐	☐	☐	☐
	Set-Based Design	☐	☐	☐	☐
	Choosing by Advantages	☐	☐	☐	☐
	Kaizen session	☐	☐	☐	☐
	Plus / Delta	☐	☐	☐	☐

II – Application of Lean Construction (7/10)	
Question:	**12. Which aspects of Lean are explicitly being driven within your company?**
Note:	Multiple responses possible
Answer:	☐ Creating transparency ☐ Identifying and avoiding waste ☐ Putting the client's needs at the centre ☐ Continuous pursuit of improvement and perfection ☐ Visualising processes, decisions, etc. ☐ Standardisation and process thinking ☐ Focusing on employee empowerment and well-being ☐ Culture of collaboration

II – Application of Lean Construction (8/10)	
Question:	**13. How do you generally assess the impact of Lean application in your company on project outcomes?**
Note:	-
Answer:	☐ **Negative:** Lean has so far tended to worsen project outcomes. ☐ **Rather negative:** So far, Lean has led to little or no improvement in project outcomes and has been problematic in some cases. ☐ **Neutral:** Overall, Lean has so far shown neither clearly positive nor negative effects on project outcomes. ☐ **Rather positive:** Lean has led to noticeable improvements in project outcomes, but not across all projects. ☐ **Positive:** In most cases, Lean has led to significant improvements in projects. ☐ *(Not possible to assess)*

II – Application of Lean Construction (9/10)					
Question:	**14. To what extent does Lean application have a positive impact on the listed aspects of your construction projects?**				
Note:	In their perception				
Answer:		*Not noticeable*	*Moderately noticeable*	*Clearly noticeable*	*No assessment*
	Cost adherence	☐	☐	☐	☐
	Schedule adherence	☐	☐	☐	☐
	Ensuring the desired quality	☐	☐	☐	☐
	Ensuring safety and health	☐	☐	☐	☐
	Client satisfaction	☐	☐	☐	☐
	Employee satisfaction	☐	☐	☐	☐
	Working atmosphere in collaboration with other project stakeholders	☐	☐	☐	☐

II – Application of Lean Construction (10/10)	
Questition:	**15. Why are not all construction projects in your company delivered using Lean?**
Note:	Multiple responses possible
Answer:	☐ *(We already deliver all construction projects using the Lean approach)* ☐ Little / no interest or limited / no support from top management. ☐ The company is not sufficiently convinced by the Lean approach and/or currently sees little or no need for it. ☐ There is a general lack of the knowledge required for company-wide application. ☐ Employees are not sufficiently trained. ☐ Applying Lean involves excessive training costs. ☐ We are working on it, but rolling out the Lean approach company-wide takes a long time. ☐ Some employees do not want to work with the Lean approach. ☐ There are challenges at the social level in acting according to the Lean approach (e.g., regarding collaboration, transparency, etc.). ☐ Many project owners / clients do not want Lean. ☐ Other reasons: *(free text)*

III – General perceptions of Lean Construction	
Note:	Please respond based on your company's general perspective and provide as open and honest an assessment as possible.
Answer:	(for all statements) ☐ Fully agree ☐ Rather agree ☐ Rather disagree ☐ Do not agree at all ☐ No opinion / cannot assess
Statements:	**1. Under Lean, we primarily understand the application of methods – Lean principles beyond method application are not or hardly a focus of our work.**
	2. For us, Lean mainly means optimising processes.
	3. In the construction projects in which we work with Lean, we are predominantly supported by (external or internal) "Lean coaches".
	4. When we work with Lean, this is usually explicitly requested or specified by the project owner / client.
	5. Lean is usually applied only in project delivery and not to other internal activities within the company.
	6. There are also construction projects in which we use Lean that nevertheless do not run (as) well.
	7. In most cases, we apply Lean only to certain aspects of a construction project and/or only temporarily.
	8. Lean is often applied only once negative deviations from the project objectives become foreseeable.
	9. When we use the term Lean in construction projects or within the company, we often encounter reservations or resistance.
	10. Ongoing digitalisation (e.g., through BIM) supports the integration of Lean in construction projects.
	11. Through Lean, at the start of a construction project or assignment, we engage more intensively with the project owner's / client's needs.
	12. Through the application of Lean, we also engage with the needs of the building's future users.
	13. For us, Lean also means empowering our employees more strongly to make decisions themselves and solve problems on their own.
	14. Lean is more suitable for large construction projects than for small ones.
	15. Lean can be applied better in construction projects for private project owners than in projects in the public sector.

Appendix 2: List of the “Top 50” project owner representatives

Ordering by number of German locations (after HAGHSHENO & JOHN, 2024)

Company	*Headquarter (in Germany)*	*Application of Lean Construction*
Sweco Deutschland GmbH*	Frankfurt am Main	Yes
Drees & Sommer SE*	Stuttgart	Yes
Schüßler-Plan GmbH*	Düsseldorf	Yes
Weber-Ingenieure GmbH	Pforzheim	No
THOST Projektmanagement GmbH	Pforzheim	Yes
Arcadis Germany GmbH*	Darmstadt	Yes
ERNST Architekten AG	Stuttgart	Yes
KREBS+KIEFER Ingenieure GmbH*	Karlsruhe	Yes
OBERMEYER Gruppe GmbH*	München	Yes
Vössing Ingenieurgesellschaft GmbH	Düsseldorf	Yes
ZPP INGENIEURE AG	Bochum	Yes
INROS LACKNER SE*	Rostock	Yes
Hitzler Ingenieure GmbH & Co. KG	München	Yes
CDM Smith SE	Bochum	Yes
Björnsen Beratende Ingenieure GmbH	Koblenz	No
ZETCON Ingenieure GmbH	Bochum	No information provided
BUNG Ingenieure AG*	Heidelberg	No information provided
Jones Lang LaSalle SE	Frankfurt am Main	No information provided
Lindschulte Ingenieurgesellschaft GmbH	Nordhorn	Yes
BPM Ingenieurgesellschaft GmbH	Freiberg	No
BPR Ingenieure GmbH & Co. KG	Hannover	No information provided
BPR Dr. Schäpertöns Consult GmbH & Co. KG*	München	No information provided
Projektmanagement AG & Co. KG	Berlin	Yes
GTU Mobility GmbH & Co. KG	Hannover	Yes
Assmann Beraten + Planen GmbH	Berlin	Yes
Bernard Gruppe ZT GmbH*	München	No information provided
COPLAN AG*	Eggenfelden	Yes
DU Diederichs & Partner GmbH	Puchheim b. München	Yes
Höcker Project Managers GmbH	Bochum	Yes
HOLINGER Ingenieure GmbH	Merklingen	No
SCHÜTT INGENIEURBAU GmbH & Co. KG	Münster	Yes
WSP Deutschland AG*	Frankfurt am Main	Yes
Dr. Spang Ingenieurgesellschaft für Bauwesen, Geologie und Umwelttechnik GmbH	Witten	Yes
FISCHER TEAMPLAN Ingenieurbüro GmbH	Erftstadt	Yes
Ingenieurgesellschaft Nordwest GmbH	Oldenburg	Yes
Steinbacher-Consult Ingenieurgesellschaft GmbH & Co. KG	Neusäß	No information provided

Company	*Headquarter (in Germany)*	*Application of Lean Construction*
Wüstenrot Haus- und Städtebau GmbH	Ludwigsburg	Yes
b.i.g. gruppe management GmbH	Karlsruhe	Yes
CANZLER GmbH	Frankfurt am Main	Yes
CBRE GmbH	Frankfurt am Main	No information provided
HPP Architekten GmbH*	Düsseldorf	Yes
io-consultants GmbH & Co. KG	Heidelberg	Yes
iwb Ingenieurgesellschaft GmbH	Hamburg	No
Tattersall Lorenz Immobilienmanagement GmbH	Berlin	No
Vollack Gruppe GmbH & Co. KG	Karlsruhe	Yes
ZWP Ingenieur-AG*	Köln	Yes
AECOM Deutschland GmbH	Frankfurt am Main	Yes
LeitWerk AG	Augsburg	Yes
PANDION AG	Köln	Yes
Emutec GmbH	Norderstedt	Yes
RPB Rückert GmbH	Heilbronn	Yes
Arnold Consult AG	Kissing	Yes
ARS Betriebsservice GmbH	Merseburg	No
EIBS Entwurfs- und Ingenieurbüro Straßenwesen GmbH	Dresden	No information provided
G.E.O.S. Ingenieurgesellschaft GmbH	Halsbrücke	No
GOS Gesellschaft für Ortsentwicklung und Stadterneuerung GmbH	Kiel	No information provided
ICL Ingenieur Consult GmbH	Leipzig	Yes
JOSEPH-Stiftung	Bamberg	No
Kempen Krause Ingenieure GmbH	Aachen	Yes
Prof. Burmeier Ingenieurgesellschaft GmbH	Hannover	No
REESE Baumanagement GmbH & Co. KG	Hamburg	No information provided
Tractebel GmbH	Weimar	Yes

Appendix 3: List of the “Top 50” design and planning companies

The ordering is based on a combination of (estimated) market volumes, number of employees, and presence in relevant industry rankings. (after ChatGPT, 17. Dezember 2024)

Company	*Headquarter (in Germany)*	*Application of Lean Construction*
Drees & Sommer SE*	Stuttgart	Yes
Arcadis Germany GmbH*	Darmstadt	Yes
Sweco Deutschland GmbH*	Frankfurt am Main	Yes
WSP Deutschland AG*	Frankfurt am Main	Yes
OBERMEYER Gruppe GmbH*	München	Yes
Schüßler-Plan GmbH*	Düsseldorf	Yes
ILF Consulting Engineers GmbH	München	Yes
Arup Deutschland GmbH	München	Yes
BUNG Ingenieure AG*	Heidelberg	No information provided
KREBS+KIEFER Ingenieure GmbH*	Karlsruhe	Yes
Ramboll Deutschland GmbH	Hamburg	Yes
Buro Happold GmbH	Berlin	No information provided
INROS LACKNER SE*	Rostock	Yes
Lahmeyer International GmbH	Bad Vilbel	Yes
Fichtner GmbH & Co. KG	Stuttgart	No
Schlaich Bergermann Partner SE	Stuttgart	No information provided
COPLAN AG*	Eggenfelden	Yes
Pöyry Deutschland GmbH (heute AFRY GmbH)	Mannheim	Yes
Bernard Gruppe ZT GmbH*	München	No information provided
Gruner Gruppe Deutschland GmbH	Hamburg	Yes
K+S Ingenieur-Consult GmbH & Co. KG	Nürnberg	Yes
WTM Engineers GmbH	Hamburg	Yes
SSP Consult, Beratende Ingenieure GmbH	Stuttgart	No
Werner Sobek AG	Stuttgart	No information provided
GOLDBECK GmbH*	Bielefeld	Yes
ZWP Ingenieur-AG*	Köln	Yes
ingenhoven associates GmbH	Düsseldorf	No information provided
gmp International GmbH	Hamburg	Yes
HPP Architekten GmbH*	Düsseldorf	Yes
ATP Planungs- und Beteiligungs AG	Karlsruhe	Yes
aib GmbH	Duisburg	Yes
assmann gruppe GmbH	Dortmund	No
GICON-Gruppe GmbH	Dresden	No information provided
HENN GmbH	München	No information provided
HDR | TMK Planungsgesellschaft (Telluride Architektur GmbH)	Düsseldorf	Yes
BPR Dr. Schäpertöns Consult GmbH & Co. KG*	München	No information provided

Company	*Headquarter (in Germany)*	*Application of Lean Construction*
IGS Ingenieurgesellschaft Stolz GmbH	Neuss	No
EBP Deutschland GmbH	Berlin	No
DGI Bauwerk Gesellschaft von Architekten GmbH	Berlin	Yes
agn Niederberghaus & Partner GmbH	Ibbenbüren	Yes
Architrav Architekten GmbH	Karlsruhe	No
GKM Ingenieure GmbH	Zweibrücken	Yes
Dorsch Global GmbH	Frankfurt am Main	Yes
RSE+ Architekten Ingenieure GmbH	Kassel	No
Herrenknecht AG	Schwanau	Yes
pbr Planungsbüro Rohling AG	Osnabrück	Yes
ISP-Scholz Beratende Ingenieure AG	München	No
BRUNS + PARTNER Ingenieurgesellschaft GmbB	Bremen	Yes
DMT GmbH & Co. KG	Essen	Yes
Ed. Züblin AG*	Stuttgart	Yes

Appendix 4: List of the “Top 50” construction companies

The order is based on total operating performance as reported in the 2023 financial statements (after LINDEN, Marcel (2025): List of the 50 largest German construction companies in 2023/*Liste der 50 größten deutschen Bauunternehmen in 2023*, https://www.bauindustrie.de/fileadmin/bauindustrie.de/Zahlen_Fakten/Uebersicht-Bauunternehmen/2024.07.22_Liste_der_50_groessten_deutschen_Bauunternehmen_in_2023.pdf)

Company	*Headquarter (in Germany)*	*Application of Lean Construction*
HOCHTIEF AG	Essen	Yes
STRABAG AG	Köln	Yes
GOLDBECK GmbH*	Bielefeld	Yes
Ed. Züblin AG*	Stuttgart	Yes
Zech Group SE	Bremen	Yes
VINCI Deutschland GmbH	Ludwigshafen	Yes
Max Bögl Bauservice GmbH & Co. KG	Sengenthal	Yes
KAEFER Deutschland Pro Services GmbH	Bremen	Yes
LEONHARD WEISS GmbH & Co. KG	Göppingen	Yes
Bauer Bauunternehmen GmbH	Schrobenhausen	Yes
PORR GmbH & Co. KGaA	München	Yes
Köster GmbH	Osnabrück	Yes
Lindner Group KG	Arnstorf	Yes
Implenia Deutschland GmbH	Raunheim	Yes
Eiffage Infra-Bau SE	Düsseldorf	Yes
BREMER SE	Paderborn	Yes
WOLFF & MÜLLER Holding GmbH & Co. KG	Stuttgart	Yes
Matthäi Bauunternehmen GmbH & Co. KG	Verden	No information provided
GP Günter Papenburg AG	Hannover	Yes
JOHANN BUNTE Bauunternehmung SE & Co. KG	Papenburg	Yes
Wilhelm Geiger GmbH & Co. KG	Oberstdorf	Yes
GALLINGER Beteiligungsgesellschaft GmbH	Zwiesel	No information provided
Deutsche Fertighaus GmbH	Simmern	No information provided
Depenbrock Holding SE & Co. KG	Stemwede	Yes
Karl Bachl GmbH & Co. KG	Röhrnbach	No
Wayss & Freytag Ingenieurbau AG	Frankfurt am Main	Yes
BERGER HOLDING SE	Passau	No information provided
KEMNA BAU Andreae GmbH & Co. KG	Pinneberg	No information provided
Adolf Lupp GmbH + Co KG	Nidda	Yes
Oikos Group GmbH	Schlüchtern	No
weisenburger bau GmbH	Karlsruhe	Yes
Peter Gross Bau Holding GmbH	St. Ingbert	Yes
thomas beteiligungen GmbH	Simmern	No
Michael Klebl GmbH & Co. KG	Neumarkt	No
LIST AG	Nordhorn	Yes

Company	*Headquarter (in Germany)*	*Application of Lean Construction*
DIRINGER & SCHEIDEL GmbH	Mannheim	Yes
AUG. PRIEN Bauunternehmung GmbH & Co. KG	Hamburg	Yes
SPITZKE SE	Großbeeren	Yes
vitronet Holding GmbH	Essen	Yes
Bickhardt Bau SE	Kirchheim	No information provided
MBN GmbH	Georgsmarienhütte	Yes
OTTO WULFF Bauunternehmung GmbH	Hamburg	Yes
Hagedorn Management GmbH	Gütersloh	No
W. MARKGRAF GmbH & Co KG	Bayreuth	Yes
FRIEDRICH VORWERK Group SE	Tostedt	No information provided
LUDWIG FREYTAG GmbH & Co. KG	Oldenburg	Yes
Weber GmbH & Co. KG	Pulheim	No information provided
KLEUSBERG Verwaltungs-GmbH	Wissen	Yes
Wolf System GmbH	Osterhofen	No
Josef Rädlinger Bauunternehmen GmbH	Cham	No information provided

Appendix 5: Lean Construction software companies

Name	*Headquarter*	*Homepage*
Abaut GmbH	München	www.abaut.de
Alasco GmbH	München	www.alasco.com
Bausicht GmbH	Münster	www.bausicht.com
BIMcosmos GmbH	Hamburg	www.bimcosmos.com
Bluebeam GmbH	München	www.bluebeam.com
BUILD 365 GmbH	Traun	www.build365.de
built[t] GmbH	Berlin	www.builtt.org
Capmo GmbH	München	www.capmo.com
CATHAGO Technology UG (hb.)	Berlin	www.cathago.de
CENDAS GmbH	Bochumg	www.cendas.net
comstruct ICT GmbH	München	www.comstruct.com
Conova^{24} GmbH	Hannover	www.conova24.de
Dalux Germany GmbH	München	www.dalux.com/de/
DATEX Software GmbH	Karlsruhe	www.datex.de
Digital Rocks GmbH	Berlin	www.tenera.io
Flexxter GmbH	Hannover	www.flexxter.com
HERO Software GmbH	Hannover	www.hero-software.de
Koppla GmbH	Potsdam	www.koppla.de
KYP Project GmbH	Emmerich am Rhein	www.kypproject.com
LCM Digital GmbH	Stuttgart	www.lcmd.io
lean.codes GmbH & Co. KG	Hünfelden	www.lean.codes
leanited GmbH	München	www.leanited.com
LetsBuild SA	Brüssel	www.letsbuild.com
Makeo GmbH	Berlin	www.makeo.com
NEVARIS Bausoftware GmbH	Bremen	www.nevaris.com
Open Experience GmbH	Karlsruhe	www.openexperience.de
PASit software GmbH	Seewalchen	www.bau-master.com
PLAN4 Software GmbH	Freiburg	www.plan4software.de
PlanRadar GmbH	Wien	www.planradar.com/de/
Project First UG	München	www.project-first.app
Sablono GmbH	Berlin	www.sablono.com
simplean GmbH	Stuttgart	www.simplean.de
SPECTER Automation GmbH	Köln	ww.specter-automation.com
The Boom GmbH	Düsseldorf	www.boomproject.de
TimeLEAN GmbH	Halle	www.timelean.de
WeLean GmbH	Stuttgart	www.yolean.com/de/home
WSS-IT GmbH	Gelsenkirchen	www.web.opticon.site

Appendix 6: Lean Construction training/professional development providers

Name	*Headquarter*	*Homepage*
AACHEN BUILDING EXPERTS e. V.	Aachen	www.aachenbuildingexperts.de
AIV Düsseldorf e. V.	Düsseldorf	www.aiv-duesseldorf.de
Akademie der Ingenieure AkadIng GmbH	Ostfildern	www.akading.de
Architekten- und Stadt-planer-kammer Hessen KöR	Wiesbaden	www.akh.de
Architektenkammer Baden-Württemberg KöR	Stuttgart	www.akbw.de
Architektenkammer Berlin KöR	Berlin	www.ak-berlin.de
aufBau Marketing und Coaching (?)	Köln	www.allianz-neues-arbeiten.de
Bau Bildung Sachsen e. V.	Leipzig	www.bau-bildung.de
Bayerische Ingenieurekammer-Bau KöR	München	www.bayika.de
Bayerischer Bauindustrieverband e. V.	Nürnberg	www.bauindustrie-bayern.de
BDB BUND DEUTSCHER BAUMEISTER, ARCHITEKTEN UND INGENIEURE e. V.	Berlin	www.baumeister-online.de
buildingSMART Deutschland e. V.	Dresden	www.buildingsmart.de
Bundesvereinigung Mittelständischer Bauunternehmen e. V.	Bonn	ww.bvmb.de
BVM Bauvertragsmanagement GmbH	München	www.bvm-seminare.de
BWI-Bau GmbH	Düsseldorf	www.bwi-bau.de
Deutscher Beton- und Bautechnik-Verein e. V.	Berlin	www.betonverein.de
DVP Deutscher Verband für Projektmanagement in der Bau- und Immobilienwirtschaft e. V.	Berlin	www.dvpev.de
FH Campus Wien Academy GmbH	Wien	www.campusacademy.at
Frankfurt School of Finance & Management GmbH	Frankfurt am Main	www.frankfurt-school.de
German Lean Construction Institute – GLCI e. V.	Karlsruhe	www.glci.de
Hamburgische Architektenkammer KöR	Hamburg	www.akhh.de
Handwerkskammer Region Stuttgart KöR	Stuttgart	www.hwk-stuttgart.de
hochschule 21 GmbH	Buxtehude	www.hs21.de
ifp Institut für Produktivität KG	Aachen	www.institutfuerproduktivitaet.de
Ingenieurkammer Niedersachsen KöR	Hannover	www.ingenieurkammer.de
Ingenieurkammer Sachsen-Anhalt KöR	Magdeburg	www.ing-net.de
IWW Institut für Wissen in der Wirtschaft GmbH	Würzburg	www.iww.de
Kapellmann und Partner Rechtsanwälte mbB	Berlin	www.kapellmann.de
KONTOR GRUPPE (?)	Dortmund	www.kontor-gruppe.de
Lean Construction Akademie Deutschland GmbH	Leimersheim	www.lean-construction-akademie-deutschland.de
Lean Construction Mastermind (?)	Fellbach	www.lean-construction-mastermind.de
Lean Group GmbH	Eschborn	www.lean-group.com
LEAN Hochschulgruppe e. V.	Karlsruhe	www.lean-hsg.de
Lean Knowledge Base UG	Heddesheim	www.leanbase.de
LEAN PROFESSIONAL INSTITUT (?)	Speichersdorf	www.lean-professional-institut.de

Name	*Headquarter*	*Homepage*
Lean Schmiede Ingenieurgesellschaft mbH	Seevetal	www.lean-schmiede.de
LMI Forum GmbH	Meerbusch	www.lean-management-institut.de
Management Forum Starnberg GmbH	Starnberg	www.management-forum.de
QualitätsVerbund Planer am Bau (?)	Dürnau	www.planer-am-bau.de
Reoss Industries GmbH	Fürth	www.reoss.com/de/
Technische Akademie Esslingen e. V.	Ostfildern	www.tae.de
VDI Verein Deutscher Ingenieure e. V.	Düsseldorf	www.vdi.de
Volz Consulting GmbH	Mühlacker	www.volzconsulting.de
WBA | Bauhaus Weiterbildungsakademie Weimar e. V.	Weimar	www.wba-weimar.de

Appendix 7: List of German universities with Lean in the curriculum

University	***Type of institution***	***Location***	***Degree programmes*** *(* Author translation – no official English programme title available)*	***Programme profile***	***Module***	***Module component/ course***	***Subtopic within a course***
Bauhaus-Universität Weimar	University	Weimar	Management [Construction Real Estate Infrstructure] B.Sc.*				x
University of Wuppertal	University	Wuppertal	Real Estate Management and Construction Project Management M.Sc.				x
Berliner Hochschule für Technik	University of Applied Sciences	Berlin	Business Administration & Engineering / Civil Engineering B.Eng.				x
Duale Hochschule Baden-Württemberg	Special-type higher education institution	Stuttgart	Civil Engineering – Façade Engineering B.Eng.*				x
			Civil Engineering – Public Construction B.Eng.*				x
			Civil Engineering – Project Management B.Eng.*				x
Fachhochschule des Mittelstands (FHM)	University of Applied Sciences	Bielefeld	Architecture and Real Estate Management B.A.*				x
			Industrial Engineering B.Eng.*				x
Kiel University of Applied Sciences	University of Applied Sciences	Kiel	Civil Engineering B.Eng.				x
University of Applied Sciences Potsdam	University of Applied Sciences	Potsdam	Civil Engineering B.Eng.				x
FH Aachen	University of Applied Sciences	Aachen	Civil Engineering B.Eng.				x
			Civil Engineering M.Eng.				x
			Smart Building Engineering B.Eng.				x
FH Münster University of Applied Sciences	University of Applied Sciences	Münster	Construction Management B.Eng.				x
Frankfurt University of Applied Sciences	University of Applied Sciences	Frankfurt am Main	Civil Engineering B.Eng.				x
HAWK University of Applied Sciences and Arts Hildesheim / Holzminden / Göttingen	University of Applied Sciences	Hildesheim	Civil Engineering B.Eng.				x
hochschule 21	University of Applied Sciences	Buxtehude	Civil Engineering M.Eng.				x
Hochschule Biberach	University of Applied Sciences	Biberach	Civil Engineering B.Eng.*				x
			Construction Project Management B.Eng.*			x	
Bochum University of Applied Sciences	University of Applied Sciences	Bochum	Digital Construction Management M.Sc.		x		
Hochschule Bremen	University of Applied Sciences	Bremen	Civil Engineering B.Sc.		x		

University	*Type of institution*	*Location*	*Degree programmes* (* Author translation – no official English programme title available)	*Programme profile*	*Module*	*Module component/ course*	*Subtopic within a course*
Hochschule Darmstadt	University of Applied Sciences	Darmstadt	Civil Engineering M.Eng.		x		
Stuttgart Technical University of Applied Sciences	University of Applied Sciences	Stuttgart	Civil Engineering B.Eng.		x		
			Lean Construction Management M.Eng.		x		
			Geotechnical Engineering / Tunnel Construction M.Eng.				x
			Infrastructure Management B.Eng.			x	
			Transportation Infrastructure Management M.Eng.				x
			Civil Engineering and Business Management B.Eng.		x		
Leipzig University of Applied Sciences	University of Applied Sciences	Leipzig	Civil Engineering M.Sc.				x
Hochschule Karlsruhe University of Applied Sciences	University of Applied Sciences	Karlsruhe	Civil Engineering M.Eng.				x
			Construction Management and Operations B.Eng.				x
			Construction Management M.Eng.				x
Koblenz University of Applied Sciences	University of Applied Sciences	Koblenz	Civil Engineering M.Eng.		x		
			Civil Engineering Management B.Sc.		x		
HTWG Konstanz – University of Applied Sciences	University of Applied Sciences	Konstanz	Civil Engineering B.Eng.				x
			Civil Engineering and Environmental Engineering M.Eng.			x	
Mainz University of Applied Sciences	University of Applied Sciences	Mainz	Building and Property Management / Facility Management B.Eng.		x		
			Building and Property Management / Facility Management M.Eng. / M.Sc.				x
			Civil Engineering B.Eng.		x		
			Civil Engineering: Construction in Existing Contents M.Eng.				x
			Industrial Engineering (Construction) B.Eng.		x		
			Industrial Engineering (Construction) M.Eng./M.Sc.				x
			Technical Property Management B.Eng.				x
			Technical Property Management M.Eng. / M.Sc.				x
Osnabrück University of Applied Sciences	University of Applied Sciences	Osnabrück	Business Administration in Civil Engineering B.Eng.				x
			Construction – Environment - Management M.Eng. *		x		

University	***Type of institution***	***Location***	***Degree programmes*** *(* Author translation – no official English programme title available)*	***Programme profile***	***Module***	***Module component/ course***	***Subtopic within a course***
Hochschule RheinMain	University of Applied Sciences	Wiesbaden	Civil Engineering B.Eng.				x
			Civil Engineering & Construction Management M.Eng.		x		
			Real Estate M.Sc.				x
Ruhr West University of Applied Sciences	University of Applied Sciences	Mülheim an der Ruhr	Civil Engineering M.Sc.		x		
IU international University	University of Applied Sciences	Erfurt	Civil Engineering B.Eng.				x
			Construction Project Management B.A.				x
			Real Estate Management for Real Estate Professionals B.A.				x
			Real Estate Management B.A.				x
			Environmental Engineering B.Eng.				x
Jade University of Applied Sciences	University of Applied Sciences	Oldenburg	Civil Engineering B.Eng.				x
Karlsruhe Institute of Technology (KIT)	University	Karlsruhe	Civil Engineering M.Sc.		x		
			Technology and Management in Construction M.Sc.	x	x		
			Industrial Engineering and Management M.Sc.		x		
Leuphana University Lüneburg	University	Lüneburg	Construction Law & Construction Management M.A.	x	x		
Ostbayerische Technische Hochschule Regensburg	University of Applied Sciences	Regensburg	Civil Engineering B.Eng.				x
			Civil Engineering M.Eng.				x
RPTU University Kaiserslautern-Landau	University	Kaiserslautern, Landau	Facility Management M.Sc.			x	
			Real Estate and Facilities - Management and Technology M.Sc.			x	
Ruhr University Bochum	University	Bochum	Civil Engineering M.Sc.				x
Technical University of Applied Sciences Augsburg	University of Applied Sciences	Augsburg	Civil Engineering B.Eng.				x
Deggendorf Institute of Technology	University of Applied Sciences	Deggendorf	Civil and construction engineering B.Eng.				x
			Building Products and Processes B.Eng		x		
			Project Management in Civil and Construction Engineering B.Eng.				x
TH Köln (University of Applied Sciences)	University of Applied Sciences	Köln	Civil Engineering B.Eng.				x
			Civil Engineering M.Eng.				x
Technische Hochschule Lübeck	University of Applied Sciences	Lübeck	Civil Engineering M.Eng.				x

University	*Type of institution*	*Location*	*Degree programmes* *(* Author translation – no official English programme title available)*	*Programme profile*	*Module*	*Module component/ course*	*Subtopic within a course*
Technische Hochschule Mittelhessen – THM	University of Applied Sciences	Gießen	Architecture M.Eng.		x		
			Civil Engineering M.Eng.		x		
			Real Estate and Facility Management M.Sc.		x		
Technische Hochschule Nürnberg Georg Simon Ohm	University of Applied Sciences	Nürnberg	Civil Engineering B.Eng.				x
Technical University of Applied Sciences Würzburg-Schweinfurt	University of Applied Sciences	Würzburg	Civil Engineering B.Eng.				x
Technische Universität Carolo-Wilhelmina zu Braunschweig	University	Braunschweig	Civil Engineering B.Sc.				x
			Civil Engineering M.Sc.			x	
			Industrial and Civil Engineering B.Sc.				x
			Industrial and Civil Engineering M.Sc.			x	
Technical University of Darmstadt	University	Darmstadt	Civil Engineering and Geodesy B.Sc.				x
			Civil Engineering M.Sc.				x
			Business Administration and Engineering: Civil Engineering B.Sc.				x
			Business Administration and Engineering: Civil Engineering M.Sc.				x
TU Dortmund University	University	Dortmund	Civil Engineering M.Sc.				x
Dresden University of Technology	University	Dresden	Civil Engineering Diplom				x
Hamburg University of Technology	University	Hamburg	Civil Engineering M.Sc.			x	
University oft he Bundeswehr Munich	University	München	Civil Engineering and Environmental Sciences M.Sc.				x
University of Stuttgart	University	Stuttgart	Civil Engineering M.Sc.				x
Wilhelm Büchner Hochschule – Private Fernhochschule Darmstadt	University of Applied Sciences	Darmstadt	Civil Engineering B.Eng.				x
			Industrial Engineering Construction Management B.Eng. *				x

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Karlsruhe Institute of Technology (KIT)

Karlsruhe Institute of Technology (KIT) is one of Germany's leading research universities, combining excellent research with practice-oriented teaching and societal impact. At the Institute of Technology and Management in Construction (TMC), innovative approaches to planning, control, and management of construction projects are at the centre of its work. TMC conducts interdisciplinary research, among other areas, on project management, Lean Construction, construction process optimisation, digitalisation, and sustainable value creation systems. Through applied studies, collaboration with practice, and international activities, TMC contributes to the further development of the construction industry.

German Lean Construction Institute (GLCI)

The German Lean Construction Institute (GLCI) is the central platform for promoting and supporting the diffusion of Lean Construction in the German-speaking region. As an independent, non-profit association, it connects experts from academia and practice, supports knowledge transfer, and helps establish practices for efficient and collaborative project delivery in the construction industry. Through working groups, publications, training programmes, and national conferences, the GLCI contributes to embedding Lean principles in construction and to sustainably improving the performance of construction projects.

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