The utility of lean project management: conceptions and impacts on project learning

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Abstract

A particular challenge in project management that has been continually highlighted is the human and social aspects of a complex dynamic project environment. This is characterised by chaos and uncertainty, necessitating more of an insight into the actuality of projects and the development of reflexive practitioners who can learn, adapt and engage through pragmatic application of theory and practices in projects. Although Lean Project Management (LPM) is generally seen as an enabler of progress, the most frequently cited barriers are those connected to Knowledge, Skills and Behaviour – the understanding and ability of individuals to communicate, commit to and undertake change.

The research was undertaken through two studies: an Interview Study, which explored the conceptions and lived experiences of 40 project managers, and a single, holistic design Case Study, which explored the relationship between lean project management and project learning (PL) in practice. Multiple sources of evidence contributed to the research, including interviews, non-participant observations, and document and photograph analysis. Thematic analysis was conducted to explore the rich data obtained from both studies. An explanatory framework was developed, which provides an understanding of the relationship between LPM and PL, and its contributory elements. The research suggests the importance and value of socially driven processes and the practice of learning within lean project management that extends knowledge beyond traditional formal and instructive means. Lean Project Management occupies a unique position in that it makes sense of, interacts, responds to and shapes the systems and processes of both learning *and* practice responsible for project progress. This strengthens its value and utility in being able to address and manage complexities as well as learning and practice within project management.

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List of Abbreviations

APM	Association for Project Management
CoP	Communities of Practice
GK	Gatekeeper
LDMT	The LDMT project (case)
LF	Lean Facilitator
LPM	Lean Project Management
LPS®	Last Planner System
OL	Organisational Learning
PL	Project Learning
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PRINCE2	Projects In Controlled Environments (v2)

Declaration

I declare that no portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other University or other institute of learning

Jane Dowson
7th May 2021

CHAPTER 1: INTRODUCTION

1. Introduction

This introductory chapter provides a summary of the research problem to situate and contextualise the research to be explored. The importance and relevance of this research is presented with respect to the contemporary project environment, its challenges, requirements, and opportunities for the development of project management practice. This chapter also introduces the research question and subsequent aims and objectives. The final section of the chapter provides an overview of the structure and organisation of the thesis.

1.1 Research context

The advancement of project management (PM) knowledge and development of the PM capability of people is crucial to the successful delivery of projects. There is a widespread appetite for an improved evidence base on effective techniques in project management and for sharing insights on what works in a rapidly changing world (APM, 2020). Projects are the new normal and therefore project management can no longer be regarded as merely about *functional* project management or interlinking systems and processes, but is more about faster, empowered, and focused execution of strategy (McGrath & Kostalova, 2020). Similarly, organisations are undergoing a paradigm shift in which projects are no longer adjacent to operations but instead the driving force behind how work is done (PMI, 2020a). As the nature of work changes, so too must the structure and dynamics of teams (*ibid*). As projects increase in complexity, organisations must rethink how teams get things done within the 'Project Economy' (*ibid*). Research shows managing changing priorities is the biggest project delivery challenge – accelerating the need for more risk-resilient, fail-fast teams capable of gracefully pivoting when customer demands shift (PMI, 2020b).

CHAPTER 1: INTRODUCTION

The world of work has changed and so too must the discipline of project management; especially in times of social, environmental, economic and increasing technological changes, project management must evolve and adapt to changing conditions if it is to remain relevant and meet the evolving demands of future-focused organisations (McGrath & Kostalova, 2020). Globalisation, Industry 4.0, Digital Transformation, and hyper-competition have changed the worldview for most project environments, and organisations can no longer approach project management with the approach applied in previous decades (McGrath & Kostalova, 2020).

Research data shows that 70% of organisations place a high priority on creating a project culture centred on delivering customer value, and to find ways to reduce pain points within the organisation (PMI, 2020b). Project professionals are no longer tasked with simply ensuring the successful execution of projects; they now often have to reimagine the vision, purpose and social impact of projects that extend way beyond the nature of the work and how it gets done (*ibid*). This often requires mixing tried-and-true skills, practices, methodologies, and approaches with emerging ones (*ibid*).

1.1.1 Contemporary Project Environment

A key aspect of helping the PM profession to thrive is facilitating learning to draw the right lessons from experience when it faces a complex and chaotic world, especially where past 'proven' solutions might not work a second time (APM, 2020). Projects, which can also be viewed as temporary learning organisations, with a unique end product or service (Janowicz et al, 2008; Davies, 2019), operate through a process of collaboration and participation, where people act as conduits or vehicles to produce the intended product or service (Tonnquist, 2002; PMI, 2008; PMI, 2020a). Focus on the

individual project and practitioner in project management as an organisational capability reflects the wider adoption of project management as a response to evolving concerns and conversations of this broader group of practitioners (Crawford, 2006; PMI, 2020b). However, complexities exist between, within and across the boundaries of projects and their environments, challenging project performance, thus creating a requirement to respond and adapt to a dynamic, which may be limited within available PM expertise (Whittingham, 2017). Research undertaken by the Project Management Institute (PMI) in 2020 found that 42% of projects were characterised as having "high complexity," a trend that has been growing over the past five years (PMI, 2020b). A particular challenge which has been continually highlighted is the human and social aspects of a complex dynamic project environment which is characterised by chaos and uncertainty, necessitating more of an insight into the "actuality" of projects, and the development of reflexive practitioners who can learn, adapt and engage through pragmatic application of theory and practices in projects (Cicmil et al, 2006; de Barros Sampaio et al, 2014; PMI, 2021). It is argued that, whilst clear goals and effective planning, monitoring and control are useful traditional approaches to project management (Atkinson et al, 2006; Perminova et al, 2008), these are insufficient where elements of complexity and uncertainty affect, and are affected by, the people delivering the project and their interactions in and around the project environment (Baccarini, 1996; Williams, 1999, 2002; Geraldi & Albrecht, 2007). Even these authors have suggested that there is more confusion than clarity since complexity and project complexity have been interpreted in different ways over time. Despite there being many traditional, established PM tools and techniques, the majority of collaborative projects fail within the first year of

implementation (Kelly et al, 2002; APM, 2016). Projects that are delivered on time, on budget and to performance expectations are rarely reported, with companies and governments either reinventing the process or losing lessons learned (Winch, 1996), as well as failing to reap the intended benefits of the project. Project environments often experience difficulties extracting, distributing, and applying learning across both cultural and structural boundaries (Prencipe & Tell, 2001; Bosch-Sijtsema & Postma, 2009), which makes it more difficult to exploit knowledge in such settings. This has led to an increasing expectation of standardised and codified project management knowledge (Hodgson & Cicmil, 2007; Packendorff & Lindgren, 2014).

1.1.2 Learning within Project Management

Scholars have been debating the potential reasons why some projects fail to incorporate the lessons learned from previous projects, and hence fail to improve their performance (Schindler & Eppler, 2003; Duffield & Whitty, 2016). This lack of incorporation is often due to resource pressures and individuals moving straight to the next project without sufficient time or means to embrace the lessons learned. Hines et al (2004) suggest that knowledge needs to be perceived as a value-added, strategic activity that is undertaken across all project life cycles and consider how and what behaviours can motivate learning. Despite the fact that the concept of lessons learned is regarded as being well established as part of formal post-completion review mechanisms, it remains narrowly defined and descriptive (Jugdev, 2012). Lindner and Wald (2011) suggest that this failure to disseminate and apply lessons learned from projects has created a need for more research in understanding the role that knowledge management can play within the project management discipline.

Research is needed that enables practitioners to move beyond lessons learned and better understand how learning is happening in projects, and how knowledge is created and shared. This must extend beyond identification of learning (Anbari et al, 2008; Bakker et al, 2011) and should reflect appropriate methods of learning as well as formats and processes of the information transmitted (Blackman & Henderson, 2001; Disterer, 2002).

Project learning can be defined as "the set of actions the project teams used to create and share knowledge within and across projects" (Kotnour, 1999, p. 36), and hence is a broader theoretical construct than lessons learned as outlined above. Whilst several authors have maintained that, where project learning has taken place, it generally fails to deliver the intended results of learning from failure and does not generate the required improvements for future project use (Williams, 2008; Milton, 2011; Duffield & Whitty, 2015; Klakegg et al, 2016), some studies suggest that causation and effect evaluations have led to incremental improvements (Reason, 2000). This limited utility of project learning remains the case despite a growing number of models, approaches, guides, and opinions on how to apply project learning (Duffield & Whitty, 2015).

Whilst the concept of lessons learned has mainly been associated with the aim of improving project performance (Terzieva & Morabito, 2016; McClory et al, 2017), the view that project learning could act as a mechanism to improve project management practice more broadly has largely been ignored. By focusing on the improvement of practices, this could potentiate opportunities to account for the unpredictability of human behaviour as an essential element of project management (Kreiner, 1992) and the project's ability (or inability) to integrate and improve the

knowledge-sharing processes and outcomes (Bechky, 2006; Ivory et al, 2007; Kim & Wilemon, 2007). Perceiving learning as a process as well as an output-based activity answers the call by Jugdev (2012) to adopt more organic, fluid, and informal learning mechanisms.

It has also been acknowledged that effective management of project knowledge is vital for continuous learning and exploiting the value-added ability of lessons learned (PMI, 2017). To achieve this, it is posited that effective communication, coupled with experiential knowledge will acquire the combined wisdom of "know-how" as well as the "know what" and "know why" (Corallo et al, 2009; Gardiner & Eltigani, 2014; Hussain et al, 2015). This can lead to improved decision-making within the delivery phase of projects as well as generating improvements across the whole project and organisational systems (Brodetskaia et al, 2013). Building an adaptive mind-set for project professionals through continuous professional development, learning and resilience, combined with the skills of anticipating and creating change were reported as a key recommendation in the latest APM Projecting the Future report (2020).

The highly specialised nature of projects additionally requires action–oriented knowledge activities to underpin and stimulate the creative activities that are needed to work collaboratively (McIver et al, 2013), and hence improve project management practices. Jugdev and Wishart's (2014) research suggests that sharing and learning about project management practices requires a processual approach to improving tacit knowledge sharing for the purposes of competitive advantage. Hence, the concept of lessons learned is insufficient to create, make use of and share the

knowledge needed within projects and requires further development (McClory et al, 2017; Duffield & Whitty, 2015).

1.1.3 Lean Project Management

Since project learning, knowledge creation, and sharing actions and practice do not exist in isolation, it could be assumed that certain projects environments will foster them whereas others will hinder them. To enhance learning within and across projects, there is a need to identify which environments and approaches are favourable for those learning actions and practices. This creates an ideal opportunity for research to explore how a project environment underpinned by lean principles facilitates project learning and which characteristics of project learning can be identified. It has been suggested that such an environment could facilitate better awareness and highlight importance of the broader role of knowledge and learning with particular reference to continuous improvement and its development (Hines et al, 2004; Rowe & Sikes, 2006; Lindner & Wald, 2011; Jugdev & Wishart, 2014; McClory et al, 2017; Sundqvist, 2019).

Across industries, lean management is underpinned by those lean principles and hence shares many commonalities in terms of its use as a production system (Pasquire, 2012; Ballard & Tommelein, 2012), its strategic purpose, its efficient scheduling, and its application as a goal-oriented tactical method (Bernstein & Jones, 2013). The benefits of adopting lean principles in the project environment are cited as higher quality, greater customer satisfaction, greater productivity, improved safety, reduced project schedule, better risk management, greater profitability and reduced costs (Bernstein & Jones, 2013), as well as wider benefits such as social, economic and environmental improvements (Rosenbaum et al, 2014). Lean principles are therefore considered to

have universal applicability across a wide range of settings (Sauser & Voss, 2001; Ballard & Howell, 2003; Shah & Ward, 2003, 2007; Joosten et al, 2009).

A project environment underpinned by lean principles focuses on delivery, improving communication between stakeholders, process design and eliminating waste (Ballard & Howell, 2003; Bertelsen & Koskela, 2004; Joosten et al, 2009; Besner & Hobbs, 2013; Cole, 2019). Such principles of lean management rely on information and collaboration, visual techniques, sense-making, and decisions based on human creativity and interpretation. However, reliance on organisation and "housekeeping", and the application of human values to determine best practice (Hopp & Spearman, 2004), has often led to difficulties in the practical adoption of those principles. Lean has also been cited as causing a lack of consideration of human aspects (Williams et al, 1992; Hines et al, 2004). This includes stifling of workers' creativity (Silverthorne, 2002; Chen et al, 2010), limitations on the ability of companies to achieve continuous improvement (Mehri, 2006) and actual ability to deal effectively with variability (Joosten et al, 2009). Nevertheless, interest in and growth of lean as a project management approach has increased in recent years (Artto et al, 2016). These lean principles have been acknowledged as a viable way to address and manage complexities, especially in the instance of the delivery of major projects, which have a tendency for high failure rates, excess waste and failure to learn and improve (Maylor et al, 2015; Holweg & Maylor, 2018).

In conclusion, the utility and impact of lean principles remains a point of contention (Staats et al, 2011). Few studies have attempted to link lean principles with overall learning, but those that have done so, have used lean principles to highlight singular process-related, task-driven systems and identify barriers to improving operational

procedures (Spear, 2005; Poksinska, 2010; Staats et al, 2011), rather than investigating the potential link between desired outcomes and behaviours (Nidumolu & Subramani, 2003). This has limited the progress of lean as a viable change initiative in solution-focused environments such as projects (Dowson et al, 2019).

1.1.4 Theoretical framing of the research

Project management has long struggled with the balance between exploration and exploitation, between unification and focus and pluralism, diversity, and openness, between the search for new topics and methods, and the capitalisation and improvement of existing knowledge (Söderlund, 2011). Pluralism offers project managers and researchers a way to illuminate the complex lived actuality of projects and their management practice (Cicmil et al, 2006), and live with its contradictions without losing focus and commonality (Söderlund, 2011). Hence, this theoretical lens will be used in the research as a means to enable deeper understanding of the lived experiences of lean project management and project learning in project environments underpinned by lean principles.

Project managers may use tools and practices from different management disciplines, but the development of the field of project management justifies research that focuses on the specificity of their practice and highlights the need to investigate the reality of practice empirically (Besner & Hobbs, 2013). It has been argued that tools have been adapted and skills have been developed in their use – skills that can be documented, learned, and transferred in order to configure project management practices as strategic assets *(ibid)*. This configuration of project management practices happens through project learning, and thus through practice theory the

research aims to demonstrate how the associated learning can be facilitated in a certain environment.

1.2 Research opportunity

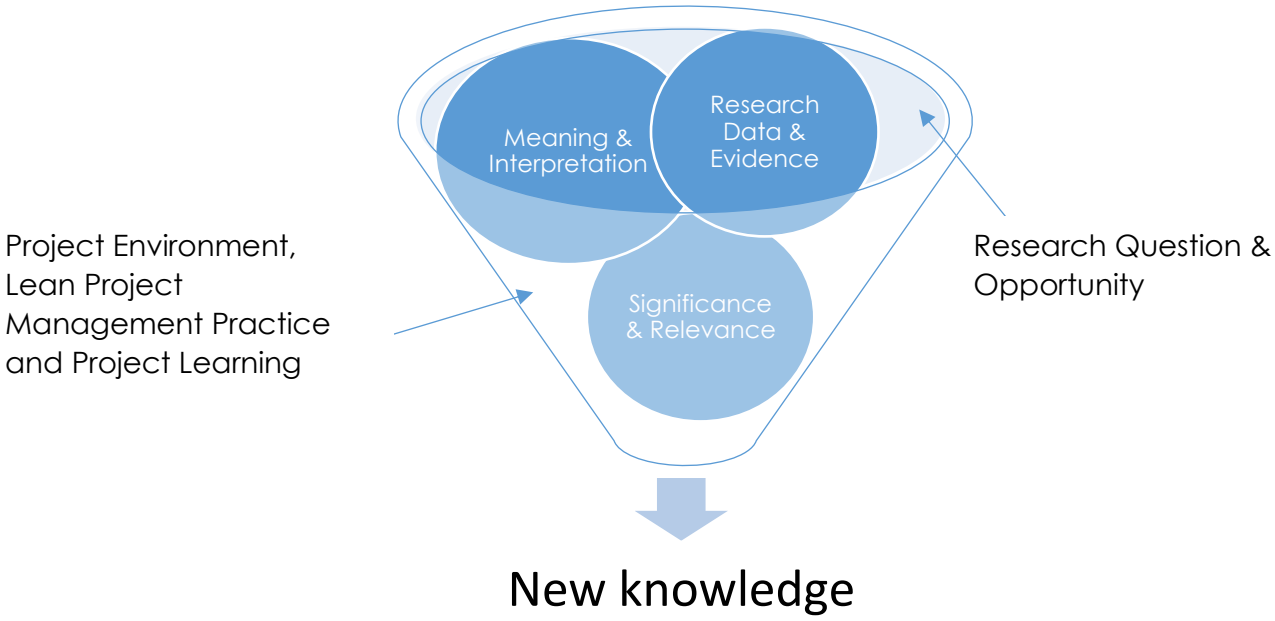
The research will propose that lean practice in project management offers a unique opportunity in that they make sense of, interact with, respond to and often shape the very systems and processes that can be responsible for both success and failure. This is particularly important in contemporary project environments that are characterised by complexity, inter-disciplinarity and multi-disciplinarity (Thiry, 2014). This requires a level of adaptability, and the ability to develop new practices, driven by the inherent need to probe, sense and respond to complex and chaotic situations, is important for the project profession (Woodman, 2020). Indeed, the Association for Project Management (APM) reported that adaptability is key, with organisations wanting to know how other sectors manage their projects – knowledge transfer and reach back is important (APM, 2020). The APM suggested there is "a need to recognise that there isn't 'one size fits all' – e.g. different levels of project plans and that project managers should feel empowered to challenge [existing] ways of working." (APM, 2020, p11). An opportunity to focus on the value that may translate directly to an effect on practice as a desired outcome (Hogue, 2011) is also presented, which naturally places a strong emphasis on historical and social contexts, in order to make sense of social phenomena (Lincoln et al, 2011). Understanding the reality of the social condition through the exploration of the lived experiences of respondents can develop knowledge and the understanding of its meaning (Saunders et al, 2019). The phenomenon under investigation is project learning within a project environment

underpinned by lean principles, which lends itself well to a phenomenological-based enquiry (van Manen, 1990; van Maanen et al, 2007).

1.3 Problem Statement and the Research Question

The research therefore seeks to explore lean project management practice and its established principles of collaboration, transparency and continuous improvement, monitoring and tracking progress within the project management environment. Exploration of this practice is two-fold; to determine what and how the practice conceptualised and implemented, and to assess the impact of this on project learning, which may give rise to informal knowledge sharing (Womack & Jones, 2003; Hines et al, 2004). By obtaining an overview of the characteristics and mechanisms of project learning as informed by the lived actuality of the respondent, this creates an output comprising authentic evidence. This research study examines and considers the concept of lean project management, as well as project learning within lean project environments to achieve a deeper understanding of the phenomenon. Exploring the interplay between project learning, lean principles and project management practice provides an opportunity to create a positive and sustainable impact on PM knowledge and practice. This is illustrated in Figure 1.1 below.

Figure 1.1 The interplay between lean project management and project learning



Therefore, having identified the research problem, the research seeks to answer the following question:

> *What are the characteristics of lean project management and how does it facilitate project learning in contemporary project environments?*

1.4. Aim

The overall aim of the research is to obtain a deeper understanding of and insight into the phenomenon of lean project management, investigating its utility and impact on project learning. By focusing on the under-researched area of the psycho-social and behavioural aspects of LPM, it is anticipated that a deeper insight into the phenomenon as it is perceived and practised in reality can be provided. Exploring this lean approach through contextuality could reveal the level of the nature of utility and

feasibility, as well as strengthening the link between project management, project learning and best practice.

1.5 Objectives

To support the aims above, the following objectives were created:

1. To identify and assess lean project managers' baseline knowledge and understanding of the principles of lean project management and project learning
2. To explore the lived experience of LPMs and project learning in practice by project stakeholders
3. To assess the role and contribution of factors such as business setting, environment and discipline on lean project management and project learning
4. To develop an illustrative framework for understanding the relationship between lean project management and project learning

1.6 Contribution to the body of knowledge

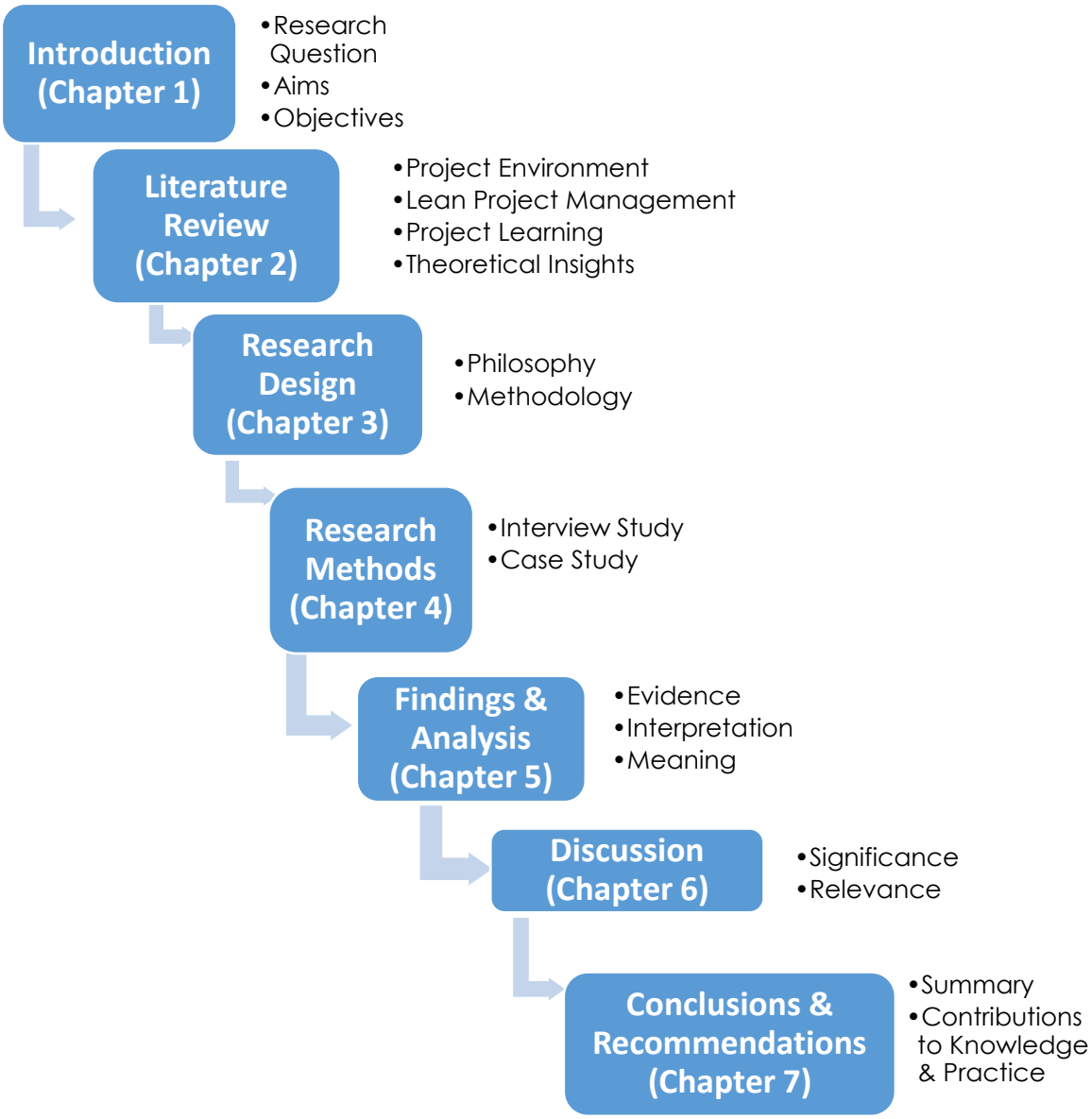
The research intends to make a robust contribution to both knowledge and practice, which aims to demonstrate the importance and influence of lean project management as a viable approach for the successful delivery of projects as well as facilitating essential project learning. By exploring the relationship between lean project management and project learning, the research intends to provide new knowledge and understanding, and this will be demonstrated through findings,

discussion, and an illustrative framework as a specific knowledge output. The research is multi-disciplinary in nature, bringing together the fields of project management, knowledge management, project learning, organisational learning, human resource management and psychology. This not only offers an opportunity to investigate how clusters of practice may merge and develop over time, but additionally facilitates understanding, more precisely, what practitioners really do to enable better management of the limited resources available (Besner & Hobbs, 2012), potentiating improvements in capacity for knowledge and future learning for project and organisational success.

1.7 Research Overview and Structure of the thesis

The research focuses on describing and deriving meaning from the perceptions and experience of project management practitioners within a broad range of disciplines (Creswell, 2013). This is achieved by detailing the actions, processes and mechanisms of project learning and its relationship to specific environments and contexts. To ensure all relevant processes, activities and phases of the research are included, a systematic approach was undertaken. Figure 1.2 provides a visual illustration of the whole research endeavour.

Figure 1.2. Chapter outline of the thesis



Chapter One sets out the research context, introduces the problem and introduces relevant approaches to address it. This is articulated through the setting of a research question and subsequent aims and objectives that enable the work to be structured.

Chapter Two provides a comprehensive literature review which includes an overview and critical discussion of extant literature in pertinent fields. This aims to build an

understanding of the state of knowledge currently available within which lean project management and project learning are situated. This chapter discusses the challenges of contemporary project environments, connecting the history and context of lean project management and project learning. These three fields are explored in order to create a rationale for the research to be undertaken.

Chapter Three explores and discusses appropriate philosophical and methodological considerations in order to understand the underlying logic and assumptions of the researcher, and the phenomenon to be researched. The relationship between theory and practice is an important concept within this and subsequent chapters, as it aims to enhance understanding of the subject being studied. This additionally informs the research design, methodological choices, strategy, and instruments, and creates a guide for the execution of the research, in order to accomplish the research aims and objectives.

Chapter Four presents and discusses the research methods used in the study, discussing their relevance and appropriateness before justifying the choices that were made for the research study. This chapter also discusses and justifies the sampling approach, organisation of data, the chosen multiple sources of evidence, techniques and processes for data collection and analysis in detail. Additionally, this chapter sets out the ethical requirements governing the research.

Chapter Five presents the data collected and illustrates the findings using a systematic rigorous approach through continuous and consistent application of thematic analysis. This includes findings from the Interview Study and Case Study, providing interpretation and meaning. This chapter's content provides the initial output for the

research in the form of its findings, and therefore delivered completion of Objectives one, two and three.

Chapter Six presents a comprehensive discussion of the relevant findings and this begins the essential process of transferring the output (in the form of findings) into the outcome that is new knowledge. The purpose of the chapter is to synthesise and develop an understanding of the phenomenon of lean project management and project learning. Further reflection on the meaning of the findings and contextualising them within contemporary project management results in the development of a framework which facilitates the deeper understanding sought, and the characteristics of the relationship between lean project management and project learning, thus achieving stated Objective four. This is discussed in terms of theoretical positioning within project management to bring fresh insight to the field.

Chapter Seven presents the summarised conclusions and recommendations completing the entire research process, its outputs, and outcomes, demonstrating achievement of the research aim and objectives and presenting contributions to knowledge.

1.8 Summary of Chapter

This introductory chapter has provided a justification for the research to be undertaken, suggesting the contribution to project management knowledge and practice. This chapter has also presented the structure, processes, and stages of each chapter in the thesis. The next chapter presents the first phase in the production of the thesis: an understanding of the current state of knowledge relevant to the research through a literature review.

CHAPTER 2: LITERATURE REVIEW

2. Literature Review

Important insight may be gained from further exploration of the relationship between lean project management (LPM) and project learning (PL) to facilitate effective project performance. Therefore, the aim of this chapter is to build a comprehensive understanding of the state of knowledge relevant for this research. The chapter is organised in four sections, project environment (PE), lean project management (LPM), project learning (PL) and a final rationale to connect the three fields of study together.

The chapter critically discusses available literature, demonstrating pertinent aspects of the project environment within which project management (PM), including LPM, is situated. It then explores different PM approaches that have attempted to make sense of and manage contextual elements of project environments to deliver optimum PM performance. This also includes an exploration of extant literature across a range of discipline areas to understand nuances that exist within various project environments.

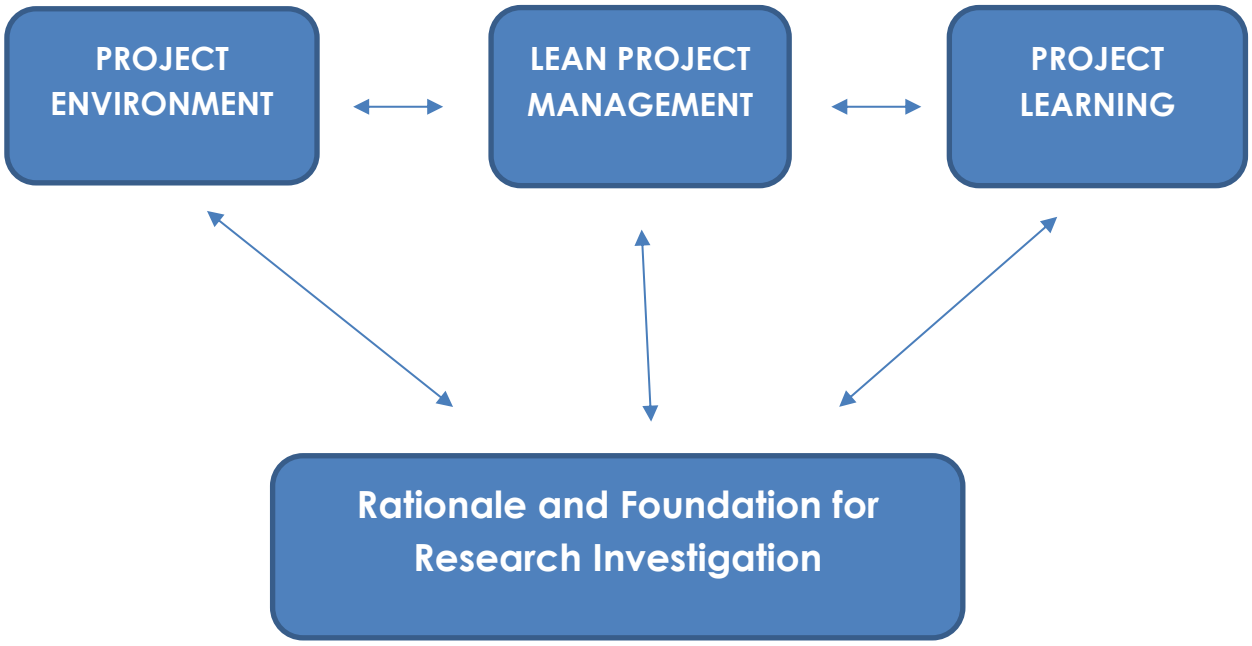
The chapter includes a detailed review of the evolution and principles of lean to provide background understanding of what constitutes lean in projects and their management.

The field of project learning (PL) is explored within the concept of knowledge management (KM) and its related processes of knowledge creation, sharing and wider organisational learning (OL), which is considered and reviewed. This section connects the need for learning within key principles of lean, to create a rationale for the exploration of LPM and PL together, as illustrated in Figure 2.1.

Finally, the chapter concludes with a critical review by drawing conclusions from different perspectives, limitations and boundaries prevalent within the literature to identify the current gaps in the research area. The chapter justifies the need and importance of

investigating LPM and PL in projects, providing a framework for the research investigation that follows.

Figure 2.1 Literature review fields of study



2.1 Theoretical insights to exploring literature

Exploring LPM and PL primarily falls within the Behavioural school of thought within Project Management (Söderlund, 2011). Research within this school investigates, amongst other things, the processes of organising and the nature and organisation of social interaction in projects, problem solving, sense-making, and learning dimensions through analysis of the nature and process of behaviour within projects (Söderlund, 2011). The unpredictability of human behaviour is an essential element of project management (Kreiner, 1992), which some argue impacts on an ability (or inability) to integrate and improve the knowledge-sharing processes and outcomes (Bechky, 2006; Ivory et al, 2007; Kim & Wilemon, 2007). Accordingly, the literature under review also draws upon concepts within the Relationship school of thought (Söderlund, 2011), which takes account of the

importance of co-ordination and co-operation in complex inter-organisational projects, dynamic networks of multiple actors and forms crossing organisational boundaries (Cova & Hoskins, 1997; Staber, 2004). The literature importantly draws on principles espoused within the Decision school of thought, which focuses on early project phase decision-making within complex projects and the interplay between project, psychological, social and organisational determinants (Söderlund, 2011). This pluralistic view of project management can help researchers to better explore the reality of project management, enhancing understanding of approaches employed to tackle the more complex projects as well as increasing the probability of project success (Chugh, 2011).

2.2 Project Environment

This section will discuss the two most prominent aspects that relate to managing projects within the project environment. Firstly, the section will consider the rise of 'projectification' and the role it plays. This is followed by a discussion of the concept of complexity, which continues to dominate the project environment and has led to calls by scholars to engage with complex reality more critically and deeply in order to develop the project studies field.

2.2.1 Definitions of "project" within the PM environment

Insights and conceptualisations of projects within project management have been the subject of continual debate. Initially this began with the idea of the project as a temporary organisation (Packendorff, 1995) tasked with the purpose of achieving a specific goal. Later this shifted to understanding project management more holistically, with a view to understanding how projects could achieve wider organisational efficiency, effectiveness and innovation (Jugdev, 2001). Lundin and Söderholm (1995) argued that projects have definite characteristics and thus a unique way of life and behaviour

compared with permanent organisations. This led to the definition of projects as 'temporary organisations' (Lundin & Söderholm, 1995; Packendorff, 1995; Bechky, 2006; Maylor et al, 2006). Such labels were seen as necessary for projects that handled complex tasks, including organisational restructuring initiatives (Lundin & Söderholm, 1995; Ekstedt et al, 1999; Cicmil et al, 2009), which were not considered integral to ongoing operations, yet were recognised as exceptional and required new and specific knowledge if these projects were going to be successful (Packendorff & Lindgren, 2014). It was recognised that although project managers had autonomy and power in temporary organisations this was not the case within their principal organisations, which led to challenges brought about by stakeholders within and across organisational boundaries (Turner & Müller, 2003; Van Marrewijk et al, 2008). Indeed, it has been established that a project usually appears as a "fleeting constellation of multiple, interrelated subprojects and multiple stakeholders collaborating and conflicting in constantly shifting alliances" (Söderlund & Sydow, 2019, p260). Projects are not only embedded in the respective permanent organisations and inter-organisational networks but also in wider institutional fields (*ibid*), regardless of their project-supporting or project-based roles (Hobday, 2000; Lundin et al, 2015). Thus, the project itself is viewed as a distinct entity and as such plays an important role in both responding to and creating interactions with these organisations and networks (Söderlund & Sydow, 2019). Indeed, just as institutions will influence what projects will come about and how these projects are to be governed and managed (Miterev et al, 2017; Brunet, 2019), projects will exert their own influences on institutions, primarily those associated with change, of bringing novelty to society, of exploring and exploiting innovation, and establishing new infrastructure and ways of interacting (Söderlund & Sydow, 2019). This continues to cause tension in relationships between projects and organisations, which has been a central concern for project studies for some time

(Grabher, 2002, 2004; Bakker et al, 2016; Geraldi & Söderlund, 2018; Söderlund & Sydow, 2019).

The relationship between projects and organisations has continued to challenge practitioners, providing much opportunity for scholars to reconceptualise and rethink project management that has critically and crucially focused on the nature of dominant and emerging PM approaches (Winter et al, 2006; Svejvig & Andersen, 2015). In the 2015 literature review undertaken by Svejvig and Andersen, contextualisation, social and political aspects, rethinking practice, complexity and uncertainty, actuality of projects and broader conceptualisation were highlighted as the most important features dominating the contemporary landscape of project management (p287). The following section addresses the challenges of projectification and complexity as two such features dominating the project environment.

2.2.2 Projectification

In order to be able to address challenges experienced within a project, practitioners and scholars of PM research must first understand the characteristics and nature of the environment within which it operates. Situating a project within an environment is relevant because of the increasing projectification that has been witnessed since the mid-1990s, not restricted to business and management, but across all parts of society and life (Midler, 1995; Packendorff & Lindgren, 2014; Schoper et al, 2018). Projectification is a term which has seen various forms since the early 1990s, for example see Peter's (1992) 'projectization'; Eskeld's (1999) 'projectivization', Bredin and Söderlund's (2006) 'project intensification.' Nevertheless, these terms enjoyed a commonality, a conceptualisation of a phenomenon which scholars had observed over many years – the observation that

projects and their management were trying (and succeeding in some cases) to find 'primacy' within their organisations (Packendorff & Lindgren, 2014, p8).

Engwall (2003) suggested that the Western economies seem to be heading towards a 'projectified society', quoting Lundin and Söderholm (1998). The well-established concept of the project as a lonely, singular and unique phenomenon, independent of history, contemporary context and future, began to be called into question. Engwall's (2003) findings emphasised the societal factors related to the players and organisations involved in the case study projects researched. He concluded that these factors had little to do with the technical content of a project *per se*, but rather with how different stakeholders interpret a project in relation to the procedures and traditions of its surrounding context. By adding history and organisational context, Engwall's (2003) study illustrates the explanatory power of a broader perspective on project management. Maylor et al (2006) observed that the sheer numbers of projects in existence and the reliance on these projects to perform well, increased awareness of projects within organisations in all types of industries, particularly in the rapidly changing and turbulent environment that organisations were facing (p664).

According to Packendorff and Lindgren (2014), projects began to transform and re-organise ongoing operations and structures, which resulted in them being more integrated into permanent organisations. This took various forms such as the use of matrix organisation (Davies et al 2006, Maylor et al, 2006, Arvidsson, 2009), where projects, their methods and management were partly integrated into permanent structures. This includes projects from all industries, from the small-scale to the portfolio level, projects that instigate small changes to remain competitive, and those that help shape and change our ways of life globally (Shenhar, 2001; Orr & Scott, 2008). A series of moves to

transform the traditionally hierarchical and functional organisation into a project-based structured organisation was then observed (Blomquist & Müller, 2006; Aubry et al, 2007; Söderlund & Tell, 2009). Organisations have continued to struggle with the transformations needed at project level to keep up with new ways of working brought in by the ever-changing business strategies since the late 1980s (Aubry & Lenfle, 2012). Commercial strategies moved away from the "one size fits all" mentality to target niche positions instead. This shift to innovation-based competition placed a great deal of emphasis on design performance and therefore, on project management, causing an unprecedented need to deliver a growing number of projects quickly (*ibid*).

This has in turn created a subsequent opportunity for project management to become more distinctive both within and away from neighbouring disciplines. Project management has enjoyed a long and strong history within such diverse areas as engineering, operations research, organisation theory and management science dating back to the 1930s (Morris, 1994; Johnson 1997; Levene 1996). Projectification has enabled its move into other knowledge and application areas responding to the wider spectrum of the use of projects as organisational forms (Söderlund, 2011; Geraldi & Söderlund, 2016, 2018; Davies et al, 2018, Sydow & Braun, 2018).

The nature of projectification can be evidenced by the growing awareness of the high impact of projects, and therefore also the influence of PM, on the society and the economy. From € 2.1 trillion spent on internal projects every year in the USA in 2001(PMI, 2010) to a projected worldwide market value of project and infrastructure spend of around €8 trillion estimated by 2025 (PwC, 2016), even global recession has not slowed down interest and activity in projects.

CHAPTER 2: LITERATURE REVIEW

Despite the growth and reconceptualisation of project management as more than just a handy set of tools and methods (Sydow & Braun, 2018), attention was turned to the consequences of projectification and the realisation that, along with increasing projectification, an increasing expectation of standardised and codified project management knowledge existed (Hodgson & Cicmil, 2007; Packendorff & Lindgren, 2014). However, project-based industries often experience difficulties extracting, distributing and applying knowledge across both cultural and structural boundaries (Prencipe & Tell, 2001; Bosch-Sijtsema & Postma, 2009), which makes it more difficult to exploit knowledge in such settings. It became clear that knowledge alone was insufficient in successfully executing projects and that cultural and discursive processes and practices were needed to improve project outcomes (Packendorff & Lindgren, 2014).

A plethora of systematic tools, techniques, models and methods have been around from disciplines such as engineering and architecture for almost 100 years which aimed to help the general PM practitioner (Seymour, 2014). However, these alone also contain little value. The Project Management Institute (PMI) found in their annual survey that organisations still undervalue project management as a strategic competency for driving change (2018). Their respondents also suggested that their organisations were still prone to an average 50% failure rate, and they report an average of 50% failure rate of projects (*ibid*). This suggests there is a need to combine knowledge and practice underpinned by robust research, which focuses on situation-specific issues. Such issues must be fully integrated within and across a multitude of conceptual, institutional and managerial frameworks (Hällgren & Söderholm, 2018).

One of the most fundamental challenges in contemporary project society is complexity, and its implications for project design and management (Hällgren & Söderholm, 2018). The next section considers the challenges of dealing with complexity in projects and their environments.

2.2.3 Complexity

The study of complexity has gained attention within both general management and PM literature over the last 20 years (Davidson-Frame, 2002; Li, 2002; Jaafari, 2003; Williams, 2005; Winter et al, 2006; Cooke-Davies et al, 2007; Hass, 2009; Saynisch, 2010; Geraldi et al, 2011). Its foundational basis is the management belief that total control inhibits the flexibility required to focus on every possible social interaction and situation (Curlee & Gordon, 2010). Complexity has been described in academic terms as 'complicated' (Remington & Pollack, 2007), and as a variable that impacts upon decisions required to effectively practise project management (Sousa & Voss, 2008). Additionally, Ramasesh and Browning (2014) suggest that complexities that exist within (different kinds of) systems create challenges regarding being able to fully recognise and understand all variables. Whilst there could be many known unknowns, there are always unknown unknowns which create more uncertainty for project managers (*ibid*).

Since projects are often viewed as organisational systems (Senge, 1990, Senge & Sterman, 1992; Taylor, 2003), it can be helpful to frame them within a systems theory approach. From as early as the 1950s, Boulding (1956) offered the view that human and social organisations exhibit a much higher level of complexity than technical systems, in his general systems theory. Since change and its management usually come in the form of a project, which is regarded as a cultural technique, a social practice and a professional discipline (Klein, 2016), it would seem appropriate to position projects at the very upper

levels. The lower levels of the system are simple, with few connections and parts to make up a whole, but, as the volume, size and variety of connections grow, leading to additional options, so complexity grows. Gleick's (1987) Chaos theory helps to explain how complexity has arisen. Systems began to demonstrate the lack of predictability of basic events and the consequential requirement to become flexible and adaptable in both the physical and social worlds in order to maintain competitiveness. This concern with chaos led to a growing interest in complexity and it is considered that project management as a discipline has operated within an environment which borders on chaos and complexity for decades (Davidson-Frame, 2002). Complexity begins when humans and systems interact with one another but what makes these daily interactions complex is the appearance of ambiguity, often causing unpredictability and instability (Pich et al, 2002; Thiry, 2011).

The concept of complexity as a systems, methodological and/or philosophical approach, has been used as a lens to raise awareness of, feature and facilitate connections (Hannigan, 2012), adaptive learning and planning (Xiao, 2013).

2.2.3.1 Complexity within PM

Winter et al (2006) determined some time ago that the complexity of projects and project management, including projects as social processes, required a rethinking of direction that would be of value to both practitioners and scholars of PM. They argued that "real projects and programmes are much more complex, unpredictable and multi-dimensional than the rational, deterministic model, which dominates the literature" (Winter et al, 2006, p. 644). Since then, increased recognition and framing of research around relevant topics of concern to management but also to society has continued to shed light within project studies. Recently scholars have again highlighted the

importance of critically engaging with complexity as projects-as-practice examples in integrative research to advance the field (Geraldi & Söderlund, 2016). Understanding the complex reality of project management practice, and the multi-dimensional mind-sets and relationships that influence it, requires different levels of knowledge to support understanding, including instrumental, practical and emancipatory knowledge (*ibid*). This could additionally increase the capability of social awareness and reflexivity of project management scholars and practitioners (Bourdieu, 2004; Clegg & Courpasson, 2004; Winter et al, 2006).

Since different environments deal with complexity differently, examples from various project environments are outlined below to illustrate characteristics of complexity, differences and similarities. For ease of understanding, references pertaining to programme(s) and portfolio(s) are taken to mean project(s) in the wider definition of project and project management as an umbrella term.

2.2.3.2 Managing complexity in discipline-specific environments

Extant literature in the health and medicine field suggests agreement with four key aspects of complexity theory with respect to health relations and networks; non-linearity, emergence and hybrids (Gatrell, 2005), with plenty of theoretical debate around definition and identification, but a general lack of empirical work to illuminate it (*ibid*). Plsek and Greenhalgh (2001) summarised complexity within healthcare as "clinical practice, organisation, information management, research, education and professional development that are interdependent and built around multiple self-adjusting and interacting systems" (p625.) Rationalisation is often cited as an approach to reduce complexity particularly in health programmes, which aim to improve outcomes through behavioural change (Glasgow, 2003; Zuiderent-Jerak, 2007; Timmermans & Almeling,

2009; Mathar & Jansen, 2010). However, the rationalistic and standardisation approach can lead to a plethora of negative effects and dilemmas, including, but not limited to, the requirement to be more flexible in approach, the need to take into account local variations in health practice as well as complexities of care practices (Wehrens & Bal, 2012). By acknowledging the unpredictability and an ever-present paradox, they suggested that traditional reductionist thinking was limited in its ability to solve clinical and organisational problems (p628). Together with others, they also suggested that healthcare systems might be viewed as complex adaptive systems (CASs), characterised by diverse agents who can learn, self-organise and co-evolve with their environment (Plsek & Greenhalgh, 2001; McDaniel & Driebe, 2005; Lanham et al, 2009, 2013).

Kernick (2003) asserts that modern medicine has been unable to describe the complex interactions between healthcare and health, but complexity theory allows us to at least challenge the dominant ways of thinking about organisational change (p29). Complexity theory enables opportunities to build rich and nuanced accounts of service delivery that may have otherwise remained hidden (Tenbensel, 2013). Lanham et al (2013) suggest that complex systems are characterised by irreducible uncertainty, which may be reduced by fostering interdependencies amongst individuals that will lead to better health outcomes than focusing on those individuals alone (p199). This is particularly important for large-scale health intervention implementation projects and practice.

Complexity within construction and engineering project management environments is not new, and scholars have been considering this as an essential managerial pre-requisite since the 1990s (Baccarini, 1996; Bertelsen, 2003). Baccarini (1996) argued that construction can be considered as the most complex process undertaken in any industry. This includes construction-as-production (Bertelsen & Koskela, 1998, 2005) for less complex

projects as well as dynamic construction, which entails greater levels of complexity, uniqueness and uncertainty (Ballard & Howell, 1994; Bertelsen & Koskela, 2004). General engineering and engineering to order (ETO) projects for manufacturing, production and construction involve a large number of suppliers and subcontractors, and are characterised by a complex combination of often geographically dispersed physical and non-physical activities, such as design and engineering production aspects (Jünge et al, 2019). Complexity has been characterised by interconnectedness of structures that link various objects and entities within project workflows and delivery (Baccarini, 1996; Lucas, 2000; Williams, 2002; Burns, 2005; Antoniadis et al, 2011), caused by time and/or cost pressures requiring creativity and co-operation (Bertelsen, 2005).

The timeliness and reliability of information that changes according to customer demand adds a further layer of complexity, often outside the control of the delivery organisations (Adrodegari et al, 2015). The inability to respond to information quickly then causes further project delay, budget overruns and defects in quality (Dubois & Gadde, 2000, 2002; Emblemsvåg, 2017). The complexity of a project, along with the level of uncertainty, is the interdependent characteristic most commonly associated with large-scale projects (van Marrewijk et al, 2008; Dunović et al, 2014). A focus on technological uncertainty and complexity, primarily related to the content and scope of projects (Shenhar & Dvir, 1996; Shenhar, 1998), had already led to rethinking the causes of complexity, including competency development of project managers (Remington and Pollack, 2007, Thomas and Mengel, 2008; Bosch-Rekveldt et al, 2009), and the introduction of soft systems methods for project modelling to support project complexity management (Williams, 1999). The broad technological, organisational and environmental (TOE) framework as developed by Bosch-Rekveldt et al (2011) with its three levels (categories, subcategories and elements) offers the opportunity to discuss on various levels of aggregation with the

different parties and stakeholders involved in a project which aspects make the specific project complex, in their individual view. In large-scale engineering construction projects this can include any number and levels of clients, designers, contractors, subcontractors, suppliers, financial instruments, contractual and governance authorities, and other stakeholders (Girmscheid & Brockmann, 2008). As projects increase in size, and become more complex, managing them becomes more challenging. Schedule slippage and cost overruns continue to be familiar occurrences in construction and engineering projects, particularly mega and large-scale projects (Omoregie, 2016).

Due to high technical specifications in the construction industry (Lillieskold & Ekstedt, 2003), the need to create complex procedures at the lowest organisational levels (Antoniadis et al, 2011) has led to an increased consideration of non-technical dimensions (Burns, 2005; Geraldi, 2008), in particular the requirement to execute less of a 'command and control' approach to human resource management (Green, 2002). Interactions between systems and formulation of structures partially driven by such increased collaborative working within a dynamic environment (Kadefors, 2006) have led to the creation of further non-linear complexity in procedures and processes across boundaries and interconnections (Bertelsen, 2005). Girmscheid and Brockmann (2008) perceive complexity to extend beyond the traditional concept of task complexity, which is delimited in space and temporality (p22). Rather, this is considered as integral to and interrelated with social and cultural complexity which develops over time, shifts and changes depending on the life cycle of the project. What influences the nature of the complexity "curve" is the level of interrelation within and across each department or subsystem managing aspects of the project (*ibid*).

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Manufacturing systems have evolved from job shops, which feature general-purpose machines, low volume, high variety and significant human involvement, to high-volume, low-variety, dedicated manufacturing lines (DMS) driven by the economy of scale (Wiendahl et al, 2007). Complexity was introduced in the 1980s through demands for mass customisation, changes in products and production technology, and markets which began to use projects as a mechanism to introduce flexible manufacturing (Chryssolouris, 2005) responding to changes in requirements, including 'offshoring'. However, Wiendahl et al (2007) suggest changeability often requires additional investment for the production and manufacturing systems, in particular costly new tools, machines, data technology, infrastructure, assembly, logistics, and even the site and buildings, which extend beyond the basic quality requirement of 'object transformability' (p803). Often this increases such initial project costs, seen in contemporary manufacturing in high-cost economies as an extension or increasingly incorporated aspect of service, such as design, maintenance, consultancy and customer support upstream as well as downstream (Oliva & Kallenberg, 2003; Neely, 2008).

Other manufacturing projects have also progressively embraced the whole value-chain associated with products, including R&D, new product development, sourcing, production, distribution, services, re-use, re-manufacturing and recycling (Guide & Van Wassenhove, 2006; Baines et al, 2009; Harrison & McMillan, 2011; Foresight, 2013). ICT (information and communications technology) has also made offshore manufacturing technically possible to coordinate knowledge-intensive and complex activities at a distance, and between organisations, aptly put by Baldwin and Evenett (2012), "ICT made it possible, wage differences made it profitable" (p74). All of these things combined have created sector competition of a very different kind to that of the 1980s. In terms of future projections, by 2025, the share of tasks performed by robots alone in

manufacturing will rise from a global average of around 10% to about 25% across all manufacturing industries (PMI, 2017). New advances in robotics and its increasing adoption will boost manufacturing productivity by up to 30% (*ibid*). This will also require the creation of new roles with new skills profiles for the manufacturing workforce over the next decade (IFR, 2020). Whilst this means additional opportunities for projects (since they are familiar with measures to test new ways of working to eventually become business as usual), this exerts more pressure on the use of projects to deliver important results quicker and faster.

In the IT project environment, high failure rates continue to dominate the global landscape. In 1995, Standish Group's Chaos Report shared its research results into failed IT software projects, including cost overruns, time overruns and failure of the applications to provide expected features, with almost a third of 50,000 projects in its sample experiencing cost overruns of 150 to 200%. The average across all (US) companies was 189% of the original cost estimate (Standish Group, 1995). Less than 10 years later, a study by KPMG New Zealand found '…an incredible 70% of organizations have suffered at least one project failure in the prior 12 months and 50% of respondents indicated that their project failed to consistently achieve what they set out to achieve.' (Rossi, 2006). Equally depressing statistics conclude that between 65% and 80% of IT projects fail to meet their objectives, and also run significantly late, or cost far more than planned." (Faeth, 2012). The struggle to resolve new issues that surface very quickly during systems development, including those that necessitate real-time articulation and resolution, is said to create excessive complexity (Benbya & McKelvey, 2006). This is different to complications which, although they may make a project difficult to manage, do not cause it to become unpredictable and unmanageable (Xia & Lee, 2004; Benbya & McKelvey, 2006).

IT services, development and systems alignment are not "one-off" events but rather a process of continuous adaptation and change, characterised by a complicated relationship between mutually interdependent technology availability and capability that extends to multiple organisations (ibid). An adaptive tension exists between intersections of overlapping sets of individual and group perspectives that shifts and evolves as the design proceeds, "evolving" complexity (ibid, p22). Williamson (2012) made a further distinction between project complication and project complexity as an attempt to recognise and understand the challenge of complexity in IT. Although this study revealed the general existence of a relationship between complicated and complex distinctions, it recommended incorporation of an assessment of project complexity into the initiation, planning and execution phases of all IT projects. This suggested a proactive approach aimed to mitigate the likely effects of IT project complexity and help improve the likelihood of IT project success (Williamson, 2012). It appears from the literature that similarities and differences exist in terms of the construct of complexity, mainly characterised by uncertainty, non-linearity, interconnectedness and the ability of complexity to lead to further complexity (Antoniadis et al, 2011a). This is as well as the need to understand and manage its elements for project effectiveness. Yet there is still no unified or convergent view on how to analyse or manage complexity without considering the project context (Saed et al, 2016; Kiridena, 2017). From the contextual examples given, there is a recognition and some support for a "systems approach" to meet project and environment requirements (Sankaran et al, 2010) which necessarily involves a high degree of understanding and managing socio-behavioural dimensions. Additionally, a general acknowledgement exists that technology and organisation and/or management approach can impede as well as facilitate progress across all project life-cycle stages (Cui & Hsu, 2011). Aritua et al (2009) suggest that there

are plentiful opportunities for PMs to adjust the theoretical basis and industry practice in adopting softer paradigms dealing with complex situations to obtain significant benefits. Complexities that exist between, within and across the boundaries of projects and their environments, challenge project performance, thus creating a requirement to respond and adapt to a dynamic, which may be limited within available PM expertise (Whittingham, 2017).

2.2.3.3 Managing complexity: tools, approaches and practices

Traditional tools and methodologies (e.g. PRINCE2) that purport to help people successfully manage projects of any nature, size and complexity (AXELOS, 2017) lack rigour in application (Maric, 2017). Maric (2017) further suggests that, when something changes in PRINCE2, its complicated process methodology means additional time is taken by project teams to adapt. Others consider that neither PRINCE2's structured traditional programme nor its more recent agile iterative approach adequately address comprehension or management of complexity of the contemporary working environment (Thomas & Mengel, 2008; Mesjasz et al 2016). Accordingly, practitioners need understanding and guidance in order to deal with and manage complexities as experienced by individuals and managers (Thomas & Mengel, 2008). Indeed, addressing complexity, and navigating uncertainty and ambiguity feature prominently in the 2021 (7th) version of the PMBOK using knowledge, experience and learning as a delivery principle (DePrisco, 2020).

In terms of practitioners, project managers in IT & Technology, and Manufacturing & Production, are encouraged to embrace complexities during earlier project phases and stages. This appears to be focused on the complexity of the 'task' and the feasibility of

the design. For example, exploratory projects such as new product development, especially research and development, engage end-user stakeholders, or at least closely represent their interests, at a much earlier stage or development cycle of projects. This has often come from the need to enhance 'business as usual' or improve a previous project that may not have been deemed successful. A particularly pertinent example is development of pharmaceutical new drug developments, and more recently vaccine products, where there is often a more stable workforce and speedier conversion of unknowns to knowns (Ramasesh & Browning, 2014). Emerging issues can lead to product adaptations and therefore quicker final results. In Health & Medicine, complexities may be identified during or after implementation; for example, piloting a new service delivery project may be undertaken over a number of years, or until a number of service delivery organisations (e.g. GP practices) have evaluated the results. This adds to pressure felt by staff to complete projects more quickly, given rising patient expectations (Baird et al, 2016).

What is also noticeable is the level of autonomy of practitioners in dealing with complexity. In IT and Technology this is generally expected, due to the self-organising nature of IT project teams, whereas in Health & Medicine, often autonomy is delegated upwards to senior managers who may or may not be aware of issues on the ground (Hughes, 2008). This then creates tensions and further time pressures, since the PMs often have the responsibility of managing complexity (and knowledge thereof) without the requisite authority. Understanding the complexity of the work environment and engaging in strategies to improve its effects is paramount to higher-quality, safer care, according to Hughes (2008). The traditional hierarchical structures of organisations often cause these tensions, given their "command and control" structures (Dorman, 2017). Although more contemporary approaches to leadership and management through the project

organisation mechanism are increasing, there is a growing number of projects that require re-work and re-design in part due to either the lack of identification of complexity and/or the autonomy to deal with it at the right time (Gemunden, 2005; Ireland et al, 2015).

The important message is that, despite the lack of consensus around a definition (Ireland et al, 2013; Bakhshi et al, 2016), there is acknowledgement that it exists and must be addressed. What connects contemporary projects, regardless of discipline or location, is the challenge to manage them on a daily basis, because of the need for situation-specific attention, on one hand, and the desire for efficiency and standardisation on the other (Hällgren & Söderholm, 2010).

2.2.3.4 Summary of complexity; challenges and opportunities for project management

The project environment can be characterised by multiple levels of uncertainty and unpredictability between, within and across any technical, human and functional systems (Pich et al, 2002; Cicmil et al, 2009; Kerzner, 2010; Söderlund, 2011). Rather than continuing to focus solely on a collection of different tools, techniques and models to define complexity within projects and their environments, understanding complexity within PM enables a move away from such normative traditional frontiers of project management (Hass, 2009). Lack of insight into what constitutes complexity can have an undesirable effect upon the interpretation of knowledge sharing and learning processes within a project, organisation or environment (Bechky, 2006; Söderlund 2011). It is not difficult to imagine why complexity can be viewed as daunting (Geraldi et al, 2011), whilst still acknowledging the need to better represent and manage the reality of the 'situation at hand' (DuGay & Vikkelsø, 2012).

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Managing complexity has been the subject of much scholarly debate which has argued that the increased complexity within and around projects and their environments (Thomas & Mengel, 2008) requires reflexive as well as technical skills (Crawford et al, 2006). This is supported by Atkinson et al (2006) and Cooke-Davies et al (2007), who suggested that more sophisticated efforts to recognise and manage sources of uncertainty were needed in terms of alternative perspectives, theories and practice. Winter et al (2006) assert that consideration of reflexive practice to better understand the complexities of projects and their environments is required. This does not abandon conventional PM methods, but rather enriches and extends the field beyond current intellectual foundations, connecting it more closely to the challenges of contemporary, adaptive PM practice. Cicmil (2006) and Geraldi et al (2008), who agree that gaining insights into the actuality of PM practice through social processes, and experience of practice, is inclusive and complementary to traditional project management. This extends the application and perception of both systems theory and complexity theory from organisations to projects and project management (Vidal & Marle, 2008), thus treating projects as human activity systems (Small & Walker, 2012) and socio-cultural systems (Sankaran, 2012; Schöttl & Lindemann, 2015). This includes, but is not limited to, understanding transformational approaches such as leadership and its positive influence on project success (Kozlowski & Ilgen, 2006; Piccolo & Colquitt, 2006; Yang et al, 2010; Aga et al, 2016). Curlee and Gordon (2010) assert that, as individuals become more aware of the importance of complexity and can understand and embrace its benefits within the environment, the more complexity theory becomes part of the organisation's culture. Indeed, Cooke-Davies et al (2007) assert that investigations in different disciplines into the complex behavioural dynamics may reveal new insights and paradigm shifts away from traditional project management.

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In order to understand the emerging phenomena of complex actuality, a multi-perspective or pluralistic view of project management is recommended (Söderlund 2011). This offers project managers and researchers a way to illuminate the complex lived actuality of projects and their practice (Cicmil et al, 2006), and live with its contradictions without losing focus and commonality (Söderlund, 2011). In particular, approaches that were directly relevant to the social dynamics of complexity associated with the people involved in delivering complex projects were of particular importance. Managing complexity became an underlying argument for rethinking practice (Svejvig & Andersen, 2015). Research has confirmed that increased project complexity prevents the generation of time-bound appropriate responses to problem signs (Williams et al, 2010; Haji-Kazemi et al, 2015). However, the multi-dimensional processes that connected people, tasks and environments that were responsible for failure and compounding further complexity, were also found to potentiate remediation and improve project performance (Lehtinen et al, 2014).

Syed (2016) asserts that, since complexity has become a dominating theme within recent PM research, new approaches and lines of inquiry are required in order for projects to achieve organisational objectives, and for PMs to thrive within chaotic, socially complex organisations (Whitney & Daniels, 2013). One such approach which is well placed to address the management of complexity within project environments as well as projects themselves is the lean approach.

A lean approach is an essential foundation for managing contextual complexity, through processes of emergent scenarios (Klein et al, 2016), frequent feedback loops and periodic corrective measures (Kautz, 2012), orchestrating better, more valuable,

meaning creation (Whitney & Daniels, 2013). The next section focuses on the origins of lean thinking and provides background understanding of its key principles and aspects.

2.3 Lean thinking in the Project Environment

The following section outlines the concept of lean project management, by firstly taking a historical look at the evolution of lean thinking and tracking its journey across operations and into project management.

The rise of projectification and increased awareness of complex reality has seen a move away from the traditional management approach to the lean approach. However, there are significant challenges in applying specialist knowledge to generalist application and this transition comprises many hurdles, not least the differences in definition and structure of phases, the relationship between them and the roles of project participants (Bygballe et al, 2018). Hence this research is relevant in recognising these shifting directions and addresses requirements and suitable approaches to deal with the challenges these shifts in direction bring.

Understanding lean project management through its underpinning lean principles provides project managers with a contemporary approach in helping to navigate daily complexities and challenges of productivity and performance (Moujib, 2007). Secondly, the literature will draw upon examples of lean as an approach used in specific disciplines, such as Health and Medicine, IT, Construction, Engineering and Manufacturing, to demonstrate its applicability within these environments, as well as the challenges brought about by its implementation. Finally, the opportunity to utilise lean project management as a specific PM approach is discussed.

2.3.1 Origins of Lean thinking

The origins of lean can be found in the 1940s and 1950s auto manufacturing assembly plants of the USA and Japan, and perhaps the best-known example is Toyota. A gradual development of lean occurred over a period of 50 years, through an accumulation of a series of small innovations, culminating in the Toyota Production System (TPS) (Fujimoto, 1999; Liker, 2004; Hino, 2006). Toyota did not have the economies of scale, resources or production capacities of Ford and GM (Womack *et al,* 1990), and thus was unable to emulate the success of these production systems exactly, but its learning goal was to improve production methods and quality with smaller volumes whilst remaining focused on efficiency (Aziz, 2012). Early methods of lean applied the production philosophy through the application of autonomation and "Just in Time" (JIT) (Ohno, 1988; Womack & Jones, 1996). Whilst autonomation relied on traditional methods and principles of quality craft production, JIT was a forward-thinking approach which looked ahead at downstream demands and forecasting. For example, autonomation enables workers to become responsible for their own and others' work through visualisation, quality checking and corrective actions, and JIT focuses on flow, scheduling and resource allocation, supported by many techniques, including Kanban, as a "pull" mechanism, to support the improvement and efficiencies of flow (Hopp & Spearman, 2004). Some argue this paved the way for an extension of lean production principles to non-automobile manufacturing contexts (Hines et al, 2004; Hopp & Spearman; 2004; Staats et al, 2011) and contend that lean carries on the legacy of these early techniques, as their wide adoption across both production and service settings evidences.

Hines et al (2004) summarised the evolution of lean thinking in the following table (Table 2.4), which considers periods up to and including the mid-2000s. The researcher considered the last 15 years of published literature and extended the table to include

2005-2020 and created a final column to reflect the key scholarly works found. As can be seen from references in Table 2.1 below, although the early works contain some definitions of what does and does not constitute lean, the underlying principles of the production-based philosophy and quality have remained throughout (Hopp & Spearman, 2004; Shah & Ward, 2007).

Table 2.1 Periods in the evolution of lean thinking

Phases	**1980-1990 Awareness**	**1990-mid-1990 Quality**	**Mid-1990-2000 Quality, Cost & Delivery**	**2000-2005 Value system**	**2005-2020 Competence Capability Project Management**
Literature theme	Dissemination of shop-floor practices	Best practice movement, benchmarking leading to emulation	Value stream thinking, lean enterprise, collaboration in the supply chain	Capability at system level	Understanding Learning Social & behavioural processes
Focus	JIT techniques, cost	Cost, training, promotion, TQM, process re-engineering	Cost, process-based to support flow	Value and cost, tactical to strategic, integrated to supply chain	Meaningful interaction and practice, Values, satisfaction
Key business processes	Manufacturing, shop-floor only	Manufacturing, materials management	Order fulfilment	Integrated process, order fulfilment, new product developme nt	Workflow Use of KPIs, Stakeholder engagement
Industry sector	Automotive - vehicle assembly	Automotive – vehicle and component assembly	Manufacturing in general (often repetitive)	High- and low-volume manufacturi ng, extension into service sectors	Construction Health IT Public services
Authors	Shingo (1981, 1988) Schonberger (1982, 1986) Mondon (1983) Ohno (1988) Mather (1988) Clark & Fujimoto (1991)	Womack et al (1990) Hammer (1990) Stalk & Hout (1990) Harrison (1992) Andersen Consulting (1993,1994)	Lamming (1993) MacBeth & Ferguson (1994), Womack & Jones (1994, 1996) MacDuffie (1995) Rother & Shook (1998)	Bateman (2000) Hines & Taylor (2000) Holweg & Pil (2001) Abbas et al (2001) Hines et al (2002) Shah & Ward (2003, 2007) Narasimhan (2006)	Proudlove et al (2008) Howell (2011) Pasquire (2012) Burgess & Radnor (2013) Ballard & Tommelein (2016) Modig & Åhlström (2017)

Source: adapted from Hines *et al* (2004)

The development of and advances in IT have also helped shape the direction and application of lean thinking, particularly towards 2000, when fears surrounding the potential negative impact of Y2K (also known as the Millennium Bug) caused significant uncertainty across society and business (National Geographic, 2011). Additional integration between software applications and functions such as HR and Finance enabled more complex information systems advances, which in turn gave rise to near total integration of all essential business processes (Hopp & Spearman, 2004). This also helped to propel JIT from a simple control technique to management of inputs and outputs (flow) to a total system that aimed to manage and measure outcomes (*ibid)*.

Eventually the rise of Quality led to the creation of best practice standardisation through ISO 9000 certification, and later statistical measurement techniques for achieving quality aspects of lean became possible (e.g. Six Sigma). Later, qualitative aspects such as values and satisfaction (Womack & Jones, 2003) began to emerge which included all stakeholders, customers, staff and end-users. Collaboration within lean practices and their social processes began to be debated (Pasquire, 2012; Bresnen et al, 2014) as lean thinking for more sustainable and longer-term goals appeared important to organisations.

The way in which lean has been used in the last 15 years demonstrates not only a broadening of the concept, but also in the way that it is applied to projects in specific settings, such as Construction, Health, amongst others. The final column above also shows that extension into service and public sectors has occurred and taken a much more social and behavioural perspective, although much of the literatures discusses the need for this, rather than reporting on examples of social or behavioural processes or practices that have been explored. New nuances of lean thinking have been introduced; for example, lean start-up is now an established methodology (Blank, 2013). The following

section provides an overview of lean principles and illustrates how they have become integrated into project management.

2.3.2 Definitions and Principles of Lean

The term 'Lean Production' was first coined by John Krafcik in 1988, highlighting the principles of limiting inventory, excess workers and waste:

> "Lean Production uses less of everything compared with mass production – half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time. It requires keeping far less than half the needed inventory on site, resulting in fewer defects, and produces a greater and ever-growing variety of products" (Womack et al, 1990, p13)

Spear (1999) and Spear and Bowen (1999) undertook an inductive and ethnographic study to identify principles of the Toyota Production System (TPS), progressing the work of early lean production thinkers such as Ohno (1988). Their research resulted in characterising the following four rules of TPS:

1. High specification of all work regarding content, sequence, timing and outcome.
2. Every customer-supplier connection should be direct, with a clear Yes/No response when sending and receiving requests.
3. The pathway for every service and produced good should be simple and direct.
4. Any improvements should be made with respect to the scientific method, at the lowest level of the organisation, guided by a teacher.

Staats et al (2011) identified four aspects of lean from the TPS that could be potentially transferred to general management practice:

- specified tasks
- streamlined communication
- simple process architecture
- hypothesis-driven behaviour

Womack and Jones (2003) define lean thinking as a narrowing of production concepts to five principles that focus on the concept of the elimination of waste:

1. Principle 1: Specifying Value
2. Principle 2: Identification of the value stream
3. Principle 3: Creating flow
4. Principle 4: Pull
5. Principle 5: Pursuit of Perfection

These are defined and discussed in more detail below, including specific examples of application within project management.

2.3.2.1 Lean Principles 1 & 2: Value

Specifying Value and Identifying Value Streams are considered essential to practitioners' understanding and this involves the definition and understanding of customer needs, defining value in terms of the product, its functions and capabilities offered at a specific price (Womack & Jones, 2003). Hence, these first two principles are explained as a combined principle. Value that is correctly specified from the standpoint of the customer comprises the following in every step and action in the process (*ibid*):

- Valuable
- Capable
- Available
- Adequate
- Flexible

This requires identification of the entire set of actions required to make a specific product or service and is perhaps the principle that most organisations can identify with in that it links the tasks of problem solving, information-gathering and physical transformations along the value stream. Analysing the value stream through identification of value-adding activities (VA), necessary but not value-adding activities (NNVA) and non-value-adding activities (NVA) takes into account every action, process and interaction between the customer and supplier(s) not just within a project or process but within and out with the organisation. This provides the opportunity for a holistic view that includes identification and removal of waste up and downstream that can be both beneficial and risky (Womack & Jones, 2003). In attempting to define value, the following is offered as a helpful starting point:

> "Value is the quotient of benefits/costs (alternatively satisfaction of needs/use of resources) where value is not absolute, but relative and may be viewed differently by different parties in differing situations." (Laursen & Svejvig, 2016, p737)

Value is a complex and broad concept requiring definition and distinction in order to understand it (Koskela, 2000; Jylha & Junna, 2011; Drevland et al, 2018). Numerous attempts have been made to distinguish between the confusion of 'value' and 'values' (the latter not meant as a plural) related to production theory (Rooke et al, 2010). During

benefits capture and realisation, both values and value are negotiated between project participants and stakeholders (Koskela, 2000), in ways that Rooke et al (2010) argue are best conceived as conversations. However, the underlying significance of value within lean is its link to waste reduction (Pasquire & Salvatierra-Garrido, 2011), and specifying its meaning is the first step in reaching a definition (Sarhan et al, 2017; Drevland et al, 2018). Drevland et al (2018) summarise this well:

> "Value is the result of an evaluative judgement, guided by values of the evaluator's knowledge at hand. This is always based on comparing two or more alternatives in a given context, which envelops all "get" and "give" consequences for a particular party from the decisions made by evaluators. Such "give" and "get" consequences are always in the form of gained or lost experiences, often expressed in monetary terms as a placeholder for experiences." (p38)

The way in which value is created by stakeholders and its (value's) relationship with project performance is important in understanding its place within project management. Stakeholder perceptions of and satisfaction with the quality of the outcome add a new level of subjectivity that was previously absent. This relates to the impact of the project and the processes undertaken in order to gain the value or benefit (Baccarini, 1996). This also suggests that the success of projects is more closely connected to the value created (Laursen & Svejvig, 2016). However, there is a distinct difference between value creation and value capture, and the process by which this is approached, managed and articulated is again subject to the perceptions and expectations of different stakeholders over time (Chang et al, 2013).

Less than 10% of the literature found in Laursen and Svejvig's (2016) study applied independent comprehensive theoretical frameworks, despite numerous (43) examples of models and frameworks that could have been used to evaluate project value

creation. Additionally, Breese (2012) posits that current value creation theories fail to comprehend the complexity of today's project environments. This offers an opportunity for this area of research to be developed that extends beyond individual project appraisal and project benefits management and moves towards a holistic integrated value management that includes the design and cost of values and benefits (Male et al, 2007; Bradley, 2010; Laursen & Svejvig, 2016). Laursen and Svejvig (2016) suggest that ambiguity dominates here and overlaps with the definition and use of frequently used terms to define "value" (here categorised by worth, success, benefits and value creation). Crucially, they suggest that the traditional place of value within output-driven operational side of project management must be extended to include strategic management given its complex, multi-level and multi-faceted characteristics (Lepak et al, 2007). This builds on Winter et al's (2008) suggestion that the primary purpose of the value creation process is to mobilise the customer to create their own value from the project's offerings, and a new conceptual model of cost, time, scope and value is required (p103). Morris (2013) extends this further by suggesting that value creation not only exists for the purposes of project outcomes, but that the act of creating value provides the opportunity for longer-term capacity and capability in this important area. Artto et al (2016) believe that co-creating value within and across all project systems and lifecycle phases adds value, not only for the final end-customer, but for each stakeholder organisation, in strengthening both internal competition and complementarity.

Therefore, value is a complex issue, with attention remaining focused on those benefitting from value on the consumption side (customers, users), rather than necessarily on those designing processes by which it will be achieved (project team members). However, the connection back to the original lean principles of specifying value and identifying the value stream could be facilitated further by the use of LPM. By

bringing together those responsible for project design and those that will benefit from value, this may provide new practice which would take account of multi-dimensional and dynamic perspectives beyond the traditional view (Bradley, 2010; Ward & Daniel, 2012). The following section outlines principles of flow and pull which follow on from value.

2.3.2.2 Lean Principle 3: Creating flow; and Lean Principle 4: Pull

Flow is at the heart of the lean message (Liker, 2004), in shortening the elapsed time or flow path between raw materials to finished goods and/or services that will lead to best quality, lowest cost and shortest delivery time (Rother et al, 2003; Liker, 2004). Also known and understood by many in manufacturing and production, this is also consistent with the "value stream", where actions to progress the product and/or service are perceived as value-adding or not value-adding (Womack & Jones, 2003), as defined in the previous section. Flow may be discrete or continuous, depending on the actions required to progress the product (Sacks, 2016). In order to optimise flow, the early works of 19th-century Adam Smith and Charles Babbage considered it necessary to break down or subdivide these processes and actions into tasks and work packages. This stems from the belief that breaking-down processes as simply as possible ensured an increase in expertise and learning (Norton-Wise, 1989; Lewis, 2007). The aim at the time was to increase productivity through continuous resource utilisation, and it was (subsequently, mistakenly) believed that, by optimising parts of the process, this would lead to organisational optimisation (Sacks, 2016). It was not until the advent of 20th-century automotive mass production systems that continuous flow of the whole process, rather than parts, was considered and developed further (Sacks, 2016).

In lean, flow has traditionally focused on processes, and "work packages" to enable physical products to be moved through a system or set of processes, typically originating

from within the manufacturing and production sector. Following adoption into the construction sector, Ballard's (2000) Last Planner System (LPS) defines workflow in his glossary as "the movement of information and materials through a network of production units, each of which processes them before releasing them downstream" (p16). This was a seminal work in that it demonstrated that improving flow reliability led to improvements and this consequently shifted focus from productivity, operations and resource utilisation to the project (or projects) as the goal for improvement (Ballard, 2005). In Koskela's (2000) work, transformation, value and view (TFV) similarly integrates operations and process through the idea of workflow. This is developed further by Bertelsen (2006), whose theory of "Construction Physics" sought to better understand construction processes from a flow perspective. This theory recognises the existence of, and interaction between, physical flows (traditional materials and equipment) and immaterial flows (information, crews, space and external conditions). Known as "pre-requisites", or "feeder flows", Bertelsen (2006) suggests that these feeder flows themselves are just as important as the processes they seek to influence and improve.

Many lean practitioners cite the use of Takt time as a tool to implement lean. Takt is defined as the total available production time divided by customer demand; its purpose is to precisely match production with demand (Lean Institute, 2018). However, Takt time is not, and never has been, a pure customer demand signal. What Takt time does is make customer demand appear level across the working day and provide an effective tool for calculating what should happen, rather than what does happen (Rosenthal, 2010). Rosenthal further contends that there is a lot of confusion with its definition and it is often used co-terminously with cycle times, and that its mere employment does not make a process "lean". It can be an effective way to determine and plan the minimum resources necessary to get the job done (aligned to JIT thinking), and a way to continuously

compare what is *actually* happening versus what *should be* happening, followed by a process to immediately act on any difference (Rosenthal, 2010, p4).

The concept of flow thus forces the implementation of many other lean tools, e.g. thinking about preventative measures, building in quality, responsive problem solving and solution seeking, and, most importantly, the removal of traditional 'batch and queue' thinking in favour of continuous flow thinking (Liker, 2004). Focusing on flow differs from the traditional business processes, in that it exposes inefficiencies rather than hiding them. Inefficiencies necessarily include cutting out wasted effort and time that is not value-adding, strongly reinforcing the first principle of lean, as discussed earlier.

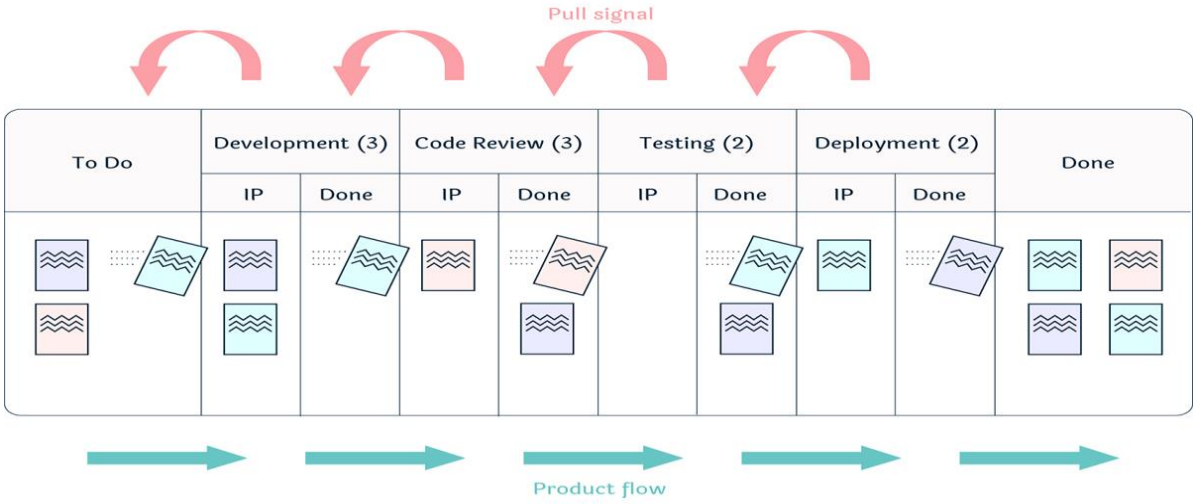
Recent researchers have investigated the concept of flow further, by considering flow efficiency, a new form of efficiency, as opposed to resource efficiency (Modig & Åhlström, 2017). Flow efficiency focuses on the "unit" processed in an organisation and measured by how much is processed during a specific time period, from the moment the need was identified by the customer to the time it takes for the need to be satisfied. The traditional view posits that resource efficiency is highly important; however, if the customer needs truly driven processes, then flow efficiency should be the more realistic measure, as it is need that dictates what value-adding activities are required and what processes are appropriate for that delivery, according to Modig and Åhlström (2017). Although both forms of efficiency clearly differ in terms of their dependencies, what differentiates them is that resource efficiency 'attaches work to people' but flow efficiency 'attaches people to work' (*ibid*, p22).

Creating flow takes account of customer need (as an underpinning principle), but additionally considers the human resource aspects of the workflow and its delivery. Womack and Jones (2003) posit that, by considering the human costs and benefits of implementing continuous flow, either at individual, function, team or project level, a simultaneous condition, known as 'psychological flow', is created (Csikszentmihalyi, 1990). Redesigning and rethinking activities that are rewarding and motivating for employees favours one type of stakeholder only, which creates an impossible challenge, and adds to already exists tensions and conflicts between functions, departments and projects (Womack & Jones, 2003). Similarly, others have equated this aspect of lean as "mean" (Garrahan & Stewart, 1992; Bergren, 1993; Parker & Slaughter, 1998), citing loss of freedom and flexibility as a regressive HRM practice (Green, 2002). It is clear from trends in the literature that researchers of lean in the 1990s/post-2000 generally viewed the concept of flow as a negative phenomenon, to be driven by the pursuit of perfection rather than the principle of value (Womack & Jones, 2003). This is discussed later in the chapter.

To understand "Pull" it is necessary to go back to the 1960s, when inventory using reorder-point/reorder-quantity (ROP/ROQ) was prevalent. This later developed into Materials Requirements Planning (MRP), primarily in the USA. Following computerisation in the 1970s and 1980s, its scope was broadened to include scheduling, manufacturing (MRP II) and Enterprise Resources Planning (ERP) by the 1990s (Hopp & Spearman, 2004). Ohno (1983) considered Pull to be an essential part of JIT, to be achieved through visualisation or Kanban (Japanese for sign or symbol), where a card system schedules and plans the movement of parts/materials for production (Huang et al, 1983; Huang, & Kusiak, 1996). Essentially, production work cannot start unless it "pulls" a parts/materials card from the

inventory. According to Womack and Jones (1997), pulling means that a process should not produce a good or a service without a request from a client or a downstream process, as illustrated below in Figure 2.2:

Figure 2.2 Pull Kanban card system applied to the IT industry



Source: Nave (2020)

In the diagram above, tasks are represented by coloured cards. Following ideas creation and a list of products to make, itemised under To Do, the first card moves from left to right; however, the pull signal goes in the opposite direction, right to left. For example, when the two cards under Testing have moved into Deployment, the Testing column will be empty. Team members in Testing will "pull" a card from the left column (Code Review) so the production process can flow smoothly, reducing the potential for high inventory (Inman, 1993). The numbers in brackets in the column headers refer to work-in-progress (WIP), one of the most effective features of Kanban, as limiting the number of items in production improves cycle and lead times, and improves capacity (Spear & Bowen, 1999), reducing potential waste and inefficient resource management (Hopp &

Spearman, 2004). Controlled WIP (CONWIP) implies less waiting time in-between processes, thus shortening lead times, lower vulnerability to uncertainties such as defective materials and changing orders from clients (Gayer et al, 2020).

Within extant literature, the focus on Flow and Pull is largely characterised by a recommendation for their implementation more generally across project-based industries such as Construction, Engineering and IT, particularly the benefits of these principles as understanding the stability of processes and workload, as tools, techniques, methods or approaches (Chau et al, 2004; Bulhóes et al, 2006).

There is some (limited) analysis of the effectiveness of their implementation, and the barriers and challenges to their utilisation (Gao & Low, 2014; Chay et al 2015; Thoumy & Hajj, 2017). However, this is generally restricted to specific project phases such as project planning, scheduling and delivery, and no sources were found that incorporated all phases from the cradle to the grave of project management.

Similarly, a plethora of named tools that purport to facilitate these lean principles are (often freely) available from commercial sources, but none were found that had specific peer-reviewed research undertaken on their usefulness for project management. There is no doubt that understanding the concepts of Flow and Pull enables project managers to adapt, by "retuning and retooling", to better deal with the uncertainties and complexities that affect project delivery (PMI, 2018, p10). However, more research is required to understand how this affects all phases of projects.

2.3.2.3 Lean Principle 5: the pursuit of perfection

Womack and Jones (1996) suggested that lean never stops in *aiming* for perfection. This vitally important fifth principle does not signify the *end* of a process, but the "continual process of applying the preceding four lean principles, reducing effort, time, space, cost, and mistakes while offering a product that is ever more *nearly* what the customer actually wants" (p5). In an interesting twist, the increased competitiveness of lean production had resulted in consumers doing increasing amounts of unpaid work on the behalf of providers, such as entering data into web-based order forms and tracking the progress of their own orders (Womack & Jones, 2005). Thus, lean consumption was born, based on an attempt to solve the consumer's emerging dilemma of more choices to make and products to manage with decreasing time and energy (*ibid*).

By optimising the process of consuming, integrating the values and needs of the consumer on a continual pull basis within the production and supply chains, the end-result is a win-win for all (Womack & Jones, 2005). It may never reach 100% perfection, but it still provides a solution to problems at the right time that is sustainable enough to provide acceptable levels of satisfaction, regardless of industry (*ibid*). Some suggest that the perfect situation will never arise, since there will always be some change introduced (environmental factors, competitors), thus rendering the situation imperfect (Teeuwen, 2018). However, the effort to pursue perfection, or continuous improvement as it is mostly known within project management, is often undertaken through kaizen.

Kaizen comprises two concepts, Kai (change) and Zen (for the better), as the cornerstone of lean (Liker, 2004). Also known as the small-step work improvement approach, Kaizen is composed of small improvements that are easily achieved, in an endless effort to ameliorate organisations (Tortorella et al, 2015). It has three main characteristics: process

orientation, small step improvements and people orientation (Berger, 1997). The standardisation of procedures on one hand enhances the responsibility of individuals, and, on the other hand, it enforces the learning mechanism through transmission and accumulation of experience from one individual to another, introducing discipline (Rossini et al, 2019). Kaizen has been used as a short-term process, as a stand-alone, distinct project mechanism, for example for specific team or task-related activity, as well as organisation-wide improvements (Van Aken et al, 2010) in repetitive environments such as manufacturing and production and, more recently, the service sector environment (Sundqvist & Backlund, 2014).

As projects and organisations realise the challenge of sustained best practice, continuous improvement has been explored as a method for the effective transfer of learning across organisational sites and across global environments (Danese et al, 2016). The challenge faced by project management, however, is the prevalence of behaviour which tends to prioritise project delivery-level improvement activities (Loo, 2002; Chronéer & Backlund, 2015) rather than at the organisational level (Müller et al, 2013). Continuous learning is regarded as the highest level of PM maturity (Yazici, 2009; Kwak et al, 2015) and the general desire to improve project management practice is acknowledged in the project management literature (Jacobsson & Söderholm, 2011). However, it is also recognised as being difficult to achieve (Scarbrough et al, 2004; Fernandes et al., 2014), especially in project-based organisations, which paradoxically resist change despite the need to improve (Brady & Maylor, 2010). This provides an opportunity for lean to emerge as an approach which can be integrated within project management practice at all life-cycle stages of projects within a multitude of organisations and environments.

2.3.3 The evolution of lean as a PM approach

The evolution of lean as a potential PM solution starts with an unwelcome contradiction. Lean is a philosophy "derived from a repetitive manufacturing context, that seeks to eradicate undesired waste and variation from the process", as noted by Holweg and Maylor (2018, p1373). Yet, projects are temporary operations (Sydow & Braun, 2017), which feature many unique processes and contain many complexities and uncertainties within and across the project and its environment, as outlined earlier. Söderlund and Maylor (2012) called for an integrated approach between lean thinking (Womack et al, 1990; Womack & Jones, 1996) and PM philosophies, systems and tools, This was suggested as a way to address and manage complexities especially in the instance of the delivery of major projects, which have a tendency for high failure rates, excess waste, and failure to learn and improve (Maylor et al, 2015; Holweg & Maylor, 2018). In terms of using lean terminology for projects, an initial focus was noted relating to measuring project success (de Wit, 1988; Pinto & Slevin, 1988) and moving towards evaluating success and benefits from a values-based organisational and systems perspective (Winter et al 2006; 2008; Artto et al, 2015). This took account of a wider array of stakeholders, including, but not limited to, project managers and their teams, customers, users and sponsors (Artto et al, 2015).

Instances of using lean as a PM approach in major (and other) projects have been cited to promote and enhance not only the final performance aspects of projects, but also to enhance the processes associated with defining and delivering major projects (*ibid*, p1369). The following sections further outline and discuss the introduction and experience

of lean in three different project-based industries: Construction, IT and Technology, and Health and Medicine.

2.4.3.1 Construction

Lean Construction (LC) has two aspects of focus that differentiate it from traditional project management in the pursuit of increased improvement and competitive advantage (Howell & Ballard, 1997). Firstly, the focus on waste reduction instead of improving efficiencies in conversion processes; and secondly, the management of flow within systems and processes along with the production process (Sage et al, 2012). As one of the first adopters of lean for projects, the Construction industry has already had some history of developing it for delivery phases of projects in the last 20 years.

The development of lean in Construction has no doubt been influenced by theories and concepts within production and manufacturing, and the work of Koskela (1992) challenged the industry to explore the possible adoption of techniques and concepts, by using projects as the fundamental system for designing and making things (Ballard & Howell, 2003). Lean provides an opportunity to potentially overcome communication difficulties by connecting planners and executers, aligning knowledge and understanding of the design scope, and enabling execution of activities at all supplier tiers (Ballard, 2017; Jünge et al, 2019).

The benefits of using LC are cited as higher-quality construction, greater customer satisfaction, greater productivity, improved safety, reduced project schedule, better risk management, greater profitability and reduced cost (Bernstein & Jones, 2013), as well as wider benefits such as social, economic and environmental improvements (Rosenbaum et al 2014). Therefore, it is not difficult to see why LC was recommended as an improvement approach for the UK Construction industry in the Egan Report (DTI, 1998),

despite critics at the time observing the human costs, in terms of long working hours, lack of worker autonomy and stress of work (Green, 1999).

That said, three characteristics differentiate the construction industry from the manufacturing industry: 1) unique projects, 2) complexity and 3) on-site production, making it difficult simply to transfer lean tools (Salem et al, 2006). Lean Construction has adapted, rather than trying to imitate, the typical Toyota production and manufacturing practices over the last 20 years (Ballard & Tommelein, 2011; Nesensohn et al, 2016). In particular, Construction products' "structures" are highly impacted by a variety of physical, environmental, social and aesthetic contexts, not least the impact of and on their locations; for example, they must be used where they are built: bridges, factories, highways and tunnels in particular (*ibid*). Construction – and, by default, the contributing processes and activities of engineering – work occurs at many stages through the life of the structure, and can include building, repair, maintenance, alteration, extension refurbishment, decommissioning and demolitions, all of which could be construction-led, but also led by or in collaboration with architecture and engineering (Pasquire, 2012).

The initial application of lean often focuses on value creation in the planning stages due to the high levels of uncertainty in design requirements (Jünge et al, 2019). However, since resource transformation occurs at the implementation (construction and production) phase, this lends itself well to a focus on process flow, waste reduction and elimination in order to achieve the value realised on behalf of the customer (Pasquire, 2012). This additionally affords an opportunity for suppliers to become involved through collaborative learning and continual improvement (Gibson, 2009). Lean Construction has been mainly characterised by the implementation of many lean tools and techniques, including, but not limited to, Just-In-Time, Total Quality Management,

Business Process Reengineering, Concurrent Engineering, Last Planner System®, Teamwork, and Value-Based Management (Marhani et al, 2013). This is summarised by the table below:

Table 2.2 Principles of lean thinking as applied to Construction and Engineering

Principles	Implementation
Waste reduction	Housekeeping JIT delivery Joint IT tools Pre-fabrication, modularisation
Process on focus	Last Planner System® Self-control Milestones and phase planning
Customer focus	Concurrent engineering Limited bid invitation
Continuous Improvement	Soft parameters in tendering/contractual process Long-term contracts Special Interest Groups Training & Education Suggestions, input from workers
Co-operative relationship	Collaborative tools, practices Broad partnering Incentive-driven Shared Gains/Pains mentality
Systems thinking	Coherent procurement decisions Large-scope contracting Balanced objectives

Source: adapted from Eriksson (2010)

Of these, the Last Planner System, or LPS® is perhaps the best known and most well documented as representing lean project management, and lean construction, in particular (Gao & Low, 2013). It is also cited as one of the most effective ways to increase efficiency in the construction industry (Aziz & Hafez, 2013), gaining popularity and notable adoption of its techniques in architecture, construction and engineering (Perez & Ghosh, 2018).

The creators define LPS® as a philosophy, rules, procedures, and a set of tools that shifts the focus of control from the workers to the flow of work that links them together, thus

proactively managing the production process (Ballard, 2000). The "Last Planner" is the person or group accountable for production unit control; that is, the completion of individual assignments at the operational level (Ballard, 1994; Ballard & Howell, 2003). LPS® focuses on reducing workflow uncertainty and unreliability following particular problems that had been encountered and thus designed in response to overturn the non-achievement of tasks due to lack of collaboration and involvement of stakeholders in the planning process (Daniel et al, 2017).

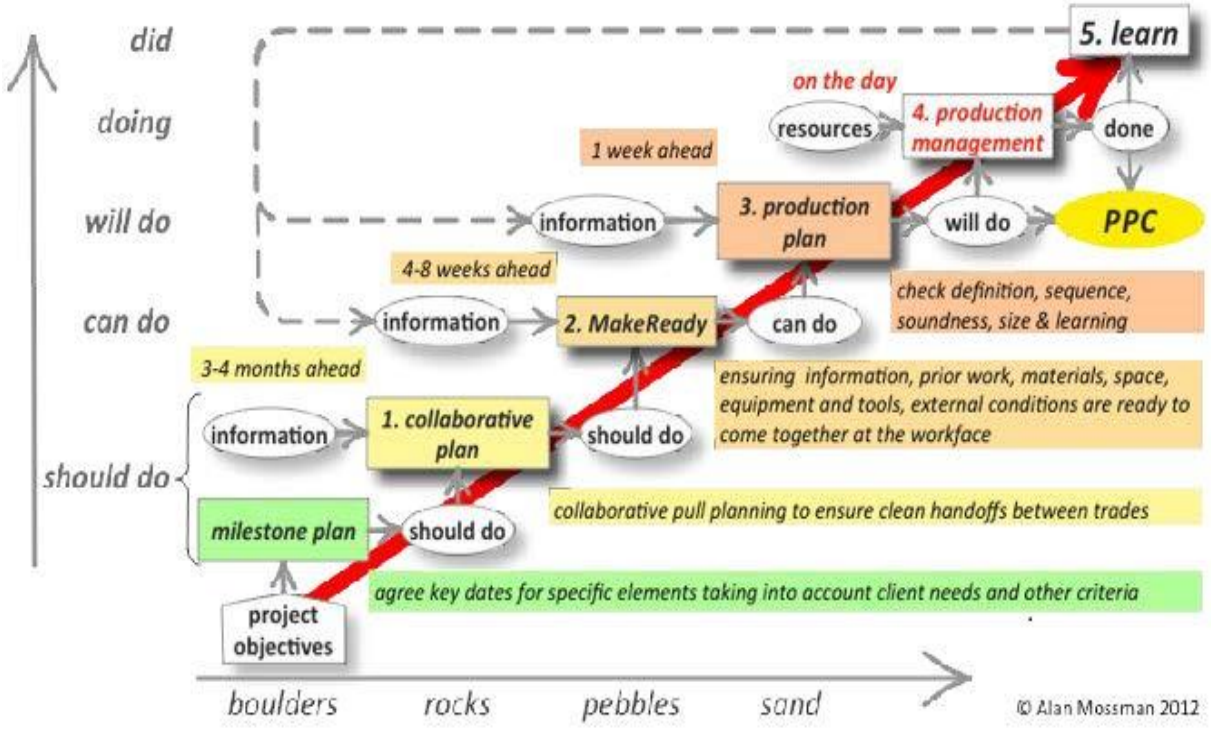
In contrast to traditional top-down project approaches where information is combined into a plan with cost, constructability, resource availability and responsibilities without consultation with contractors (Ghosh et al, 2017), LPS® encourages the social interactions, collaboration and commitment between stakeholders, linking logistics, and building assembly teams (Mossman, 2013). To improve the planning and predictability of increasingly rapid, complex and uncertain project delivery, key elements of the LPS® are described below and illustrated in Figure 2.3:

- Collaboratively creating and agreeing the production sequence (and compressing it if required) 1. Collaborative Plan
- Make-Ready: Making tasks ready so that they can be done when we want to do them 2. Make Ready
- Production Planning: Collaboratively agreeing production tasks for the next day or week 3. Production Plan
- Measurement of progress, recording and measuring progress, including non-completion 4. Production Management

- Continual Improvement: Learning about and improving the project, planning and production processes.

5. Learn

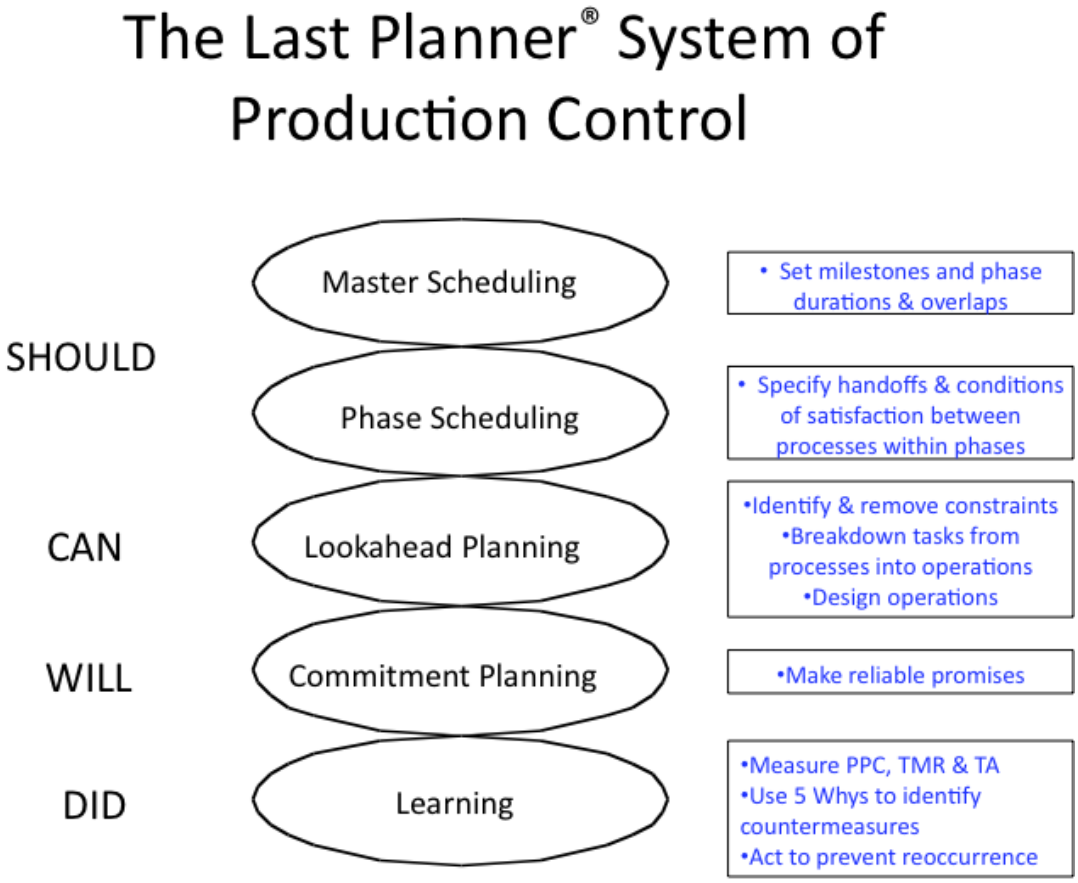
Figure 2.3 Key Elements of the Last Planner System



Source: Mossman (2013)

What connects these parts, is the ability of individuals to establish and sustain the relationship between the production and planning processes within the LPS®. Since all work gets done through language and in the way people speak, listen and collaborate with each other, reliable promises must be made that are "the result of the commitments made to each other out of respect for each other's concerns" (Ballard & Tommelein, 2016, p16). The diagram below shows the tasks and responsibilities that individuals have (boxes on the right) with the centrally featured production planning phases (middle) and the ideal outcomes (capitals on the left).

Figure 2.4 Last Planner System of Production Control



Source: Ballard and Tommelein (2016)

The effectiveness (or otherwise) of such promises is captured within the setting and review of 'percentage of promises completed' (PPC). Project studies by Koskenvesa and Koskela (2005) revealed increases in PPC from 47% to 80% on average after eight weeks of implementing LPS®. Similarly, in 2006, PPC averaged 60% after just six weeks of implementation and of that 70% of plan failures were the result of late, incomplete or defective materials or deliveries (Koskela & Ballard, 2006). Following analysis of the root causes of these failures and subsequent learning, PPC increased to 80% and the contractor completed the project with a 31% gross margin (*ibid*).

However, despite global adoption of the LPS® and reported improvements in project performance, specifically cost and duration, and the promotion of participation, transparency and teamwork elements in commitment (Formosa & Moura, 2009; Koskela et al, 2010; Priven & Sacks, 2013), barriers and constraints were also identified causing only partial implementation for new-adopters of LPS®. This includes the collaborative use of look-ahead planning, continuous improvement and root cause analysis (Perez & Ghosh, 2018). Experience in the Chinese construction industry suggests a reluctance to grant ownership of project planning to site supervisors despite their relatively high levels of commitment to project success (Gao & Low, 20114). Similarly, the concept of problem identification and sharing is not well understood and is often regarded as a sign of lack of respect for colleagues, rather than the joint responsibility LPS® aims for (*ibid*).

Critical success factors to effective implementation of LPS remain top management support, commitment to promises, involvement of all stakeholders, and communication and coordination between parties to achieve teamwork (Salem et al, 2005; Alarcon et al, 2008; Al Sehaimi et al, 2014; Dave et al, 2015). Ballard and Tommelein (2016, p7) strongly advocate and re-state the requirement for *holistic* implementation of LPS®, describing it as a system of interconnected parts and observing that "omission of a part destroys the system's ability to accomplish its functions". Choosing the right tool at the right time also appears to epitomise the concept of lean in Construction, which may improve performance while minimising waste as long as the stakeholders take responsibility for choosing the best approach of the key concepts.

2.3.3.2 IT and Technology

According to Feldman (2012), lean challenges project managers to think hard about the metrics that have traditionally been used. Results measurements in **IT systems PM** are a good example of such metrics – for example, users and usage statistics that increase as systems become entrenched are examples of 'vanity' metrics, which do not necessarily indicate success. A better metric would be answering the question, does the project fix the problem or create the business result that was originally intended? Are repeat customers using the new system? (*ibid*). Early and continual ongoing measurement of these metrics will indicate whether a project is failing or succeeding, challenging and potentially fixing issues for requirements as needed, rather than once the system is built and handed over. The ability and permission to fail – and fail fast – as part of the 'build-measure-learn loop' (*ibid*, p29) would reduce pressure on the organisation's finite financial resources and avoid costly re-configurations. Although development operations ('Dev Ops') seeks to overcome such pressures, through shorter and evolving iterative cycles connecting users and developers earlier on in the design process (Highsmith, 2009), it is not without its challenges, namely, delayed and extended waiting times for decisions (Holweg & Maylor, 2018).

2.3.3.3 Health and Medicine

The potential use of lean in **healthcare** first appeared in a work published by the NHS Modernisation Agency (2001). The Modernisation Agency was established in 2001 to coordinate improvement efforts in the NHS and has replaced the NHS Institute for Improvement and Innovation (III). This is a good example of the strategic decision to use project management, with its underlying lean principles, as an extension of ongoing

operations management. Additionally, the focus on improvement thinking, which, although it may have been designed for short-term use, could potentially become business as usual. However, transferring lean to healthcare has not been without its challenges, not least where the specification of value is multi-faceted and indeterminate, conceived variously by a wide range of customer and user perspectives (Burgess & Radnor, 2013). Early pockets of lean projects that are often cited include increased competence in value stream analysis, reducing duplication and errors in hospital patient pathways (Fillingham, 2007), and training schemes that introduced the Six Sigma Green Belt, to test its viability as well as to create capability for identifying institutional issues (Proudlove et al, 2008). An early innovative project to combine lean healthcare and computer simulation to reduce waiting lists in an audiology department is often cited as a particularly effective best practice which many have tried to replicate (de Souza et al, 2008). The same NHS trust undertook a one-week kaizen blitz that led to the implementation of new, more consistent schedule for clinics and better-organised consulting room and storage areas. These low-cost changes led to a 25% increase in capacity and persuaded funders to finance extra short-term capacity (de Souza, 2009).

However, whilst these early examples may not necessarily provide the solution to dealing with the intricacies of complexity within and across the project environment, they do at least point to the right direction due to the partnership established to solve patients' problems referred to by Womack and Jones (2005). Proudlove et al (2008) state that in hospitals there is still "a lot of undergrowth to clear"' and that "a deeper appreciation of lean may be necessary" (p33). The authors suggest, nevertheless, that considerable learning was obtained from the green belt initiative in terms of the strengths and challenges of applying the Six Sigma process improvement approach in the messy, complex environment of the NHS (*ibid*). Indeed, Shah and Ward (2007) stated that "lean

is an integrated socio-technical system and should be considered as a set of tools, techniques and practices combined with a cultural or social system" (p791), recognising the time it takes to change organisational principles and routines (Burgess & Radnor, 2013).

2.3.4 Lean Project Management – conceptualisation and definition

Criticisms of lean in general within the literature generally comprise two main elements: the lack of consistency and consensus in achieving a definition, despite its use as a worldwide management concept (Modig & Åhlström, 2017), and the application of the concept and the extension of its application, not least in non-automotive manufacturing settings. Such criticisms have relevance for project management because many of the principles, tools and techniques are assumed to simply transfer to project management, without understanding of their origin and challenges, as well as benefits.

Lean project management is not a new PM methodology (Saier, 2017), but is recognised as the pursuit of adding value for customers/clients and removing (project) waste through continuous improvement (Ballard & Howell, 1999, 2002; Jørgensen & Emmitt, 2009). Lean project management (LPM) necessarily focuses on delivery, improving communication between stakeholders, process design and eliminating waste (Ballard & Howell, 2003; Joosten et al, 2009). The alignment of values, concepts and criteria bridges the gap between project definition and lean design which lean project management facilitates. It achieves this through social interaction, and time taken to understand, develop and align production and process design at the level of function systems (Ballard & Howell, 2003, p121). It differs from traditional project management in that decisions are taken at the last responsible moment so that exploration and/or development of the best alternatives can be met (*ibid*).

Thus, the principles and mechanics of lean as outlined above rely on information and collaboration, visual techniques, sense-making and decisions based on human creativity and interpretation. Such reliance on organisation and 'housekeeping', and the application of human values to determine best practice (Hopp & Spearman, 2004), has led to difficulty in execution (Proudlove et al, 2008; Tan, 2011; Gao & Low, 2014; Amran et al, 2019) but also an interest in the further exploration and growth of lean project management. Practising lean within project management is generally defined in the literature as a system of production control, project delivery system (Howell, 2011), a conceptual model of the production process (Koskela et al 2002, Green & May 2005).

Seymour (2014) asserts that understanding the past history will help us to understand the future for project management (p238), but fails to acknowledge that a reconceptualisation of methods, processes and practices is required before effective adoption and adaptation (Uriarte et al, 2019). For example, Hopp and Spearman (2004) assert that many site-specific innovations are required to produce workable solutions, and this includes the limitation of JIT as an underpinning technique. Although the concepts of JIT, Kanban and Pull are simple to understand, a large array of adapted versions and techniques (Zipkin, 1991) have been used, adding to the many working descriptions and definitions of the concept. For example, Ohno (1988) and others (Schonberger, 1982, 1986; Mondon, 1983) outlined the general strategic elements and mechanics of such concepts, but Hopp and Spearman (2004) assert that this is too high level and strategic, whereas the focus at the time required more tactical and clean working definitions.

Similarly, despite attempts to integrate lean into healthcare, Radnor et al (2012), Poksinska et al (2016) and Matthias and Buckle, (2016) all report that the tool-based approach for short-term problem solving is still prevalent, and the lack of agreed definition of value on the part of professionals may lead to limited progress. Indeed, although the patient role in co-defining value remains overlooked (Poksinska et al, 2016, p101). Lindsay et al (2019) assert that focus on staff during lean implementation is still required in order to understand the challenges and the potential for sustaining effective lean practice. Similarly, if the underlying principles that facilitate implementation of lean and LPM are not well understood, there is less likelihood of LPM as a concept being integrated into usual patterns of work practice and behaviour (Saier, 2017). Saier (2017) further asserts that lean project management combines the incremental nature of learning for continual improvement, logic of standardisation and waste reduction, which has the potential to increase business and social impact (*ibid*)

Lean thinking principles are considered to have universal applicability across a wide range of project and environment settings (Sauser & Voss, 2001), as well as causing a lack of consideration of human aspects (Williams et al, 1992; Hines et al, 2004). This includes more worker injuries and poorer health (Lewchuck et al, 2001; Brenner et al 2004), a stifling of workers' creativity (Silverthorne, 2002; Chen et al, 2010), limitations on the ability of companies to achieve continuous improvement (Mehri, 2006) and actual ability to deal effectively with variability (Joosten et al, 2009). Longoni et al's (2013) research found workers' perceptions and understanding of the lean work environment appeared to influence subsequent lean behaviour. Their research additionally demonstrated that, "when lean is done right it need not be mean" (Longoni et al, 2013; p3314), and that lean should continue to be considered a best practice, not just for its potential to improve operational outcomes. But what is important is that the adoption of lean without the

human component is not only mean, it prevents positive operational outcomes as well (*ibid*).

Despite the lack of a commonly accepted definition, lean has nevertheless continued to be adopted and adapted in a variety of industries as a project delivery system, tool, method and an approach, and these terms are used interchangeably. What is clear is that lean shares many commonalities across industries in terms of its use as a production system (Ballard & Tommelein, 2012; Pasquire, 2012), strategic purpose (e.g. waste reduction, efficient scheduling), and a goal-oriented tactical method (e.g. through the many tools and methods it contains) (Bernstein & Jones, 2013).

The next section focuses on project learning within project and knowledge management and considers its purpose, challenges and opportunities.

2.4 Project Learning

This section will provide a critical evaluation and analysis of the concept of project learning literature, situating it within project management and knowledge management in general. The purpose of project learning is then considered with respect to the challenges and opportunities arising from contemporary project management, including its relationship with lean principles. Extant literature is also reviewed with respect to examples of lean project management and its important connection with learning within project environments.

2.4.1 Definitions and context of project learning

Project learning can be defined as "the set of actions the project teams used to create and share knowledge within and across projects" (Kotnour, 1999, p36). These actions do not exist in isolation and certain actors, mechanisms and environments will foster them, whereas others will hinder them.

"Lessons learned" is a well-established concept within project management that has been typically focused on knowledge capture and share from one project to another, as part of formal post-completion and project review mechanisms (Kransdorff, 1996; Kamara et al, 2002; Liebowitz & Megbolugbe, 2003; Rowe & Sikes, 2006; Jugdev, 2007; Williams, 2008; Jugdev, 2012). Knowledge gained during a project often comprises the documented information that reflects both the positive and negative experiences of the project. Project management has traditionally been viewed in terms of codified, tangible assets, and much of the project management literature has focused on this side of the project management body of knowledge (Ulri & Ulri, 2000; Kloppenborg & Opfer, 2002). However, the literature still appears to categorise knowledge and learning as a functional product or output of a project (Filstad, 2017), despite the argument that knowledge is shared through a process of transformation of diverse knowledge where co-creation of common grounds and understanding occurs, which leads to new practices (Bechky, 2003).

Williams (2008) states that the social process of storytelling and recording is also an effective way to explore project issues, capturing their complexity and behaviours outside organisational norms. Goffin and Koners (2011) noted that stories are often used in project lessons learned reviews to explain problem solving, product specifications and budget. This type of informal learning is not new and has been in practice for as long as

people have been learning and sharing experiences in order to increase expertise (Groff, 2013; Lawless, 2014). Informal learning can be learning from experience that takes place outside formally structured, institutionally sponsored, classroom-based activities (Macià & García, 2016). In 2016 a review of informal learning found that online networks and communities are an effective method of professional development (*ibid*).

Despite such informal and less-structured forms which can also happen at any time-point (PMI, 2010), lessons learned remains narrowly defined and descriptive (Jugdev, 2012). To understand how project learning supports effective project management, it is necessary to understand its meaning and purpose within knowledge management, as outlined below.

2.4.2 Project learning in relation to knowledge management

Knowledge management (KM) concerns itself with the complex process of capturing, developing, sharing and effectively using organisational knowledge (Pedler et al, 1997) through a multi-disciplinary approach to achieving organisational objectives by making best use of knowledge (O'Keeffe, 2002). Tacit knowledge is the most valuable source of knowledge and the one which poses the greatest management challenge since it is hard to communicate and deeply rooted in action, commitment and involvement (Nonaka, 1994). Explicit knowledge is found in databases, memos, notes, documents (Botha et al. 2008) and requires a variety of systems and environments and processes in order for it become tacit (Frost, 2014). Although most attention in the literature tends to focus on the distinction and challenges between tacit and explicit knowledge, it is important to also include the notion of embedded knowledge. This refers to knowledge that is locked in rules, processes, manuals, organisational culture, codes of conduct,

ethics, products, routines, artefacts or structures (Gamble & Blackwell, 2001). Embedded knowledge emphasises the link between knowing and action (Paraponaris, 2003).

All knowledge is inherently social and cultural, and organisational knowledge can only be realised through change in organisational activity and practice (Metaxiotis et al, 2005). Bettis and Hitt (1995) suggest that rapid creation and efficient management of knowledge is critical to success and facilitates the notion of knowledge conversion. Since knowledge capital is considered to be the most significant driver that dictates an organisation's processes and performance (Dunford, 2000; Ditillo, 2004), this requires organisations to create knowledge by tackling problems and learning from experience (Rose et al, 2014). This includes ensuring that people have access to what they need; that important explicit knowledge is stored, reviewed, updated or discarded in a timely manner (Frost, 2014). Tacit knowledge is considered most likely to lead to breakthroughs in the organisation (Wellman, 2009) and the lack of focus on tacit knowledge can be attributable to the reduced capability for innovation and sustained competitiveness (Gamble & Blackwell, 2001).

Nonaka et al's (1994, 2000) dynamic knowledge spiral conversion illustrates that knowledge can be converted from, between and across tacit and explicit domains through shared experiences, information processing, learning by doing and meaningful dialogue (Nonaka et al, 1994; Nonaka et al, 2000). However, a focus on the socialisation aspects that have involved knowledge sharing through shared experiences in the same physical space, people working towards the same goal and striving to understand what others are doing (Jugdev, 2007), limits the ability of any new knowledge that has been internalised (for an individual) to become codified knowledge, for others to capture and integrate (*ibid*). Indeed, Gray (2007) asserts that any knowledge acquisition that aims to

promote and facilitate behavioural changes requires reflection, and that reflective practice requires creating awareness and understanding to improve a certain practice (Mahani & Molki, 2012). Tran and Anvari's (2014) Five-Dimensional reflective cycle framework is helpful in understanding the process which requires individuals to effect positive behaviour change, for example improvement in problem-solving skills. Consistent messages throughout the literature include reflecting on action (Schön, 1983) and forward planning (Cowan, 2014) to transform and enhance participants' abilities to make meaning of change and build capability.

In summary, knowledge and learning cut across and between projects and organisations. However, it is the interrelated process and action of transferring knowledge into a business's service/product offering that helps us to understand how knowledge management can support effective project management and wider organisational development thinking against the backdrop of sustainability (Hind et al 2013). Since learning is the process by which the required knowledge becomes known, thus, any learning approaches that can help to facilitate and support an enduring change in behaviour that goes beyond the traditional learning curve (Marquadt & Waddill, 2004) are worthy of exploration.

2.4.3 Theoretical insights to understanding project learning within project management

In order to characterise project learning and to understand its potential relationship to lean project management, the following section draws on theoretical insights from situated learning, practice theory and engaged scholarship. These are highly relevant for the study and practice of project management, and relevant examples are drawn to illustrate the appropriateness of this theoretical approach.

2.4.3.1 Situated learning

Situated learning enables learning by individuals trying to solve problems within communities of practice (CoP), as outlined by Lave and Wenger (1991). Three fundamental elements of 'Domain', 'Practice' and 'Community' facilitate the bringing together of the individual, the subject area and the organisation, through a common practice of learning. The occurrence of situation, location and nature of legitimisation of these important elements and the ways in which social learning also took place were important factors that led to the creation of CoP as a concept for learning theory initially. The concept of CoP in the early 1990s was able to describe the social learning that could also arise spontaneously as part of membership and participation. Many questions were raised about the position, power and identity of individuals as participants (Bechky, 2003), and over time it was organisations themselves who became more interested by the participants' use of learning and knowledge rather than how it was acquired (Probst & Borzillo, 2008). Morke et al (2008) noticed that existing CoPs proved valuable in capturing tacit, context-based experiences which could then be translated through organisation-controlled measures rather than the learner-controlled measures cited in other works (Davenport & Prusak, 2000; Wenger & Snyder, 2000; Hildreth & Kimble, 2002). Thus, the concept of CoP shifted from an individual-led action learning activity to a potential knowledge management tool that could be actively fostered as an important organisational asset in order to improve business performance (Cox, 2005). This led to a reconceptualisation which focused attention on mutual engagement, joint enterprise and shared repertoire as new essential interrelated terms (Wenger, 1998; Wenger et al, 2002). This reconceptualisation highlighted essential elements of the benefits as well as the challenges of operating within multiple communities of practice. For example, there is an emphasis on the individual learner taking responsibility for self-directed learning and

the notion of "competency" which contributes to the organisation's capability in demonstrating application of knowledge into skill and practical action (Duguid, 2005).

Lesser and Storck (2001) believed that the reconceptualisation of CoP could lead to a positive effect on the following areas:

- Decreasing the learning curve of new employees
- Responding more rapidly to customer needs and enquiries
- Reducing re-work/preventing re-invention of the wheel
- Spawning new ideas for products and services.

Multi-disciplinary and inter-professional project settings provide an added opportunity for the creation of not one, but many communities of practice where social relationships prevail. In such circumstances, the challenge is to work out how social practices are organised and to find ways of aligning them (Brown & Duguid, 2001). This includes groups that are temporally, spatially and culturally differentiated and additionally influence the diffusion of knowledge despite the development of well-established communities of practice (Bresnen et al, 2003).

Collaboration is the process of interacting with others where individuals are responsible for their actions, including learning, and is considered an equally promising but also risky mode of human engagement (Laa & Ghodsi, 2012; Pearce & Pons, 2013). In these environments, the value of knowledge sharing itself can be as important, if not more so, than the finite end product of the created knowledge (Massingham, 2020). As such collaborations is an effective ally for lean project management and project learning where individuals working collectively may be an efficient and effective conduit of

information and experience (Seely Brown & Duguid, 1991). Wenger argues that the applicability and adaptability of CoP into a range of different learning landscapes, whether for the purposes of organisations and/or individuals, shows that it can be flexible and suitably adapted if that is what the community in question requires (Wenger, 1998, 2013; Wenger et al, 2002). This is supported by Bresnen et al (2014), whose comprehensive study of the use of management knowledge across healthcare communities of practice in the UK reiterated the value of social capital and the role that CoPs play in knowledge mobilisation and utilisation. However, complexity and diversity in specific organisational environments inevitably create limitations, such as fewer opportunities to access potentially valuable knowledge and support, "reinforcing any reliance on local and experiential knowledge, adding to any inward-looking tendencies" (Bresnen et al 2014, p102). Lee-Kelley and Turner's (2017) study of project communities of practice confirms the importance of interaction for situated and distance learning (Gruber et al, 1996; Bosch-Sijtseman & Henrickson, 2014) over managerial process for knowledge transfer, but it has also been observed that the types of interactions tend to be more goal-oriented, solutions-focused and transactive (Lee-Kelley, 2018).

2.4.3.2 Practice theory

Project managers may use tools and practices from different management disciplines, but the development of the field of project management justifies research that focuses on the specificity of their practice (Besner & Hobbs, 2013). In their 2013 study, Besner and Hobb revealed that it was nearly impossible to identify which practices would have the most impact on performance but suggested that the reality of practice should be investigated empirically. They concluded that project management practices should be adapted in the same way that project management tools have been adapted and skills

developed in their use – skills that can be documented, learned and transferred in order to configure project management practices as strategic assets.

The research is guided by the concept of practice theory to examine the ways in which individuals (or classes of individuals) inhabit a position, invoking practical knowledge, which enables them to function in particular situations (Bourdieu, 1977, 1998, 2000; Feldman & Orlikowski, 2011). Such a lens affords the opportunity to analyse social, technological and organisational phenomena (Feldman & Orlikowski, 2011), as well as considering the conceptual meaning of the practice(s) under investigation (Giddens, 1984). Using practice helps scholars to make sense of and characterise the interactions between social actors (Goffman, 1959), and the acquisition and application of rules (Garfinkel, 1967). According to Bourdieu (2000), the "repertoires" that social actors develop – the perception, appreciation and action – enable them to function on a day-to-day basis in a unified way that makes sense to and coheres those engaged in the accomplishment of particular practices in situ. Similarly, the process and action of learning within projects can be considered as a specific dynamic social practice (Jarzabkowski et al, 2012). Baxter and Chua (2008) suggest that this practical knowledge is something that can only be understood from a study of action, that practical knowledge has a "logic" that develops out of the situation from which it emerges. The logic of practice is internalised as second nature but must be re-examined in order to improve it (Bourdieu, 1990, 2000).

Practice theory within project management can be situated empirically and theoretically in the way in which is focuses on understanding the relationships and relations between actions people take and the realities of their organisational (social) lives (Feldman & Orlikowski, 2011). This responds rather than reacts to earlier concerns

relating to human actions and capacity to share knowledge and undertake lean processes (Weick, 1995; Green, 1999, 2002; Hopp & Spearman, 2004). The theoretical contribution practice theory can make is concerned with articulation and explanation of the dynamics of daily lived actuality, according to Feldman and Orlikowski (2011). By focusing on the way in which daily practices and processes are generated and how they may operate in different contexts, it is possible to observe the journey that practice involves, from production to outcome, re-generation and change *(ibid)*. This draws on the earlier works of Bourdieu (1977, 1990), Giddens (1976, 1979, 1984) and Garfinkel (1967) as well as more contemporary approaches including Lave (1988) in the way in which practices are perceived as fundamental to the production of social reality, especially where learning and knowledge are specific outcomes (Feldman & Orlikowski, 2011). The social constructivist nature of practice theory recognises the philosophy or ontology that practice is consequential to activity that can be influenced by both humans and structures (Schatzki, 2001, 2002). Indeed, the use of practice theory within project management is helpful in conceptualising the activities, the mechanisms and processes, which are required to successfully deliver projects or 'collective organisational outputs' (Orlikowski, 1996; Faraj & Sproull, 2000). Practice theory is especially pertinent within multi-disciplinary project environments, where there is a tension between those co-ordinating mechanisms and processes and those responsible for enacting them (Jarzabkowski et al, 2012). Multiple definitions and conceptualisations of practice and underlying philosophies cause further tension and uncertainty across members of the same organisation before, during and after attempts to enact any practice take place *(ibid)*. Therefore, a practice theory perspective can help scholars to understand the processes through which practice occurs through examination of the nature of practice interaction. This interplay between characteristics of practice and the enactment of practice by

practitioners themselves enables deeper sense-making and may offer new insights into established situations or problems (Feldman & Orlikowski, 2011). This includes attention on the complexities brought about by recurrent and concurrent problem solving (Okhuysen & Bechky, 2009), which is often the initial driver for the examination of practice in the first place. Focusing on the processual approach and interactions of the practice rather than specifically on the outcomes that practices are often intended to produce shifts attention to much earlier in the process (Jarzabkowski et al, 2012). The authors maintain that the resulting outcomes lead to more robust and valid foundations of knowledge because the "knowledgeability" (Giddens, 1984; Lave, 1988; Bourdieu, 1990) has been produced by ongoing, dynamic and recurrent enactment (Feldman & Orlikowski, 2011; Jarzabkowski et al, 2012). Finally, using practice theory as a theoretical lens to examine the socially constructed reality of LPM practice shines a light on the phenomenon of LPM and supports the principle that social actions are consequential, interdependent and grounded in human agency (Feldman & Orlikowski, 2011).

2.4.3.3 Engaged scholarship

Engaged scholarship considers "the advice and perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) to understand a complex problem or phenomenon" (Van de Ven, 2018, p37). Practitioners face phenomena in their everyday activities and possess knowledge that lies 'in the action'. Hence, they can provide rich insights, features and dimensions regarding how phenomena evolve and explain their underlying characteristics (Schön, 1983; McKelvey, 2006; Van de Ven & Johnson, 2006). Grisold et al (2020) suggest that this is not to say that practitioners' insights provide a holistic understanding but could elucidate any new aspects of the concept under investigation. Others argue that the combination of theoretical and practical knowledge "is more penetrating and insightful than knowledge produced when scholars

or practitioners work on a problem alone" (Van de Ven & Johnson, 2006, p817). A behavioural perspective focuses on the entrenched behaviours and actions of individuals and organisations, often gained through experiential means (Becker, 2017).

Whilst experiences can help build organisational knowledge and embed routines, they may also serve as a barrier to unlearning (Easterby-Smith & Lyles, 2011). From a social and behavioural perspective, the authors suggest that (new) capabilities, practices and routines may be forged, based on collective learning and sense-making (*ibid*). Sense-making is the process through which individuals work to understand novel, unexpected or confusing events (Dyer, 2016) or experiences. In other words, the process of sense-making is the practice of working out what meanings people are attributing to their experiences. Sense-making gives a clear idea as to what the prevailing beliefs, thinking and actions are likely to be of those individuals and groups. Additionally, sense-making research methods enable organisations to see areas of agreement and conflict, especially at a cultural level.

Conversation offers the opportunity for reflection, coupled with meaning-making about experiences that improve the effectiveness of experiential learning within the project team (Kolb & Kolb, 2009). Thus, projects are ideal mediums to enable this kind of sense-making since knowledge is gained through transformation of experience to create knowledge (Love et al, 2015). Project learning entails learning gained from performing the project, stimulating further on-the-job learning, developing competency (Yap & Skitmore, 2020).

2.4.4 Critical review of project learning

Several authors have maintained that, where project learning has taken place, it generally fails to deliver the intended results of learning and does not generate the required improvements for future project and organisational use (Schindler & Eppler, 2003; Atkinson et al, 2006; Williams, 2008; Kerzner, 2009; Klakegg et al, 2010; Milton, 2010; Williams et al, 2012; Duffield & Whitty, 2015, 2016). Apart from a few notable exceptions reported by scholars (Fernie et al 2003; Green, 2005; Mathur et al, 2007), these processes have largely ignored the tacit "know-how" knowledge, deemed important in value creation and appropriation (Barney, 1991, 2002). Indeed, it has been reported that up to 90% of the value from knowledge is contained in the unexpressed experiences, social processes or tacit knowledge of the project contributors and stakeholders (Smith, 2001). Despite a growing number of models, approaches, guides and opinions on how to apply project learning (Reason, 1997, 2000; Hayes, 2009; Hayes & Maslen, 2014), limited incremental improvement data exists in industries such as healthcare, nuclear power, rail and aviation (Duffield & Whitty, 2016). Practitioners continue to struggle to mine, use and benefit from the rich vein of value held in the lessons learned from projects (Gao, 2002; Williams, 2004, 2007, 2008; Fuller, 2011; Butler, 2012).

Lindner and Wald (2011) suggest that the failure to disseminate and apply lessons learned from projects has created the need for more research in understanding the role that knowledge management can play within the PM discipline. This must extend beyond identification of learning (Anbari et al, 2008; Bakker et al, 2011) but should reflect appropriate methods of learning, format and process of the information or lessons being transmitted (Blackman & Henderson, 2001; Disterer, 2002). Knowledge about lessons learned becomes 'buried' in project files which are not easily accessible (Schindler and Eppler, 2003; Carrillo et al,2011), and lessons learned were the least popular and useful

methods for both tacit and explicit knowledge sharing in Carillo et al's (2014) study into lessons learned practice in the construction industry. Researchers report instances where lessons were learned from small incremental "wins" following successful implementation of lean practice (Hines et al, 2008; Kundu & Manohar, 2015; Antony et al, 2017), with a view to building staff commitment and momentum (Womack, 2007; Hines et al, 2008). However these wins were short-lived, often due to the staged timing of lean interventions that were only appropriate at specific points in time (Pearce & Pons, 2013) but also due to the high turnover of staffing, especially in IT and Construction projects, where knowledge and skills are considered to be at an all-time low (Saini et al, 2017; Rashid et al, 2019).

This is a view supported by Jugdev (2012), who recommends that project management practitioners and scholars need to undertake more organic, fluid and informal learning mechanisms, thus viewing learning as a process as well as output-based activity. Projects are multi-level phenomena which create a level of obligation and determination of the type of knowledge shared that the individual must necessarily control and not the organisation (Swart et al, 2014). The greatest challenges in handling types of knowledge within project management are the cultural norms at play which can foster or hinder motivation to share knowledge and learning (March, 1988; O'Dell & Grayson, 1998; Williams, 2007, 2008; Sense & Badham, 2008). The unpredictability of human behaviour is an essential element of project management (Kreiner, 1992), which some argue impacts on the ability (or inability) of the organisation to integrate and improve the knowledge-sharing processes and outcomes (Bechky, 2006; Ivory et al, 2007; Kim & Wilemon, 2007). This relates to individuals where motivations to share knowledge may be variable (Ardichvilli et al, 2003) as well as attempts by organisations to formally manage, control or cultivate the process and/or practice of knowledge sharing (Kislov et al, 2012), which

potentially results in knowledge loss. This can be demonstrated in part by employees moving to competitor organisations, as their perception of their individual knowledge may be valued more highly within the industry rather than the organisation (Swart et al, 2014). To improve lessons learned practice in Construction project environments, Carillo et al's (2014) research found that inadequate communication and dissemination was a major factor, even when there were formal structures and processes already in place to widen access to lessons learned.

Gardiner and Eltigani (2014) suggest that there remain fundamental issues within projects that inhibit learning, driven by their temporality and fundamental complexity (Brusoni et al, 1998; Lindkvist et al, 1998; Principe & Tell, 2001; Williams, 2008). One such issue is the dominant logic in this field, which is structured planning to achieve workable projects on time (Dreyer et al, 2020). This pressure is often heightened by the lack of availability of, or timeliness of knowledge experts which can also have an adverse impact on project learning (Yap & Lock, 2017).

PMBOK acknowledges that effective management of project knowledge is vital for continuous learning and exploiting the value-addedness of lessons learned (PMI, 2017). Yet, there is also a growing realisation that project management excellence lies beyond the espoused bodies of explicit knowledge produced and managed by the PMI, APM and IPMA, among others, and the predominantly **"know-what"** knowledge domains they represent. A consideration of the tacit or "know-how" knowledge as part of its value-added processes is long overdue (Gardiner & Eltigani, 2014). It is posited that effective communication coupled with experiential knowledge can lead to improved decision-making, thus acquiring the wisdom from the "know-what", "know-how" and "know-why"

domains (Corallo et al, 2009; Hussain et al, 2015). This can significantly increase the likelihood of project success (Pawar & Sharifi, 2002; Yeh, 2008; Lindhard & Larsen 2016).

2.5 How can lean principles contribute to project learning?

According to Ballé (2012), lean is a learning system, not a management method. This echoes the lean thinking of Sakichi Toyoda (the founder of Toyota Industries Co. Ltd.), who exhibited a keen desire to learn from the outset, with knowledge, learning, improvement and growth emerging as the prevalent themes of Toyota's alternative approach to business (Powell & Coughlan, 2020).

Formal training and learning is the first step in the learning process that can create knowledge, but the principles of continuous improvement (CI) build and develop new knowledge in an incremental manner, and provide a systematic form of improvement that goes beyond learning (Sacks et al, 2010). This additionally moves beyond compliance with processes and procedures, generating improvements which affect the whole system or operation (Sacks et al, 2010; Brodetskaia et al, 2013; Salem, 2016).

Respect for people is without doubt a founding principle of lean as part of the Toyota Production System (Ohno, 1988; Womack & Jones, 1993, 2006; Liker, 2004). Indeed, Liker (2004) suggested that the best way to do this was to "grow leaders who understand the work, live the philosophy, teach it to others, develop exceptional people and teams, and respect extended partners by challenging them and helping them to improve." (pp169-199). This respect for people can be achieved by focusing on the collaborative aspects of lean as part of a learning system (Pasquire, 2012). Indeed, one of the most heavily criticised aspects of traditional PM is the way in which its silo mentality hinders people in effectively collaborating and working together (Biton & Howell, 2013). Sustained efforts have been made to build a lean culture that cuts across projects; a good example of

this is Lean Construction, where lean education is contextualised across the business environment, creating a critical mass of stakeholders who understand lean principles (Hacker et al, 2017). Because training is interactive and often provided to a range of functional groups and levels, this allows people to be heard and engenders respect (*ibid*).

In healthcare, lean implementation through **collaborative planning** is often considered for short-term projects such as enhancing (visual) communication systems for patient waiting times (Merlino et al, 2014) and financial forecasting for budgeting (Toussaint, 2015), where quantitative and qualitative measurable improvements can be easily seen (Ballé & Régnier, 2007). Studies have shown that, in line with the criticisms outlined earlier, collaborative problem solving can also engender a lack of respect, typically seen in longer-term healthcare delivery projects that involve the customer experience as well as clinicians' knowledge (Ballé & Régnier, 2007) where lines of social power are often ignored (Joosten et al, 2009; D'Andreamatteo et al, 2015). Scholars have claimed that implementing "soft" lean practices allows people to experience lean and acts as a vehicle for the cultural shift of the whole organisation (Mann, 2005; Wincel & Kull, 2013). Indeed, research by Bortolotti et al (2015) found that manufacturing projects that extensively adopted "soft" lean practices concerning people and relations, small group problem solving, employee training to perform multiple tasks, supplier partnerships, customer involvement, and continuous improvement, resulted in higher-performing plants. Many firms focus on implementing lean tools and techniques through "hard" practices but pay little attention to human-related "soft" practices (Hines et al, 2004; Liker and Rother, 2011), which paradoxically, misses the fundamental and unchanged lean concept of respect for people before systems (Womack & Jones, 2016).

The **focus on application of lean tools** for process excellence for short-term gain has been found to cause problems in the longer term. The plethora of available lean tools means that different (and combinations of) tools may be appropriate for different project situations (Pearce & Pons, 2013). A fixation on tools can also be caused by a conflict between the lean principles of pull and flow, especially in manufacturing environments where production strategies rely on complex interrelated hybrid systems (Pons, 2010; Bertolini et al, 2013).

According to McIver et al (2013), the highly specialised nature of projects and organisations requires action-oriented knowledge management activities to underpin and stimulate the creative activities that are needed to work collaboratively. Jugdev and Wishart's (2014) research suggested that sharing and learning about project management practices requires a **processual approach** to improving tacit knowledge sharing for the purposes of competitive advantage.

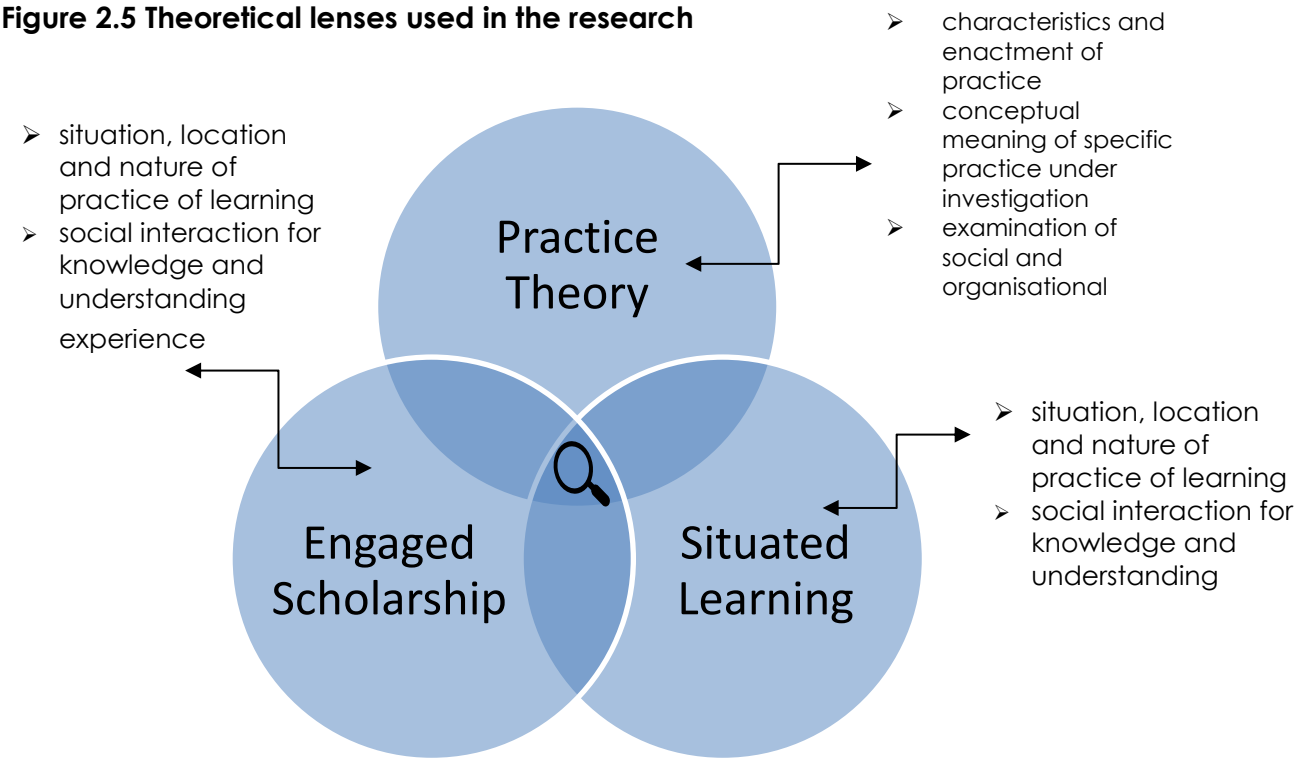
Research has proposed that lean tools unintentionally facilitate knowledge creation (Zhang & Cheng, 2016) and that decision-making in supply chains can be supported by a knowledge management (KM) framework (Liu et al, 2013). Thus, although there is some (limited) evidence to suggest potential synergies between lean and learning within project management, the literature also suggests that as many challenges exist, particularly in the social and behavioural processes that are necessary for effective learning at project level. This provides an opportunity for the research to investigate what and how lean project management could facilitate learning, and to discover if a – and what kind of – relationship exists between the concept of LPM and the requirement for learning.

2.6 Summary of Chapter

Examples in the literature report instances where projects to implement lean have been instigated and evaluated, for short- and long-term use. Learning mechanisms, models, tools and techniques have been studied that have generated the desired improvements to a varying degree of success, using both traditional and lean methods for project learning. The literature investigating the experience and effect of practice-based initiatives for professionals is also limited, but, where it does exist, a more positive trajectory can be seen in terms of facilitating desired change (Kasasbeh et al, 2016). The most recent research into lessons learned within project management, as outlined above, suggests that, whilst the practice and process of lessons learned within project management remain valid and valued (APM 2012; PMI, 2013), further development is still required (Duffield & Whitty, 2015; McClory et al, 2017). McClory et al (2017) reported that learning can be demonstrated by a change in behaviour due to experience. Their triple-loop project learning framework has further amplified the importance of learning within project management but still requires significant development within the PM industry before reaching levels of maturity (*ibid*). Similarly, others (Geraldi & Söderlund, 201; Holweg & Maylor, 2018; Maylor et al, 2018) have suggested that project-based organisations struggle with a number of challenges which are associated with the problems of coordinating across a landscape of projects, of learning across projects and of mastering innovation, to name but a few. Indeed, Maylor et al (2018) suggest that "the classic tension between efficiency and effectiveness has wide ranging implications on new forms of organising projects, on new kinds of projects being implemented, as well as new approaches to managing projects" (p1285). Whilst complexity and agreed performance indicators remain a challenge to the stability and structure of project working, lean project management creates an opportunity to promote learning and

collaboration. Interestingly, much evidence exists around the importance and principles of lean as both a driver for project management and as a strategic capability for industry (Gosling et al, 2019). Many recommendations, tools and techniques can be found that raise the profile of learning and knowledge (McClory et al, 2017) and imply change (Milton, 2011), but lessons are only truly learned (and evidenced) by a gradual adaptation to those changes brought about by learning (Aerts et al, 2017). Project management has long struggled with the balance between exploration and exploitation, between unification and focus and pluralism, diversity and openness, between the search for new topics and methods, and the capitalisation and improvement of existing knowledge (Söderlund, 2011). Lean Project Management occupies a unique position in that it makes sense of, interacts with, responds to and often shapes the very systems and processes that are part of this balancing act. LPM utilises situation-specific, socio-cultural and discursive processes which may enable diversity, uncertainty and continuous change to thrive within projects and organisational environments. In the research, lean project management combines the activity of the practice (the engagement of actors), as well as the development of the practice itself through project learning (MacIntyre, 2007; Jarzabkowski & Seidl, 2008). Exploring the relationship between Lean Project Management and Project Learning through these three theoretical lenses enables deeper, context-based examination, and provides an opportunity to understand the utility and impact of lean project management. This is outlined in Figure 2.5 below.

Figure 2.5 Theoretical lenses used in the research



A pluralistic approach combines the theories of situated learning, practice theory and engaged scholarship which can be achieved by exploring the actuality of the practice and process of implementation of lean project management within situated contexts of project management, as denoted by the magnifying glass in the confluence of the figure above. Examining the practice of lean project management could additionally give practitioners the space and time to establish and sustain collaborative, mutually beneficial working relationships in such a VUCA world. Such a relationship that is underpinned by lean principles of continuous improvement, learning from experience and collaboration, may help scholars and practitioners alike to better understand characteristics and mechanisms of the implementation of the LPM approach. By exploring the existence and nature of any relationship between LPM and project learning, the research has the potential to create a positive and sustainable impact which individual practitioners can both contribute to and benefit from in projects.

3. Research Methodology

The literature review presented a critical review of available literature to enable the research question to be answered. The literature review explored extant literature across a range of discipline areas and contextual environments within which projects operate. Following this, the research methodology chapter provides a deeper understanding of how and why the research is best undertaken through exploration and discussion of appropriate philosophical and methodological considerations (Clough & Nutbrown, 2002; Saunders, 2019). This additionally informs the research design and creates a guide for the implementation of the research to be explained in Chapter 4.

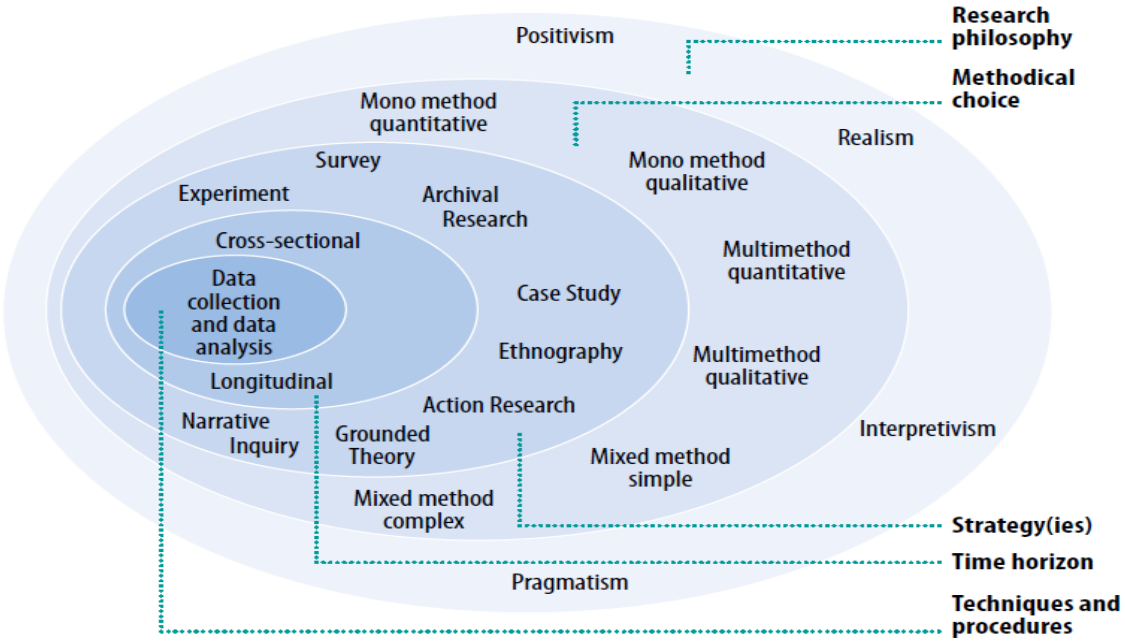
3.1 Introduction to research methodology

It is important to understand the relationship between theory and research, as the terminology occurs throughout the body of this work. Theory is "a formal, logical explanation of some events that includes predictions of how things relate to one another" (Zikmund, 2010, p39). Theories and concepts can also develop from research, depending on the type of data collected, principles, methodologies and methods employed (Koskela, 1996). A purely theoretical approach to research which is undertaken through secondary data only, uses the works of others and draws on the researcher's own conclusions and may be subjected to the researcher's own philosophical assumptions (Crotty, 1998; Remenyi et al, 2003). Similarly, an empirical research study using primary data collected and analysed by the researcher to draw conclusions will still be affected by the researcher's own view of the world (Saunders et al, 2012). Both types of research nevertheless still employ and engage theory, albeit

for different reasons, and still aim to increase knowledge or understanding of the subject being studied (Crotty, 1998; Saunders et al, 2019).

According to Creswell (2009), a theory might appear in a research study as an argument, a discussion or a rationale, and it helps to explain (or predict) phenomena that occur in the world (p51). A further distinction of theory results in **descriptive-driven** research, which may be chosen to explain a concept, or **prescriptive-based** research, which could be used as an instrument for a solution-based research enquiry, both of which are prevalent in organisational and management research (van Aken, 2004). The theoretical perspective is the philosophical stance informing the methodology and thus providing a context for the process and grounding its logic and criteria. Crotty (1998) recommends understanding the underlying philosophies at work in order to avoid confusion when discussing theoretical debates and approaches to social phenomena. Dainty (2008) additionally suggests that "research methods cannot be viewed in isolation from the ontological and epistemological position adopted by the research" (p3). Therefore, it is worth identifying and exploring the underlying theories, assumptions and philosophies of the research process in order to be able to understand and justify why an approach was chosen to undertake the research at hand (Saunders et al, 2019). As a first step, the research onion framework (*ibid*) was used to guide the planning and execution of the research, as illustrated in Figure 3.1.

Figure 3.1: The Research Onion Framework



Source: Saunders et al (2019)

The layered approach is helpful to the researcher in considering not only several elements for inclusion into the research process, but also how they relate to each other (Saunders & Tosey, 2012). Starting with the outer layer, the researcher must undertake an explicit and detailed consideration of the different research philosophies, and progress through to subsequent layers of the onion, to determine methodological choice, research strategies, time horizon considerations, and, lastly, research design elements including techniques and tools for data collection and analysis (*ibid.*). Its usefulness lies in its adaptability for almost any type of research methodology and it can be used in a variety of contexts (Bryman, 2016). However, to answer the research question(s), it is vital to demonstrate deep consideration of the elements related to research design, and to show the ability to reflect upon research philosophy and approach to theory (Eisenhardt, 1989; Easterby-Smith et al, 2018). This initial, reflexive questioning at every stage of the framing process underpins and

influences the research study (Neumann, 2011; Saunders et al, 2019). If research is to have real, practical value, be considered relevant and potentially applicable for academic and practitioner use, an appropriate research methodology must be implemented within the context of paradigm(s) (Wahyuni, 2012).

3.2 Research philosophy

Philosophy is defined generally as the study of the fundamental nature of knowledge, reality and existence, especially when considered as an academic discipline (Oxford Dictionary, 2020). Saunders and Tosey (2012) define research philosophy as the way in which the researcher views the world, and the researcher's own taken-for-granted assumptions about what constitutes acceptable human knowledge, the nature of realities encountered and the process by which this is developed (p58). This is also known as the research **paradigm**: a basic set of beliefs that guide actions (Creswell, 2013). Failure to think through philosophical issues will have a negating effect on the quality of the research, as it crucially enables the research strategy to be derived (Easterby-Smith et al, 2018). In addition to the researcher's personal views, the choice of research philosophy may also have a direct impact on the type of knowledge being investigated in the research project and how it is to be collected and analysed (May, 2011). In business and management research, robust research investigation not only leads to the potential to solve business problems, but also contributes to management knowledge in the pursuit of innovation (Edmondson & Harvey, 2018).

The main philosophical assumptions of Ontology and Epistemology (Crotty, 1998; Creswell, 2013; Saunders et al, 2019) are presented and reviewed below, and

complemented by additional considerations relating to Axiology, Rhetoric and Methodology (Collis & Hussey, 2009; Saunders et al, 2019).

3.2.1 Ontology

Reality is multiple, as seen through many different views, ranging from subjective to objective. Easterby-Smith et al (2018) suggest that there is no truth; reality is created by humans based on their experiences. This viewpoint of subjective reality (Subjectivism) argues that social entities or phenomena are highly influenced by the awareness and understanding of social actors and the environment, hence reality is socially constructed (Saunders et al, 2019). Constructionism suggests that the categories people use to understand the natural and social world are in fact social products – where meaning is built up through interaction, is in a state of flux, and evolves over time and place (Bell et al, 2019). In project management, the term "lean project management" comprises a multitude of meanings to different social actors and their operating environments. Therefore, a social constructionist perspective would suggest that Lean Project Management is an evolving social construct, created and practised by individuals and groups, and developed as part of a particular social context: the project and its management (Crotty, 1998).

3.2.2 Epistemology

Saunders et al (2019) articulate Epistemology as, "what constitutes acceptable knowledge in a field of study" (p132), considering different kinds of knowledge and how it can be deduced, produced, developed and derived (Saunders et al, 2009; Gill & Johnson, 2010; Neuman, 2011; Bryman, 2016; Easterby-Smith et al, 2018; Saunders et al, 2019). Crotty (1998) posits that epistemology is "what it means to know" (p10) and

suggests that researchers must consider the emergence of ontological and epistemological perspectives together, rather than separately, in order to understand what we seek to know as well as how we should set about gaining the knowledge. There are different views and considerations in establishing epistemological assumptions, broadly:

- **Positivism** – the social world exists externally, and its characteristics are best measured by objective methods. Behaviours are thus straightforward and, since there is no consciousness, they are easily explained through observable stimulus/reaction (largely favoured by the Natural Sciences). This approach seeks facts or causes of social or business phenomena, with little regard to the subjective state of the individual. Logical reasoning is applied so that precision, objectivity and rigour replace hunches, experience and intuition as the means of investigation (Collis & Hussey, 2003).

- **Realism** – the perception of reality, subdivided into direct realism and critical realism. Direct realism assumes that reality is not alterable and the world we see is real, whereas critical realism favours the perception that the world can change depending on the perspective of the person studying the 'real world'; the latter is largely favoured by Business and Management fields (Bhaskar, 1978; Blaikie, 2007).

- **Interpretivism** – Interpretivists believe that reality is constructed by social actors and people's perceptions of it. They recognise that individuals with their own varied backgrounds, assumptions and experiences contribute to the on-going construction of reality existing in their broader social context through social interaction (largely the realm of Social Sciences research). Knowledge is

derived through subjectivity and its underlying philosophical assumptions (Gill & Johnson, 2010).

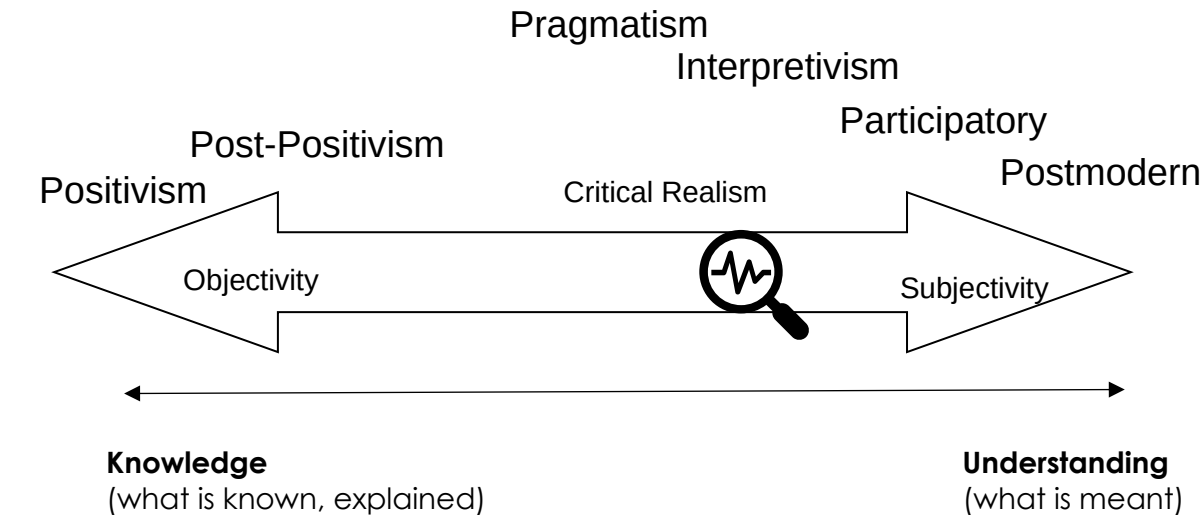
- **Pragmatism** uses a practical approach to problems and issues. Pragmatics recognise that there are many ways of interpreting the world and multiple realities are possible, using experimental and active strategies. A specific aspect of pragmatism is the focus on the outcomes of research – the actions, situations and consequences of enquiry – rather than antecedent conditions (Creswell, 2013).

3.2.3 Epistemological and theoretical perspectives influencing the research

Interpretivism is the contrasting epistemology of positivism (Neuman, 2011; Bryman, 2016; Bell et al, 2019) and focuses more on understanding, as opposed to explaining, human behaviour (Neuman, 2011; Bryman, 2016; Easterby-Smith et al, 2018). As such, it cannot have a separate view or existence to the researcher (Bryman, 2016), it cannot be generalised (Neuman, 2011; Easterby-Smith et al, 2018), and is reflective of the values-based subjectivity of the humans, their attitudes, cultures, feelings and experiences (Gill & Johnson, 2010; Neuman, 2011; Bryman, 2016; Easterby-Smith et al, 2018). Critical theoretical approaches place a strong emphasis on historical and social contexts, in order to make sense of social phenomena (Lincoln et al, 2011). This approach agrees with many of the criticisms that the interpretive approach levels at positivism, but it agrees with interpretive social science on some points. The main point of criticism levelled at positivism by the critical approach is the absolutising and idolisation of the objectivity principle. Cohen et al (2007) and Neuman (2011) maintain that positivists are status-quo bound; however, criticism of interpretivism centres around the emphasis placed on the feelings (opinion) – at the expense of broader

trends. The critical approach stresses that reason is the highest potential of human beings, and by using reasoning it is possible to criticise and challenge the nature of existing societies (Blaikie, 2007). Critical realism theory in particular attempts to find the middle ground between positivist and social constructionist theoretical perspectives (Easterby-Smith et al, 2018), and it is this understanding of the reality of the social condition that develops both knowledge through data collection and the understanding of its meaning (Saunders et al, 2019). This interplay between object and subject places great importance on the social conditions constructed by humans and their real consequences, regardless of how data was gathered (Easterby-Smith et al, 2002). According to Hathaway (1995), the selection of a systems is indigent upon the suppositions and presumptions made by the researcher. This shapes the examination manner, from the manner applied to the type of enquiries asked. Such epistemological assumptions and perspectives lie at the heart of the research aims and objectives. This can be illustrated by the summary diagram in Figure 3.2 below:

Figure 3.2: The epistemological spectrum



Source: adapted from Crotty (1998)

3.2.4 Axiology

Axiological assumptions play an important role in the design of research depending on the researcher's ontological perspective. Axiology is a branch of philosophy that studies judgements about value (Saunders et al, 2019). This branch of the research philosophy attempts to clarify if the researcher and the research are trying to explain, predict or understand the world (Lee & Lings, 2008). These values help to determine what are recognised as facts and the interpretation of them. Since axiology is engaged with assessment of the role of the researcher's own value on all stages of the research process, the researcher's personal values affect how the research is conducted and how value in the research findings may be concluded and articulated (Li, 2016; Saunders et al, 2019). Mertens (2017) guides the researcher to seek methods that will allow them to come into contact in legitimate and authentic ways with members of the communities that we are conducting the studies with, not "on" or "about" (p4). This additionally considers the potential transformative nature of the research as a valued process (Mertens, 2017), and a value in research that may translate directly to an effect on practice as a desired outcome (Hogue, 2011). Biedenbach and Jacobsson (2016) suggest axiology and the role of values should be established as a central theme in research within project management research. This provides an opportunity to strengthen the legitimacy of the research field beyond the limits of value as a theoretical concept alone (*ibid.*). Thus, the research in question will employ an axiological lens through which to understand projects on an in-depth level.

3.2.5 Rhetoric

Rhetoric refers to the language that is used in research and is deemed especially important, according to Collis and Hussey (2009). Denzin and Lincoln's (2011) definition of qualitative research as "a set of interpretive, material practices that make

the world visible. These practices transform and turn the world into a series of representations" (p. 3), suggests that rhetorical enquiry is a valuable and valid type of qualitative enquiry. A rhetorical focus can contribute to the practices of qualitative enquiry throughout the research process, specifically in design, data collection and analysis phases, meaning it is ultimately concerned with how material/symbolic resources are practised, performed, mobilised and disseminated in ways that have influence and consequences for our understanding of the world (Blair, Dickinson, & Ott, 2010; DeLuca, 1999). Rhetorical enquiry is a humanistic practice of theorisation and interpretation (Endres et al, 2016) and necessarily focuses on reflexivity, asking fundamental questions about the epistemology and ontology of being in the field or context, taking stock of the critic's relationship to participants or rhetors (Denzin, 1997; Alexander, 2006; Morris, 2010; Madison, 2011; Middleton et al., 2015). Additionally, many authors have recognised the value of rhetoric for writing-up research and engaging issues of representation (Van Maanen, 1988; Atkinson, 1990; Conquergood, 1992; Hammersley, 1993). Federman (2004) suggests that this tells us to "look beyond the obvious and seek the non-obvious changes or effects that are enabled, enhanced, accelerated or extended by the new thing" (p2).

It is not difficult to see why rhetorical enquiry is rapidly gaining traction (Endres et al, 2016) as the nature of its participatory focus seeks to better understand the potential impacts of the new, evolving social construct of lean project management. The use of Rhetoric is therefore important for this research in terms of the *way* in which the knowledge and understanding about the phenomenon in question is sought. By employing a rhetorical focus on the process of data collection and analysis, and facilitation of the outcomes of this research, this aims to provide additional assurance of its rigour as underpinned by robust philosophical considerations.

3.2.6 Methodological

Crotty's (1998) definition of methodology includes the strategy, plan of action, process and design lying behind the choice and use of particular methods, linking those choices and use of methods to the desired outcomes. Building on this, Easterby-Smith et al (2018) define methodology as "the way in which research techniques and methods are grouped together to provide a coherent picture" (p. xv). Although the terms "methodology" and "method" are referred to above in the same sentence, Neuman (2011) suggests that they are closely linked, whilst still independent of each other. Mills (2014) distinguishes methods as procedures and techniques employed in the study, while methodology is the lens through which the researcher views and makes decisions about the study. Both Neuman (2011) and Bryman (2016) support the notion that the choice of methods to be used makes sense if the researcher is aware of the philosophical assumptions on which they are based.

Methodological issues can be distinguished between qualitative and quantitative research. Characteristics of qualitative research include an emphasis on words rather than numbers, and the focus of research is concerned with the quality of entities, and the meaning of processes as well as phenomena (Bryman, 2016; Bell et al, 2019; Saunders et al, 2019). Denzin and Lincoln (2005) argue that, since the research provides rich descriptions of the world, such a focus cannot be measured. Thus, qualitative research enquiry favours theory generation rather than the testing of theory (*ibid*). Whilst qualitative research favours subjectivist ontological considerations and an interpretivist philosophical orientation (*ibid*.), quantitative research necessarily relies on an objectivist ontological view of reality, and positivist epistemological orientation (*ibid*.). Thus, a qualitative methodology appears the most appropriate methodology of choice in order to answer the research question.

3.2.7 Linking research philosophy with the proposed study

Andrews et al (2008) and Ozguler and Yilmas (2017) suggest that projects themselves are increasingly seen as vehicles for change, particularly in traditionally structured functional settings. Projects that are involved in the development of any new processes and products are therefore ideal settings to bring about novel ideas, and that necessarily requires cross-functional learning, thus enhancing organisational innovative capacity and potential (Bresnen et al, 2003). Similarly, in the field of organisational learning and knowledge management research, there is an imbalance in the types of methodologies favoured by most scholars, which has been traditionally determined by geography and the type of research methods training provided (Easterby-Smith et al, 2009). The research at hand necessarily connects the fields of project management, knowledge management and learning, which is motivated by the researcher's pragmatic need for deeper knowledge and understanding of the phenomenon of lean project management (Habermas, 1987). Taking this into account, this research study is best approached from an ontological perspective that acknowledges that **reality is socially constructed**, rather than some objective truth, by the meanings, perceptions, conceptualisations and judgements that are created by the lived experiences of the phenomenon (Myers, 1997). The study aims to understand and interpret data underpinned by an interpretivist epistemology. The study of the social action of lean project management as it is lived through interpretive (rather than purely empiricist) means, based on understanding the purpose and meaning that individuals attach to their own actions, is typical of the Weberian Verstehen interpretivist tradition (Turner, 1991; Calhoun, 2002).

Therefore, after having considered and justified the philosophical and theoretical perspectives above, the qualitative paradigm is congruent with this study, and thus

best suited to achieve findings that are reflective of the objectives. The derivation of specific research logic that informs the research strategy and methods is explored in more detail below.

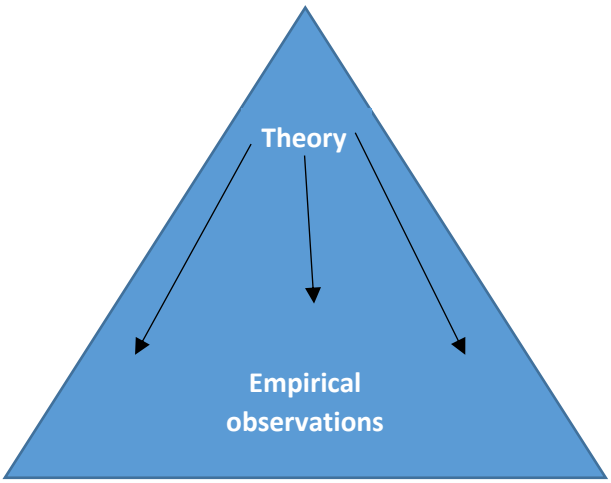
3.3 Research logic

Research logic is concerned with the reasoning adopted for the research (Saunders et al, 2019; Creswell, 2013), and this is defined by Mantere and Ketokivi (2013) as "the reasoning to draw conclusions on matters of importance" (p71). This research approach, or reasoning, is important to ensure transparency and consistency in the justification of the research, as well as connecting theory with conclusions *(ibid)*. Three types of reasoning are outlined below – Deductive, Inductive and Abductive reasoning.

3.3.1 Deductive logic

Deductive logic starts from the position of a theoretical argument or hypothesis that is tested through empirical observations of data (Saunders et al, 2019), as per Figure 3.3 below.

Figure 3.3: Deductive research logic

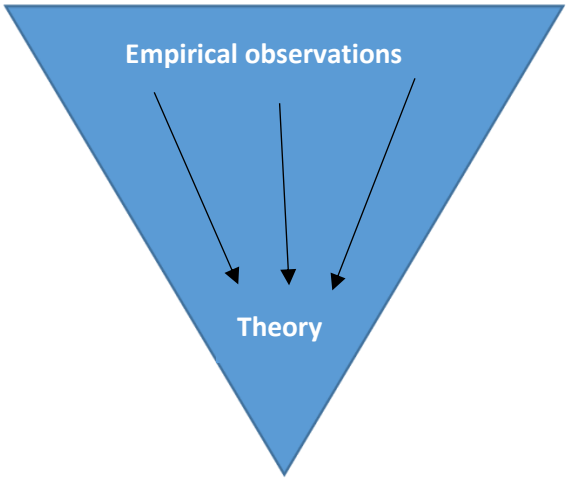


Conclusions are drawn logically from a set of pre-requisites and deemed to be true when all pre-requisites are true, e.g. no new knowledge is forthcoming and the theory is either verified or proven to be false (Ketokivi & Mantere, 2010, p330).

3.3.2 Inductive logic

Inductive logic takes the opposite form, in that its logic derives from the generalisation from data, or empirical observations, to theory. Saunders et al (2019) rationalise this use of data to explore a phenomenon, whilst identifying themes and patterns, to formulate a theory or for creating a conceptual framework. Ketokivi and Mantere (2010) define inductive logic as an enumeration, or one-step empirical generalisation, based on multiple observations (of data) (p330). The goal of induction is to generate and build theory (Saunders et al, 2019), as per Figure 3.4 below.

Figure 3.4: Inductive research logic



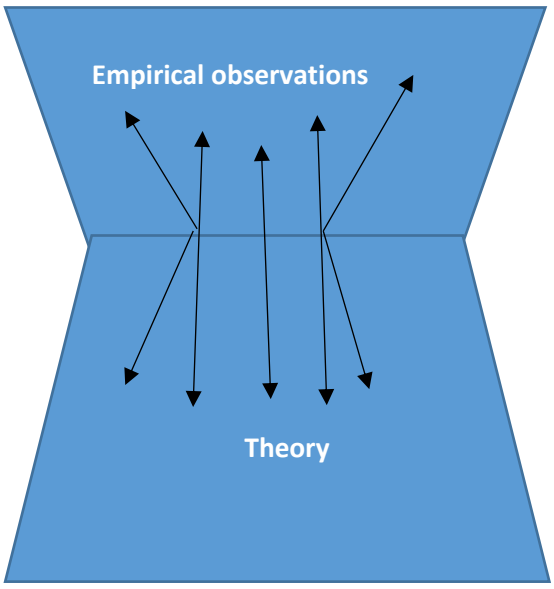
Although it is important to note that not every research study achieves theory generation, the inductive logic is often applied together with other iterative processes in order to improve theoretical significance (Bryman, 2016). Despite criticisms of

induction as an incomplete reasoning (Ketokivi & Mantere, 2010; Blaikie, 2010), the strength of this logic lies in its ability to take account of the context of the phenomenon being studied, to develop an understanding of the humans' interpretation of their socially created environment (Saunders et al, 2019).

3.3.3 Abductive logic

Abduction is the third research logic and is in effect a combination of the above two approaches, as the approach moves back and forth iteratively between data and theory (Saunders et al, 2019), as per Figure 3.5 below.

Figure 3.5: Abductive research logic



Van Manen et al (2007) define this is a "path of critical reasoning" (p1149) in that it better explains the interplay between concepts and data, which may lead to new ideas and theories beyond the restriction of one or other (inductive and deductive) approaches. Researchers employing this approach use data to explore a phenomenon and develop theory or conceptual frameworks, and test again with succeeding data collection. Thus, the goal of abduction is to generate and/or modify

theory and to incorporate existing theory for further modification or building theory (Saunders et al, 2019). Criticisms of this approach define abduction as the weakest form of reasoning (Ketokivi & Mantere, 2010) due to the different statements that can be developed from the research, which may in turn lead to different conclusions that may be drawn. Although abduction shares some common elements with induction, it should be noted that abduction is much broader in its approach, but still builds theoretical understanding driven by contextual factors, meanings and perspectives derived from human interaction (Bryman, 2016).

Thus, the research logic approach for this work is informed by a predominantly inductive reasoning logic since multiple forms of evidence in the form of data are collected and analysed, inferences drawn from themes, patterns observed and a conclusion to be formed based on the evidence provided.

3.4 Research design considerations

Project management research has evolved since the year 2000 in pursuit of diversity in enquiry and domains (Söderlund 2004b; Hall 2012; Turner et al, 2013). In particular, studies have sought explanation regarding phenomena including, but not limited to, knowledge, skills and learning (Maylor, 2001; Sauer & Reich, 2009), learning in project management (Tesch et al, 2003), human interaction and resource management in project-oriented companies (Huemann et al 2007; Whitty & Maylor, 2009), effective project practice (Tesch et al, 2003) as antecedents of project performance (Söderlund, 2004a) and project success (Turner & Müller, 2005). Such studies have been conducted primarily through the employment of empirical methods (Padalkar & Gopinath, 2016). Increasing numbers of articles in the PM literature recommend a

move towards non-deterministic research (*ibid*.). In order to improve the relevance of research for practice particularly in interdisciplinary areas, project and process complexity, and social and organisational contexts, the adoption of diverse methodologies has been encouraged (Pollack, 2007; Hodgson & Cicmil, 2008; Morris 2010), and also supports the arguments for a theory-based approach for research on PM (Koskela & Howell, 2002). Indeed, as society becomes more dependent upon projects (Lundin et al, 2015), this calls for a new research focus within project management – and accordingly methodological choices – which reflects contemporary practice. Geraldi and Söderlund (2016) propose that this extends the well-established instrumental and practical knowledge and develops emancipatory knowledge in project management. They argue that reflexive, engaged scholarship which takes account of the actuality of projects through carefully chosen methodologies helps project practitioners to question and instigate change for emancipatory knowledge purposes.

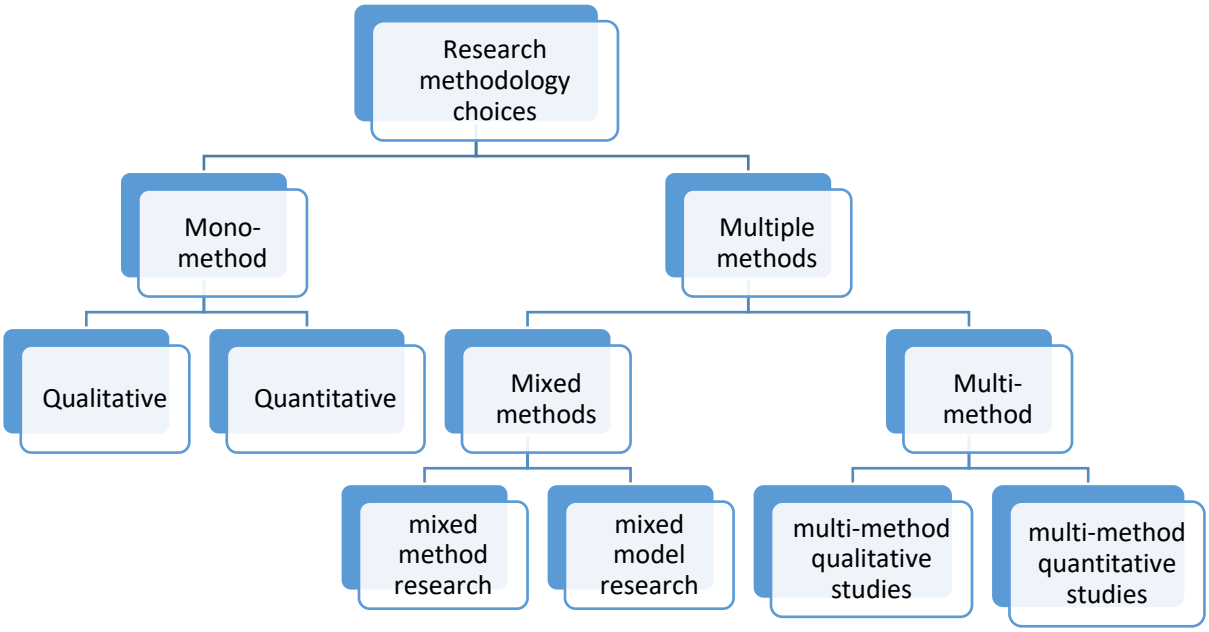
3.4.1 Contribution of the proposed research to project management

The research aims and objectives can be said to provide methodological fit to advance both theory and practice in real-world situations ((Edmondson & McManus, 2007, p1156). This is supported by Padalkar and Gopinath (2016), who suggest that, since knowledge management is interconnected with organisational processes, human characteristics and the social context, this presents an opportunity to conduct the suggested integrative and instrumental research written about by PM scholars above. The overall aim of the study in exploring the utility of lean project management with its focus on assessing conceptualisations of, and impacts on, project learning, raised three specific aspects of which in turn inform the methodology and methods:

- what is understood by the term 'lean project management'?
- how do practising project managers apply lean project management, and
- what, if any, are the impacts of practising lean project management on project learning?

Thus, a key requirement for the research design is that the process needs to be aligned to answer these research questions (Bryman, 2016). Based on the above, the following section discusses options for research design and explains how the underlying philosophical assumptions and perspectives led to a suitable methodology which was chosen for investigation of the research. Firstly, an overview of the different methods is provided below, followed by exploration and identification of chosen aspects. This can be seen in the initial research methods design choices below in Figure 3.6.

Figure 3.6: Research methods design choices



Source: Saunders et al (2019)

3.4.2 Qualitative Research

According to Creswell (2009), qualitative research is a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The research process involves "emerging questions and procedures, with data typically collected in the participant's setting, data inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data". (p4). Denscombe (2014) asserts that a qualitative approach provides a holistic view, whereby the in-depth information gathered from human experiences and beliefs enables a deeper understanding of the phenomena. Rather than performing social world measurements, it allows the researcher to uncover the subjective and often complex experiences of the individuals (Schwandt, 2001) and to study the participants' interpretation of the phenomena (Marshall & Rossman, 2011). To develop and interpret meaning, researchers collect naturally occurring data and analyse it using varying techniques, procedures and approaches, such as phenomenology, ethnography, grounded theory, case study and narrative research (Creswell, 2013; Saunders et al, 2019). Analysis is usually open to emergent concepts and ideas which produce detailed descriptions and classification, identifying patterns of association, or develop typologies and explanations. Data is transformed into findings which focus on the interpretation of social meaning through mapping and re-presenting the socially constructed reality of the participants (Snape & Spencer, 2003, p3). Analysis involves various steps, from storing and organising the data to interpreting, representing and visualising it (Creswell, 2013).

In business and management research, qualitative methodologies are commonly used in order to achieve rich insights into the research question or problem (Zikmund et al, 2013). In particular, research that investigates behavioural aspects of

management is largely exploratory, as numerical data often fails in providing a nuanced, detailed explanation of a situation (Amaratunga et al, 2002). Qualitative methods can help to establish confidence in understanding the underlying explanations of significance where concepts or constructs are still in the exploratory phase (*ibid*. p22). Despite the apparent appropriateness and suitability of qualitative research methodology, there are challenges and criticisms associated with its use. For example, Bryman (2016) suggests:

- the research findings may be too subjective due to the researcher's personal relationship with the participants and/or the area being studied
- there can be a difficulty of replication due to the lack of standardisation of procedures
- sample sizes are generally small and largely unstructured, therefore generalisability may be difficult

3.4.3 Quantitative Research

Quantitative research methods are numerical, something that is "expressible in terms of quantity, a definite amount, or number" (Schwandt, 2001, p215). Numerical data is gathered for the purposes of testing and developing testable arguments, with objective investigation and the use of heavily descriptive measures (Amaratunga et al, 2002). Creswell (2009) asserts that, "Quantitative research examines the relationship between variables, which in turn can be measured and analysed through statistical procedures. Like qualitative researchers, there are underlying assumptions, but these are deductive in nature, building in protections against bias, enabling control measures and explanations, leading to the ability to make generalisations and replicate findings" (p4).

Bryman (2016) suggests that, because data is measurable in a reliable and valid way, the causality between things can be explained using a variety of dependent and independent variables. This enables a level of objectivity that is required for theory testing, and as such is usually underpinned by a positivistic epistemology (*ibid*.). Quantitative methods focus on the measurement and analysis of causal relationships between variables and not on the meanings of the processes (Denzin & Lincoln, 2005). Challenges associated with the use of quantitative research methods generally include the failure to consider and distinguish people and social institutions, as well as the view that the precision of measurements may be artificial and spurious (Bryman, 2016, p178).

In business and management research, both methods have strengths and weaknesses and a combination of the two can be used in order to reduce potential bias (Amaratunga et al, 2002; Creswell, 2009). Since the research at hand does not require a focus on quantifiable measurement, this justifies the qualitative method of choice.

3.4.4 Mixed Methods research

This is broadly defined as the combination of both (mono) methods as described above, elements of which can be merged together, used in tandem, kept separate and independent or combined in some other way (Creswell, 2009, p4). This can refer to the collection of data and its analysis, which can either be undertaken sequentially (first one, then the other) or at the same time (parallel or simultaneously) (Creswell, 2009; Bryman, 2016; Saunders et al, 2019). An example of this is the sequential explanatory strategy – where quantitative data is collected first (core), then analysed qualitatively last (supplementary). This is commonly denoted as QUAN → qual, which

illustrates the causal relationship of the phenomenon under investigation using the quantitative approach as primary focus, following by supplementary focus on the qualitative aspects, where resulting causal relationships are then examined and explained. Exploratory designs using QUAL→ quan and simultaneous mixed methods designs denoted as QUAN+qual, QUAL+quan, QUAL+QUAN indicate differing levels of priority and sequence of methods applied. However, since the methodological choice should be dependent on the philosophical perspective (Bryman, 2016), it is clear why mixed methods would not be the appropriate choice for this research study. Fellows and Lui (2008) and Creswell (2009) additionally argue that mixed methods have a huge resource implication in terms of additional time requirements and increased researcher skills in employing multiple data analysis techniques. As well as the appropriateness of the situation, and the explicit need for the choice Silverman (2013) and Bryman (2016) both agree that the fundamental choice for the researcher should be based on the appropriateness of the design as well as the application of the design in investigating the research field.

3.4.5 Choice for the work at hand

Given the above discussions and consideration, this section discusses and identifies a suitable research design. Since the aim of the research is to understand the concept of lean project management and its potential impacts on project learning through exploring the perceptions and lived experiences of practitioners, the choice for the work at hand is **qualitative methodology**. This would suggest a straightforward fit between the research topic, contextual setting and method (Silverman, 2013). However, this also involves **multiple methods of data collection** to enable validity and

triangulation. Validity is concerned with the extent to which the research findings accurately represent the situation or phenomenon being studied (Collis & Hussey, 2003), and it is important to select methods which will allow the researcher to gain full access to the knowledge and meaning of those within the situation (*ibid*. p59). Triangulation is defined by Denzin (1970) as the combination of methodologies in the same study of the phenomenon (p297). In terms of data triangulation, data can be collected at different times or from different sources in order to ensure greater validity and reliability of the methodological approach. This aims to reduce or minimise the potential weaknesses of bias and sterility of a mono-method design choice (Collis & Hussey, 2003). Additionally, Collis and Hussey (2003) suggest that inclusion of triangulation is integral to a good design and can encourage more productive research (p78).

3.5 Research design strategy

The research strategy directly follows on from the methodological approaches as outlined above. This forms the essential link between research philosophy, methodology, and the data collection methods and analysis (Saunders et al, 2019). Since the research is intended to describe and explore the meaning of a lived experience of a concept or phenomenon (LPM), this lends itself well to a **phenomenological-based enquiry** (van Manen, 1990; van Manen et al, 2007). The aim of phenomenology is to deeply understand, explain and describe subjective experiences (Creswell, 2013), but it also requires a critical objectivity as it calls into question the "taken for granted assumptions" (Crotty, 1998, p83), in order to question current or accepted meanings. Hence, phenomenologists are often concerned with seeking a new interpretation or fuller, deeper, richer meaning by analysing the

essence of what is described by the lived experiences of individuals (Moustakas, 1994). Phenomenology builds on the works of 19th-century European philosophers and social scientists Edmund Husserl and Alfred Schütz and studies a phenomenon as it appears to individuals in their consciousness (Moustakas, 1994). The appearance of anything or something makes it a "phenomenon", therefore anything can be studied (Moustakas, 1994). This rather broad definition of 'phenomenon' can therefore result in an idea, a concept, a judgement or an understanding that is identified by the subjective experiences of a phenomenon by individuals (Easterby-Smith et al, 1991; Moustakas, 1994; Creswell, 2013).

Husserl devised the notion of phenomenological reduction (Racher & Robinson, 2003), in order to **facilitate the essence of a phenomenon to emerge**; that is, to determine and understand what individuals experience pre-reflectively (Husserl, 1970). That is, what is original, naïve, free from cultural context and prior to critical or theoretical interpretation (van Manen, 1990; Caelli, 2000; Moran, 2000). This was important to Husserl as he regarded experience as the fundamental source of knowledge (Racher & Robinson, 2003). He believed that the rigorous and unbiased study of things as they appeared in human consciousness was the way in which to understand and classify conscious acts and experiential mental acts (Valle et al, 1989; Racher & Robinson, 2003). Researchers can only achieve this understanding by receiving a description of the experience as described by the participants themselves (Parse, 2001). In order to arrive at a description of a phenomenon, van Manen (1990) suggests that essence is what makes a thing what it is, without which it would not be what it is. His view of phenomenology concerns itself not only with the concreteness of the phenomenon but also its nature, "a preoccupation with both the concreteness (the ontic) as well

as the essential nature (the ontological) of lived experience" (van Manen, 1990 pp39-40).

The original intention of phenomenology in seeking the essence of the phenomenon from the individual's experience and engagement has been extended by the addition of the interpretive and culturally grounded nature of phenomenological enquiry (Caelli, 2000; Giorgi, 2000). Regardless of the debate surrounding the link between experience and philosophy, one of the biggest challenges for the researcher is to observe the phenomenon as it should be experienced, by the researcher laying aside their belief systems, according to Crotty (1998, p82). This distinguishes van Manen as a supporter of hermeneutic or interpretivist phenomenology, in the practice and pursuit of interpreting text, humans or social institutions to clarify and deepen our understanding of the things in which we are engaged, rather than to arrive at categorical, natural and empirical solutions (Magrini, 2012).

Exploring the phenomenon of lean management and its impact on learning as experienced through the practitioner's lived actuality aligns well with the van Manen and Heiddegerian views advocating the way in which humans exist, act or are involved with the world, and the way in which this is explored. This hermeneutic and interpretive phenomenological thinking is demonstrative of the meaning-making (interpretation) process that requires the researcher to "immerse themselves in the phenomenon they seek to thematically elucidate" (van Manen, 1990, p13), bringing structure and reflective design to the organisation of the research study (Brett, 2004) and its use as a data analysis tool to reject generalisability but focus on the exploration

and written articulation of the "uniqueness of human experience" (van Manen, 1990, p22).

Creswell (2013) suggests that employing interpretive phenomenology is a clear strategic choice for studying the lived experience of a phenomenon within its social context and practice (Groenewald, 2004; Cohen et al, 2013). For the purposes of this research, the researcher is guided by the philosophical roots of phenomenology to determine the reality of the practice in order to help transform knowledge and understanding of the practice and knowledge itself (Marlowe & Maycock, 2000; Thome et al, 2004; Dowling, 2007). This is demonstrative of a more reflexive and pluralistic learning approach as denoted by the works of Bredillet (2010), Rolfe (2011), and Van der Hoorn and Whitty (2015).

3.5.1 Case Study as a Methodology

A case study can be defined as a qualitative approach, a strategic design choice and a methodology (Creswell, 2013). It has also been defined as a vehicle or mapping domain for illustrating a phenomenon (Thomas, 2011), addressing the uniqueness of a particular real-life study (Myers, 2013), and a design frame or approach that incorporates a number of methods (Simons, 2009). Collis and Hussey (2003) define case study as a methodology to explore a single phenomenon in a natural setting using a variety of methods to obtain in-depth knowledge (2009). A case study is often associated with an underlying philosophical stance of interpretivism (Saunders et al, 2012), which is most suited to understand and explore the research objectives (Crotty, 1998). Case study research facilitates deep investigation of a real-life contemporary phenomenon in its natural context where the researcher has little control over the

phenomenon, context and behaviours that are studied (Yin, 2017). This includes, but is not limited to, the use of multiple data collection techniques in order to generate the descriptive elements required to address the research objectives (Wayhuni, 2012). The research investigates how the process of LPM unfolds, developing insights into the phenomenon, questioning assumptions from literature, and exploring through open-ended means of interviews, observations and document analysis. This facilitates the identification of elements and uncovers substances observed which directly link to the research objectives (Denzin & Lincoln, 2011; Saunders et al, 2019). This research adopts and considers the broadest definitions of case study as outlined above, but moreover justifies its inclusion to enhance the robustness of findings that are required in order to provide evidence for the nascent theory area of lean project management (Edmondson & McManus, 2007).

3.6 Time horizon for data collection

The research time horizon refers to the timeline available for data collection and is usually referred to as one of two specific types of design: cross-sectional and longitudinal. Whereas cross-sectional design aims to gather data on variables in different contexts but at the same time, in order to arrive at patterns of association (Bell et al, 2019), longitudinal studies gather data on one variable or a group of subjects over a longer period of time, usually in order to map change and/or development in business and management research (Collis & Hussey, 2009; Bell et al, 2019; Saunders et al, 2019). The most prominent characteristic of cross-sectional designs is that all of the observed data is collected at a single point in time (Allen, 2017). Such designs are commonly used to identify patterns and prevalence of an outcome within a population and its subgroups at the given time point (*ibid*). In this

study, the researcher is interested to know how lean project management is conceptualised and implemented and whether this differs for participants in the dataset. In this sense, a cross-sectional design is used to analyse numerous variables at once (such as age, gender, geographic location) in order to see if they relate to different conceptualisations and applications of the phenomenon of lean project management. This is achieved by data collection and analysis of 40 semi-structured interviews, involving human respondents as the primary units of analysis.

Cross-sectional studies can also include a snapshot where research questions are answered or problems are addressed at more than one specific point in time, and usually include, but are not limited to, case studies as data collection methods (Allen, 2017; Bell et al, 2019; Saunders et al, 2019). Known as repeated cross-sectional designs, these studies can be used to establish greater understanding of a population of interest by observing the same variables at different cross-sections of time (Allen, 2017). Each observation stands as its own cross-sectional study that observes a single population at a single time point, but together the set of observations can help to establish trends, patterns and rates of change or similarity to establish evidence on a subject of interest to researchers (*ibid*). In this study, four non-participant observations of project meetings are undertaken with the same group of project team members, over a period of one year. These observations aim to generate knowledge and understanding of the implementation process of lean project management, and to determine what, if any, characteristics of project learning can be seen within a specific context (lean construction project management). Evidence is also gathered through interviews, photograph and document analysis, and this data is brought together as a case for exploration of the phenomenon of the lived actuality of lean project management and its impact on project learning.

Cross-sectional studies have the advantage of generally being inexpensive and may be conducted with relative ease and speed (Collis & Hussey, 2009); however, as large sample sizes are required to gain information on variation and representation, this can take time. Bell et al (2019) note that cross-sectional studies in business and management contain challenges relating to validity, reliability, replicability and measurement, regardless of the type of data being collected (*ibid*, p61). A final consideration when selecting an appropriate research design is the resource availability of the researcher, in terms of time and cost (Collis & Hussey, 2009). Since there are few limitations in terms of time and the researcher has access to an already well-established network of practising professional project managers across a wide range of discipline areas, the most appropriate design choice is a cross-sectional study in which the researcher seeks to gain an in-depth understanding of a phenomenon through collection and analysis of interview and observational data.

3.7 Summary of Chapter

The methodological considerations outlined in this chapter are intended to increase the researcher's understanding of the phenomenon of lean project management. The table below summarises the key methodological considerations and elements discussed in this chapter and informs the researcher's choice of methods, which will be outlined and discussed in Chapter 4. The research and its design, methodological choices, strategy and instruments to be employed, aim to provide evidence of the utility and mechanisms of lean project management implementation to facilitate project-based learning. This is supported by Bresnen et al (2003), who argue that learning in project settings relies heavily on social practices, patterns and processes, not only to identify knowledge and learning outcomes, but also requires the transfer of the elements of context and essence together with the learning outcomes created.

The table below (Table 3.1) summarises the methodological considerations outlined in this chapter.

Table 3.1: Summary of Research Philosophy and Design Approaches

Research Philosophy Summary	Adopted Position	Key Elements
Ontology	Social Constructionist	Reality is constructed by self and others' sense-making of situations and interactions
Epistemology	Interpretivist	Understanding meanings ascribed by interactions from and between individuals
Theoretical Perspective	Critical Realism	Emphasis on social context, in order to make sense of social phenomena
Axiology	Present	The researcher is necessarily involved with that which is being researched
Rhetoric	Central to the research process	Consistently applied for design, data collection, analysis and dissemination processes
Research Logic	Inductive	Emphasis on understanding
Methodology	Multi method	Qualitative
Strategic Design Approach	Phenomenological enquiry	Focus on exploratory uniqueness of a phenomenon
Data collection design instruments	Interview and case study approach	Semi-structured interviews Case Study Documents and Photographs
Time Horizon	Cross-sectional	Observational Comparison of different variables, e.g. demographics

4. Methods

Within this chapter, the key methods used in the research are presented and justified. This follows on from the previous chapter, which presented and discussed the research philosophies, ontological, epistemological, and methodological considerations, which serve as an essential foundation for the research design (Bryman, 2016). This chapter will follow on from the theory of **how** the research is best undertaken to answer the research question and focus on the **way** in which the data is collected. Methods are "a systematic way of accomplishing something orderly and disciplined with care and rigor" (Moustakas, 1994, p104). This commonly involves processes and techniques, including not only data collection, but additionally organisation of data, data analysis and synthesis (*ibid*). Amaratunga et al (2002) posit that a methodical process of enquiry is essential to increasing the knowledge required. Easterby-Smith et al (2018) agree that, whilst some of these techniques and procedures may appear apparent and obvious characteristics of the research study, they are much less visible, although nevertheless important as they have been chosen based on the underlying philosophies as outlined earlier.

4.1 Overview of research methods

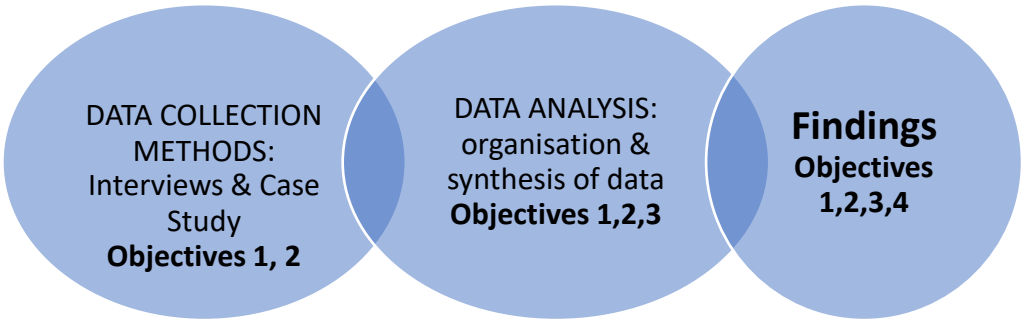
In order to generate findings that can be used as high-quality evidence, interviews and case study methods were selected as robust and appropriate qualitative methods in addressing the Research Objectives. These are provided below as a reminder before overviewing, detailing and justifying the chosen research methods.

Table 4.1 Research Objectives

Objective Number:	Research Objective:
1.	To identify and assess lean project managers' baseline knowledge and understanding of the principles of lean project management (LPM) and project learning
2.	To explore the lived experience of LPM and project learning in practice by project stakeholders
3.	To assess the role and contribution of factors such as business setting, environment and discipline on LPM and project learning
4.	To develop a framework for understanding the relationship between LPM and project learning

Interviews are intended to yield an understanding of the practitioner's perceptions about the conceptualisation and implementation of LPM, addressing **Objective 1.** Exploring the experience of LPM and project learning in practice by project stakeholders is best explored through **case study** as the most suitable method in order to gather evidence for and understand the social and behavioural processes of the phenomenon within the real-world context, as per **Objective 2.** Demographic data is collected to enable the deeper understanding sought (Thomas, 2016; Yin, 2018), addressing **Objective 3**. Both methods facilitate collection and analysis of data to generate findings that illuminate the phenomenon under investigation, which is the output intended in **Objective 4.** This is illustrated by Figure 4.1 below:

Figure 4.1 Research Methods and Objectives



4.1.1 Interviews

Qualitative interviews are considered a frequently employed, central technique (Crouch & McKenzie, 2006). The interview is a managed verbal exchange and can be used in a variety of research designs (Ritchie & Lewis, 2003; Crouch & McKenzie, 2006; Brinkmann & Kvale, 2015). Interviews comprise a purposeful discussion (Easterby-Smith et al, 2018; Saunders et al, 2019) and a relatively free-flowing interchange of views (Saunders et al, 2019), facilitating the ability to go below the 'surface' of the phenomenon in order to explore aspects of the research (Kvale, 2007).

Thus, interviews are a powerful method to understand individuals and the constructs they use based on their beliefs and opinions about a particular situation across many different disciplines (Britten, 1995; Amaratunga et al, 2002; Kvale, 2007). Indeed, Kvale (2007) suggests that interviews not only elicit responses, they also enhance the understanding of the world of practitioners, as it is assumed that they have experienced the phenomenon under investigation over time. This is particularly important when interviewing in a number of different countries and disciplines, to establish a sense of breadth and depth of the experienced phenomenon (Shehu & Akintoye, 2010) and the richness, depth and saliency of data necessary for authentic analysis (Lincoln & Guba,

1985; Curtis et al, 2000). This addresses Objective no. 1 of the research, revealing knowledge beyond the interview event itself (Banfield, 2004).

Three main types of interviews can be distinguished, all of which may be placed somewhere along a continuum of structured, unstructured and semi-structured interview types (Newton, 2010; Bryman, 2016 Easterby-Smith et al, 2018; Saunders et al, 2019). The following sections describe and explain the differences between them and will also justify why semi-structured interviewing is the most appropriate for this research study, to elicit responses and understand the socially constructed world of the interview participants (Adams, 2015).

4.1.1.1 Structured interviews

Structured interviewing uses the same type of question, wording and sequence (order) of questions for all interview participants (Bryman, 2016; Saunders et al, 2019). Questions are usually closed questions (pre-coded) and the interview participant can often choose from a selection of pre-defined answers (Bryman, 2016). The aim of this 'closed questioning' method is to create reliable answers through the acknowledgement and confirmation of keywords usually for quantitative purposes, hence why it is usually employed as a quantitative research approach (Bryman, 2016; Saunders et al, 2019). The role of the interview participant is limited to answering the questions without flexibility to add or edit their answers, which serves to discover 'what or whether **X** works' rather than 'how' or 'why'. The realist perspective would argue that such evaluation is concerned with theory testing and refinement (Pawson & Tilley, 2004), representation and legitimacy (Lincoln, 2005).

4.1.1.2 Unstructured interviews

In contrast, the unstructured interview has no pre-determined or pre-defined questions, no interview guideline or 'topic guide', meaning that different phrases, content, sequencing and, unsurprisingly, different outcomes arise (Bryman, 2016; Saunders et al, 2019). This 'open-style' interview suggests that the interview participant is in complete control of the content to be divulged rather than the interviewer (Corbin & Morse, 2003; Bryman, 2016; Saunders et al, 2019), with the aim being to explore in depth the area of research interest (Bryman, 2016). Such unstructured interviews are usually categorised within qualitative research methods, often employed together with observational methods, but the main challenge of this type of interview is the inability to fully compare and evaluate such different responses (Newton, 2010). However, it can allay fears around the internal validity of the data, since it is almost impossible for the researcher to ask leading or pre-conceived questions (*ibid*.). Moreover, its highly participative focus can often illuminate and address topics that may not have been previously thought of by the researcher (Gubrium et al, 2012).

4.1.1.3 Semi-structured interviews

Semi-structured interviewing sits in the middle of the continuum as one which is aligned with both participatory and emancipatory thinking (Newton, 2010). Questions within the interview are structured more formally, yet still fluid, enabling a flexibility of approach for the researcher and the interview participant (Bryman, 2016; Saunders et al, 2019). A particular advantage of the semi-structured interview is the control the researcher has surrounding the questions (Bryman, 2016). To prevent the chaotic nature of the unstructured approach, a boundary is drawn up by the researcher through a 'guideline' or 'topic guide' (Patton, 2015) including predefined and phrased questions. However, these questions are more of a guide to the topic in general than set questions

that may be asked in any sequence (Bryman, 2016). New questions may arise during the interview, which allows freedom for follow-up and discussion by the researcher or for the interview participants to respond to as they deem necessary (Wahyuni, 2012; Thomas, 2017). Semi-structured interviews are commonly used in qualitative research since they are primarily focused on gaining insight and understanding (Ritchie & Lewis, 2003; Bryman, 2016; Saunders et al, 2019). More specific issues can be addressed and the extent to which one interview can be compared with another is greater (Bryman, 2016), thus uncovering more of the 'how' and potentially 'why' **X** works, rather than the restrictive questioning nature of 'what'. This additionally affords an opportunity for the co-creation of understanding between the researcher and interview participant (Denzin & Lincoln, 2005) at the point of data collection itself (Mojtahed et al, 2014).

However, limitations to the use of semi-structured interviews include a reduction in comparability since not all questions are necessarily asked in the same way, with a potentially different sequence and wording depending on the interview event itself (Newton, 2010). Researchers are also advised to take note of their own questioning style to guard against too much explanatory rather than exploratory probing (Ritchie & Lewis, 2003; Roulston, 2013; Denscombe, 2014), although this can often be overcome with the effective communication skills and interpersonal skills of the interviewer (Gomm, 2004; Opie, 2004).

4.1.1.4 Choice for the work at hand

Gaining insight into how, and why, as well as what features and characteristics are prevalent within the practice of lean project management and potential impacts on project learning, is essential to the research study, therefore semi-structured interviews

are deemed the most appropriate to use. Importantly, this format is consistent with the theoretical assumptions that underpin the research and is the most appropriate to generate the richness of data in order to answer research questions. Furthermore (PM) practitioners selected for interviews are unlikely to respond well to less formal and unstructured approaches to interviewing, since they are often time-pressured and generally welcome a well thought-out, planned and focused approach. This is particularly prevalent when the interview participants have been specifically approached by the researcher based on their professional expertise and wish to help improve the profession's legitimacy (Muzio et al, 2011).

4.1.2 Case Study

Simons (2009) suggests that case study is an approach which incorporates a number of methods, to explore the complexity and uniqueness of a particular project, policy, institution, programme or system in a real-life context from multiple perspectives (p21). A clear definition and understanding of the case study method is required to demonstrate its applicability for the work at hand. This is discussed below.

4.1.2.1 Definitions of case study

Yin (2018) defines case study as an "empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p349). The desired case should be a real-world phenomenon that has some concrete manifestation (Yin, 2018). A case study can be defined as "not a methodological choice but a choice of what is to be studied, by whatever methods we choose to study the case" (Stake, 2006, p443). According to Thomas (2016), a case study is a design frame rather like a vehicle or a mapping domain for illustrating phenomenon, where the choice of method does not

define the case study and, as such, is most suited to the "what's going on here?" and "what is related to what?" questions that are essential to research investigation (p37). This is defined as follows:

> "Case studies are analyses of persons, events, decisions, periods, projects, policies, institutions, or other systems that are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame—an object—within which the study is conducted and which the case illuminates and explicates." (Thomas, 2016, p23).

Harrison et al (2017) suggest that the most appropriate definition or case study approach to follow is one which will align with the researcher's worldview (p6). Thus, this research aligns most closely with the constructivist and interpretivist orientation of the works of Stake (1995, 2006, 2013) and Merriam (1998, 2009), which is underpinned by the researcher's keen thirst and strong motivation for discovering meaning and understanding experiences in context (Stake, 2013). In line with Objective 2, the work is necessarily specific to a chosen phenomenon and therefore not intended to be generalisable (Thomas, 2016). Harrison et al (2017) state that the knowledge generated from the research process is relative to the time and context, and necessarily involves the researcher as interactive and participative in this process (p7). The ability to appreciate any blurring of case and context as part of a case study is considered a strength of case study research, and the contextual conditions can even lead to an entirely new understanding of a case – an understanding that was not necessarily appreciated at the outset of the case study (Yin, 2018).

4.1.2.2 Purpose of case study

A case study is often associated with an underlying philosophical stance of interpretivism and is an appropriate choice for enquiry (Creswell, 2013; Saunders et al, 2019). To gain deeper, more meaningful insights, by addressing the uniqueness of a particular real-life study (Lampropoulou & Myers, 2012), the case study is rooted in intrinsic, instrumental and evaluative purpose, but equally has an interest in explaining any interconnections and interrelationships that the study reveals (Thomas, 2016). George and Bennett (2005) suggest that the purpose of a case study is to serve as a probe for plausibility, providing evidence for building-block studies, where the findings serve as identifiers for future studies. Case studies are designed to capture and appreciate nuances of dynamic, lived actuality (Lui & Maitlis, 2010), thus they play an important role in the creation of new knowledge, derived from situationally grounded exploration (analysis) (Ketokivi & Choi, 2014).

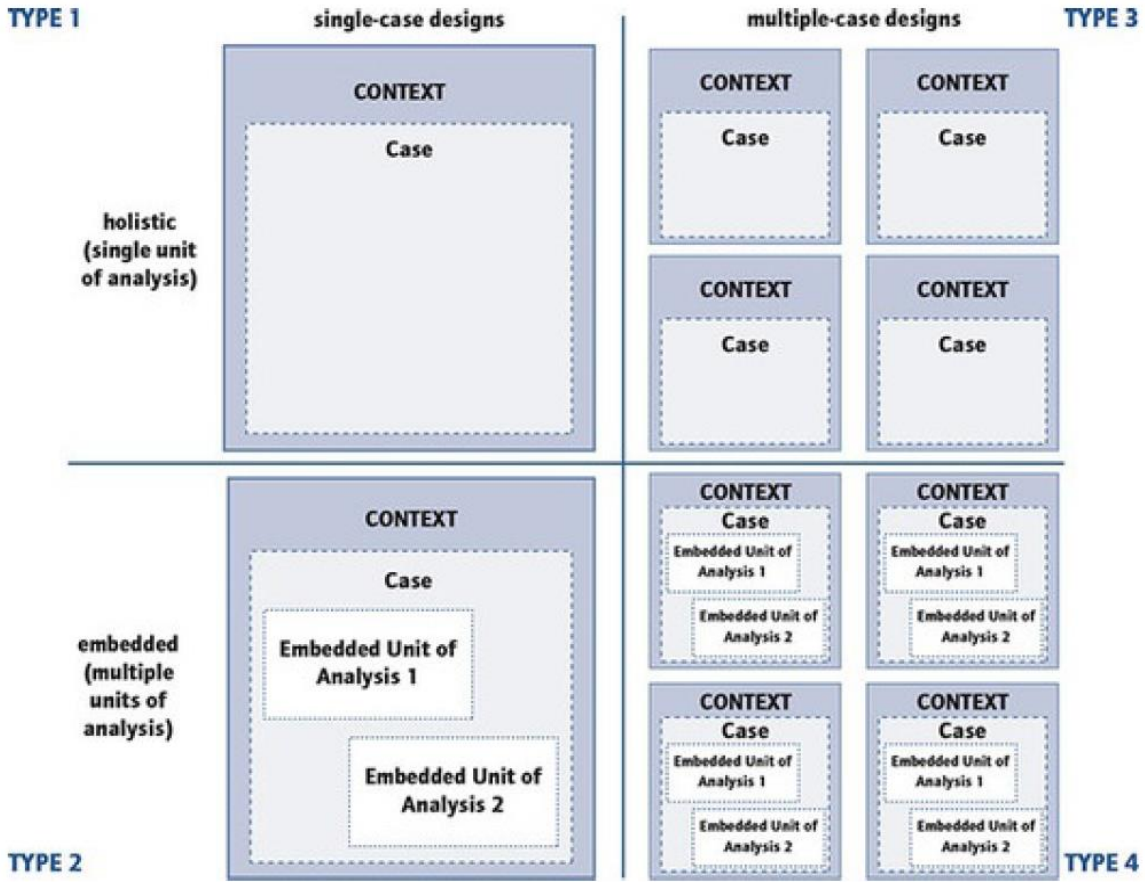
Although the case study can be essentially exploratory, interpretive and illustrative in nature, it does not mean an absence of theory in attempting to drill down into the depth of the phenomenon to understand its intricacies, complexities and features (Thomas, 2016). By focusing on the detail of the phenomenon, a story unfolds, which offers insights as the study progresses (Bruner, 1991; Bassey, 1999). This is particularly relevant where the intended outcome is illustrative and confirmatory of a proposed concept, rather than comparable, seeking differences and similarities (Vannoni, 2014). Collecting data, gathering evidence, and interpreting previously known and emerging knowledge is part of building a complete picture, or one that is more complete from what was "known" prior to the case study (Thomas, 2016). In this way, it holds an additional general appeal in that it can facilitate emergent theory, alongside its situated context (Martin & Eisenhardt, 2010). The anticipation of findings that potentially

help to solve a pragmatic, contemporary problem or issue faced by practitioners, adds to the relevance of case study research within business and management (Ketokivi & Choi, 2014).

4.1.2.3 Types of case study

The main types of case study include single or multiple cases, analysed by single or multiple units of analysis, depending on the context of the research. This is illustrated below in Figure 4.2. The single-case study is an appropriate design that comprises five single rationales; that is, having a critical, unusual, common, revelatory or longitudinal case (Yin, 2018). This type of case study can represent a significant contribution to knowledge and theory building by confirming, challenging or extending a theory but also, additionally, deviating from a theoretical norm (*ibid*). This is particularly relevant for exploratory single case studies that seek to reveal what phenomenon or theory exists within a field of interest and to support naturalistic generalisation (Stake, 1995). Thus, criticism of generalisability is of little relevance when the intention is one of particularisation (Willis, 2014).

Figure 4.2: Case study design types



Source: Yin (2018, p48)

4.1.2.4 Choice for the work at hand

The choice of a single (holistic) design is favoured over a multiple design because it provides a distinct and appropriate frame for documenting and analysing insights into **common** or normal processes; yet, at the same time, such processes could affect and be affected by multiple stakeholders, thus a case could present itself as an **unusual** or uncommon case (Yin, 2018). Data collected could potentially contribute to an assertion or typicality of the concept of LPM as well as a particularisation around the impacts of implementation of project learning to be articulated (Stake, 1995), especially where interactions or interrelationships are prevalent or emerging.

4.1.3 Justification for choice of methods overall

Since the case study approach can generate a rich picture and insights, it fits as both a stand-alone method and when combined with interview methods. Given the position of lean project management as a "nascent theory arena" (Edmondson & McManus, 2007, p1162), these two methods combined are intended to highlight the particularisation and unique features of the situational context of the case and thus yield the greatest learning (Bell et al, 2019, p64).

4.2 Interview Study

This section outlines and justifies the key methods employed, from design to collection and analysis, for the interview study, before moving on to the case study methods.

4.2.1 Unit of Analysis

An important part of any research is the unit of analysis, as the entire research is based upon it. According to Neuman (2011), the unit of analysis is "the units, cases, or parts of social life that are under consideration. They are key to developing concepts, empirically measuring or observing concepts, and using data analyses" (p69). The unit of analysis could be individuals, dyads, groups or organisations, or any bounded system that is determined by the researcher (Stake, 1995; Merriam & Tisdell, 2015) and the research question (De Carlo, 2018). At this stage in the research, defining the unit of analysis is crucial as the conceptual framework, methodological decisions, data collection techniques and sampling play an important role in the subsequent parts of the overall research (Lincoln & Guba, 1985; Cavana et al, 2001; Neuman, 2011; De Carlo, 2018). Since the research question is concerned with exploring the utility of lean project management, the unit of analysis is the individual. The individual is defined as the individual PM practitioner (or interviewee participant), as determined by the inclusion criteria (see section 4.2.3). Additionally, the unit of observation (De Carlo, 2018) is also the individual, since the data collected focuses on the individuals' perceptions, opinions and lived experience of the implementation of LPM through the semi-structured, in-depth method of interviewing. These questions allow data to be collected in the course of learning something about the unit of analysis (De Carlo, 2018).

4.2.2 Sampling strategy and methods

The strength of qualitative studies in the interpretivist tradition lies in the capacity to provide insights, rich details and thick descriptions (Jack & Anderson, 2002, p473). In order to achieve this, a suitable sample from within a relevant population must be determined. Easterby-Smith et al (2018) define population as "the whole set of entities that decisions relate to, whereas sample relates to a subset of those entities from which evidence is gathered" (p103). Using the analogy of a bowl of chicken soup, the authors suggest the contents of the bowl (the flavoured soupy liquid) constitute the discipline. In this study, project management could be said to be the wider population, the chunks of chicken are those working in *lean* project management, and a tablespoon dipped into the soup to taste it could be said to form the sample. This is also illustrative of the notion that it is the sample (the size and contents of the spoon) that matters more than the population to which it belongs (*ibid*), especially as the current research is not intended to be generalisable or representative at this stage. The aim is to taste a focused and precise sample through exploration of *one* spoonful, or the sampling proportion (Nguyen, 2005). Since the constructs of "lean project management" and recognition of the distinct role of "lean project manager" are not yet well established in the literature, as supported by the findings of Chapter 2, therefore the size of the bowl and the nature and constitution of the specific chosen spoonful are not important.

Sampling methods are intended to maximise efficiency of resources and validity, according to Morse and Niehaus (2009). A purposive sample, also referred to as a judgmental or expert sample, is a type of nonprobability sample (Lavrakas, 2008). Such sampling is most appropriate for research that needs to target specific elements of the population, is exploratory in its purpose and where there is no need for a representative sample (Daniel, 2012).

4.2.2.1 Purposive sampling

Purposive (or purposeful) sampling is a technique widely used in qualitative research for the identification and selection of information-rich cases for the most effective use of limited resources (Patton, 2015). This involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a phenomenon of interest (Cresswell & Plano Clark, 2011). In addition to knowledge and experience, Spradley (1979) and Bernard (2002) note the importance of availability and willingness to participate, and the ability to communicate experiences and opinions in an articulate, expressive and reflective manner. Of the many purposive sampling techniques within qualitative research, the following sections describe and justify the convenience sampling, opportunity sampling and snowball (or chain) sampling methods employed within the research (Patton, 2015). What these have in common is the fact that the sample builds as the enquiry progresses during field studies. Patton (2015) also suggests that the strengths of qualitative fieldwork flexibility is the ability of the researcher to adapt the sampling strategy, based on new insights and new opportunities that present themselves as the fieldwork progresses.

4.2.2.2 Convenience and opportunity sampling

Convenience sampling seeks interview participants that are easiest to obtain (Bryman, 2016; Saunders et al, 2019), and is a type of nonprobability sampling in which people are sampled simply because they are "convenient" sources of data for researchers (Lavrakas, 2008). Similarly, opportunity sampling can allow researchers' access to groups that would remain hidden if they had relied on conventional sampling techniques (Brady, 2006). As the name suggests, opportunity sampling uses the knowledge and attributes of the researcher to identify a sample; for example, using a researcher's local knowledge of an area on which to base a study or using a

researcher's past experiences to contact participants or gatekeepers *(ibid)*. Most importantly, both sampling methods together allow the researcher to define who and where to study, thus increasing time and cost-effectiveness aspects of the research process (*ibid*, p2).

4.2.2.3 Snowball sampling

Snowball sampling refers to the process of "snowballing", where the potential interview participant is located who fulfils the theoretical or inclusion criteria determined (Warren, 2011). That participant then helps to locate others through his or her networks, including personal, social and/or professional, and they could include acquaintances or strangers known for their perceived experience, knowledge or interest in the phenomenon to be studied (Bertaux, 1981; Lincoln & Guba, 1985; Weiss, 1994; Warren, 2011). It begins by asking key participants and well-situated people, "who knows a lot about….?" (Patton, 2002), and it can be a useful recruitment strategy, especially where finding participants is challenging (Warren, 2011). Snowball techniques can be used to locate those on the ground who are needed to fill in the gaps in our knowledge on a variety of social contexts (Atkinson & Flint, 2001). In this sense, snowball sampling can be considered as an alternative or as a complementary strategy for attaining more comprehensive data on a particular research question (*ibid*). However, it is based on the initial *perception* of the participant, who may not have the exact knowledge of the depth, or range, of the suggested participants' experience. Indeed, the potential to skew the data based on those "too keen" or "least keen" to be interviewed (Kirchherr & Charles, 2018) may have already been introduced, and as such it should not be relied upon as the sole method of sampling (Palinkas et al, 2015).

4.2.2.4 Determining the sample size

It is considered good research practice to provide an estimate (at proposal and planning stages) and rationale for an indication of numbers (Robinson, 2014; Patton, 2015; Saunders & Townsend, 2016). This includes a justification based on underlying philosophical considerations, research purpose, availability of resources, access to participants and saturation features (*ibid*). Qualitative methods place primary emphasis on saturation; in other words, obtaining a comprehensive understanding by continuing to sample until no new substantive information is acquired (Miles & Hueberman, 1994). However, there has been much debate regarding sample size for qualitative research, regardless of the challenge that qualitative semi-structured interviews are unable to make statistical generalisations possible (Denzin & Lincoln, 2005; Bryman, 2016; Saunders et al, 2019). Saunders and Townsend (2016) recommend that participant numbers should always be reported precisely, along with their characteristics and the population from which they were chosen (*ibid*, p848).

Despite the general lack of explicit discussion across the social sciences, the authors examined established and published practice in order to suggest a recommended number to help researchers with planning, conducting and reporting their qualitative research in consideration of methodologically valid, authentic and credible research *(ibid,* p836). The number considered sufficient is between 15 and 60 participants, adjustable for the homogeneity or heterogeneity of the population, and whether single or multi-organisational grouping (*ibid,* p849). Warren (2011) suggests that, to have a non-ethnographic qualitative interview study published, the minimum number of interviews appears to fall between 20 and 30 (p19). Johnson (2011) suggests that the number of interviews needed to explore a given research question really depends on

the nature of the questions and the type of knowledge the research seeks (p13). Thus, Johnson suggests that, rather than a required number, the researcher should feel he or she has learned all there is to be learned from the interviews. However, he recognises the ambiguity of how and when this should be conducted, considering each qualitative piece of research has its own "acceptable and reportable truth" within a diverse and multi-faceted community (*ibid*. p14).

4.2.2.5 Choice for the work at hand

This research was informed by the guidance outlined above and a combination of all approaches as outlined in 4.2.2 was used. Between 20 and 60 interviews were planned, although 40 semi-structured interviews were conducted. Later sections explain how this number was deemed relevant for data saturation. The researcher considered the types of interview participants who may be capable of shedding light on the study phenomenon (Flyvbjerg, 2006; Thomas, 2016), and this is explained further below.

4.2.3 Recruitment and selection of research participants

Based on the sampling strategy aim of gaining the most suitable and relevant interview participants, careful recruitment and selection of experienced individuals for interview participants was undertaken (Flick, 2002). The processes for recruitment of participants and gaining their consent were undertaken in line with ethical approval, obtained 17.5.2018 (and explained in section 4.6). The selection of potential research participants was informed initially by the researcher's personal and professional networks by way of initial convenience sampling, followed by snowball sampling as and when the opportunity arose. All interview participant sampling was based on the following inclusion criteria:

- Individuals holding/have held Project Management roles, including titled as Lean Project Manager/professional

- Experience of implementing lean project management with at least five years' experience working within the project environment

The inclusion criteria aimed to be as inclusive as possible, therefore interview participants could be currently or recently employed within any (private, public or voluntary) sector and, similarly, no discipline was excluded. Where interview participants were not currently working within project management and/or lean project management but could demonstrate expert knowledge and experience, for example, through well-established and known membership of professional, governing bodies, senior leadership positions, policy positions and/or having published in peer-reviewed papers, such participants were also not excluded. Although selection of interview participants who reflect such characteristics is important, it was important to also include those who *may not, or do not*, reflect such characteristics, as suggested by Lincoln and Guba (1985). This can be an effective way to avoid the pitfall of drawing easy or early conclusions of the research (Seidman, 2006). This also takes account of potential participants sourced via snowballing where the researcher is not already a direct contact, and thus the characteristics are as yet only perceived but not fully known to fulfil the inclusion criteria. This serves the purpose of building the potential pool of participants, enabling maximum inspection and exploration (*ibid*).

It is only by gaining access to interview participants that the researcher is able to obtain information and data. Convenience sampling, as outlined earlier, enabled early data to be gathered since the researcher was able to obtain interview participants who

would very quickly be in a position to agree or refuse an interview or suggest others as part of snowballing. Since qualitative research has the potential to enquire about and challenge the often personal assumptions of participants, whether known to the researcher or not, it is even more important to conduct ethically-practised interviews (Brinkmann, 2007; Tanggaard, 2007, 2008), even if the interview participants themselves are unaware of or unconcerned about ethics (Neuman, 2011).

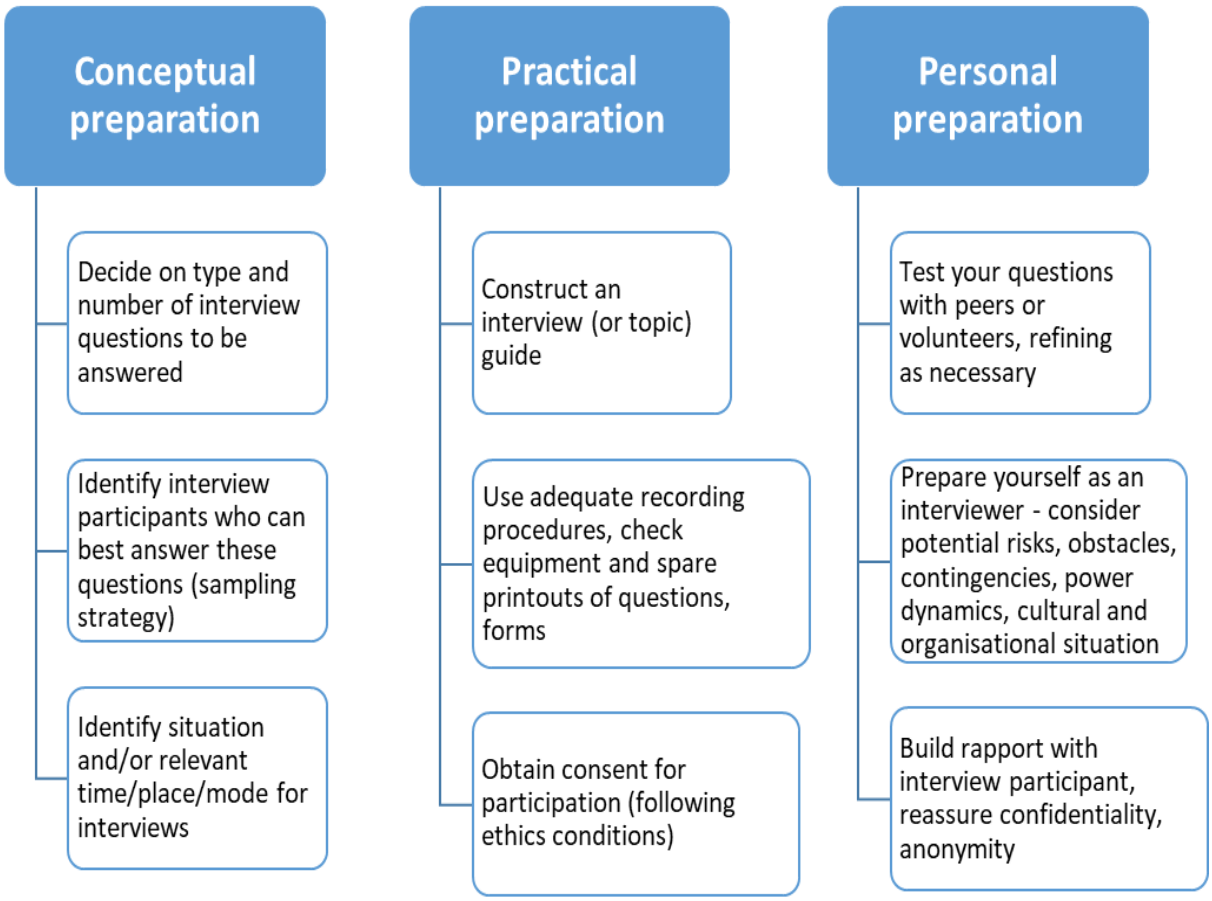
Using the holistic approach outlined in Figure 4.3, the researcher was prepared to conduct interviews, remaining flexible and attentive to the variety of responses and meanings that could emerge as the interviews progressed (Kvale, 2007; Warren, 2011). Additionally, the researcher was mindful of the potential financial and emotional cost of conducting interviews (Johnson, 2011), including, but not limited to, the amount of time and effort that would be required to consider each potential participant, prior to accepting them into the study sample, as well as the potential length of time required to conduct interviews with participants considered to have the insights and the experiences of the phenomenon in question (McGrath et al, 2019).

All interviews were fully consented to in advance regarding conducting, recording and analysing, in line with ethical approval. All interview participants received a very brief verbal reminder of the research purposes, and how their data would be collected and analysed, despite having already consented verbally and in writing. This served as a quick reminder as well as a further opportunity for the interview participant to ask any further questions prior to recording. All ethical processes are detailed in section 4.6.

4.2.4 Preparation for Interview data collection – principles and processes

The following figure illustrates the essential steps taken by the researcher in order to adequately prepare for conducting the interviews, inspired by the approaches from Creswell (2013) and McGrath et al (2019). The order of steps takes into account preparation of the content, format and structure of the interview data to be collected, but additionally incorporates essential personal and practical factors especially considering the emphasis of data collection is the exploration of human phenomena, which are affected by and affect various probes and descriptive elements (Roulston, 2013). In this way, researchers need to be aware of the different expectations that an interview participant has, which may well be different from those of the researcher. Considering the potential cultural and power dimensions of the interview requires careful planning (McGrath et al, 2019). To conduct in-depth interviews, the structure of the interview requires the three aspects of focus, detail and meaning, which should be demonstrable across all preparation areas (Seidman, 2006). Figure 4.3 breaks this down into helpful preparatory steps:

Figure 4.3 Preparatory steps for Interview data collection



Source: adapted from Creswell (2013) and McGrath et al (2019)

4.2.4.1 Type of interview questioning

In-depth interviewing is appropriate for collecting data on an individual's self, lived experiences, values and decisions, occupational ideology, cultural knowledge and perspective (*ibid*, p3), and flows from the nature of the research question. Johnson (2011) suggests that, if the researcher is also a "member" of the type of activity or phenomenon under investigation (as was the case), he or she can use in-depth interviewing to check their own understanding, as well as stimulate reflection of self and others (p5). Obtaining such deep understandings can allow the researcher to grasp and articulate the multiple views of, and perspectives on, meanings (Johnson, 2011).

However, Johnson (2011) suggests that novice researchers can often have more difficulty in seeing the nuanced or layered meanings of interview participants, even where the researcher has knowledge of their own lived experience (p7). Warren (2011) suggests that the interview process itself is a social interaction which is not easily controlled, and already contains assumptions (including that of social class, race and gender, amongst others) which are situated in the moments prior to interview, as well as "anticipatory notions of what the interview might entail, before the tape recorder is even switched on" (p10).

Such socially situated contexts cannot be eliminated from the data, according to Warren (2011, p11), and the researcher should be aware that, as the interview unfolds and progresses, the interview participant will "incorporate their own sense-making and reflexivity into the process of their own interpretation" (p19). Even if the researcher has an appreciation, knowledge or understanding of the interview participant's perspectives, Warren (2011) suggests that the researcher may not necessarily understand the same meaning. She depicts this process of the perspectives of both researcher and interview participant "dancing together for the moment, but also extending outward in social space, and backward and forward in time" (*ibid*, p19). This is supported by Johnson (2011), who suggests that the interview participant becomes a "collaborative partner with the researcher in the intellectual adventure at hand" (p9). The type of investigation and the process as outlined by these scholars can provide valuable lessons for the researcher, since part of the researcher's learning curve is to hear (as well as listen) to what is being articulated by others' lived experiences (Rubin & Rubin, 2012), despite any prior knowledge of the phenomenon being studied.

Active or **epistemic interviewing** is a type of interviewing practice that uses the interactivity and interpretation in order to develop knowledge, rather than simply conveying experience (Bellah et al, 1985; Holstein & Gubrium, 1995; Dinkins, 2005; Brinkmann, 2007; Tangaard, 2007, 2008; Roulston, 2013). Whereas the descriptive phenomenological method of interviewing (Giorgi & Giorgi, 2003) records the voices of participants with minimal influence from the researcher (Kvale, 1996; Fontana & Frey, 2005), epistemic methods frame the interview participant as someone who is able to justify and account for the phenomenon being explored (Brinkmann, 2007). In the epistemic interview, opinions and beliefs (*doxa*) and self-interpretation based on previous experience and knowledge (*episteme*) are brought about by conversational discourse between the interview participant and researcher *(ibid*, 2007).

4.2.4.2 Development and Design of the interview questions

The development process for interview questions was based the researcher's own experience of practice within the field of project management and the extant literature surrounding the nature and type of lean implementation within projects. The following interview guide (Table 4.2) was developed inspired by the preceding process in line with the objectives of the research. These questions were shaped by underlying philosophical perspectives and aimed to invite discussion, exploration and expansion with relevant probes (Ritchie & Lewis, 2003) using an open format with all participants (Kvale, 2007).

Table 4.2 Interview questions

Questions:	Purpose (and link to research objectives)
1. **What** is your understanding of Lean Project Management (LPM)?	To establish understanding of the perception of LPM in the participant's own words (Objective 1)
2. **How** do you measure progress in projects managed by lean principles?	To gain semblance of experiences within context of working practices (Objectives 1, 2, 3)
3. **How** is progress recorded?	To elicit further detail, description of the question above (Objectives 1,2,3)
4. **How** could LPM enable more progress within your environment?	To enable consideration and reflection of phenomena within the participant's environment (Objectives 2,3)
5. **What** in your opinion are the barriers to implementing LPM in projects?	To enable reflection and consideration of working practices to enable improvement (Objectives 2,3)
6. **How** would you define learning from projects managed by lean principles?	To establish understanding of the perception of project learning, in the participant's own words (Objective 1)
7. **When** and **how** does learning take place? By whom?	To elicit further detail and description of the question above (Objective 1)
8. **What** is your understanding of Organisational Learning?	To establish understanding of the perception of organisational learning in the participant's own words (Objective 1)

4.2.5 Conducting Interviews

In total, 16 interviews were conducted in the UK, 20 in Germany, one in Switzerland, and three with participants who considered themselves as working globally. Demographic data from the Interview study is presented in detail in the Appendices and key highlights are provided in Chapter 5.

4.2.5.1 Mode of interview data collection

The researcher considered and employed various techniques to gather data via interviews and made use of face-to-face, telephone and video interviews. The advantage of using telephone and video interviews meant that geographical distance was not an issue, as well as reducing the need for travel time to different locations for the researcher. Additionally, each interview participant was located in a place of their choosing, which may have helped them to feel more at ease. However, only one interview was conducted over the telephone, and four via video (Skype), with the risk of losing or compromising social cues considered (Opdenakker, 2006).

4.2.5.2 Time horizon for interview data collection

In terms of the time horizon for collecting interview data, the planned timelines were May 2018 until Dec 2018, to undertake up to 60 interviews as a first phase before moving onto case study elements. This may have been unrealistic and, in reality, the interviews were sporadic across a longer time span (Bell et al, 2019), since many of them fitted in within specific scheduled periods of time spent in the UK and Germany, and also coincided with case study observations. Additionally, as interviews fitted in with the business activities of the interview participants, the researcher felt that she had not yet reached full saturation as at December 2018, with 24 interviews concluded at that time point. The researcher felt that data saturation had occurred after around 27 interviews; however, due to the opportunities for access to interview participants including those already set up in advance, the researcher continued into 2019, and thus saturation was confirmed.

4.2.5.3 Interviewing style and format

The researcher has a responsibility to facilitate the social space in order to instigate ongoing dialogue (Bourdieu et al, 1999; Roulston, 2013) and create the circumstances conducive to knowledge production. This deconstructs previously held "fixed knowledge", and new opinions and beliefs are refined to develop "new knowledge" (Brinkmann, 2007, p 1127). Typical conversational discourse might include asking questions that interview participants can consider in terms of values and goals that are important in social or professional life (Bellah et al, 1985). Examples of these value-rational questions (Flyvbjerg, 2001) can be demonstrated by question numbers 4 and 5 (Table 4.2), which offer the interview participant the opportunity to become part of the knowledge-generating journey, helping to co-create foundations and platforms for knowledge to develop (Dinkins, 2005). Gubrium and Holstein (1995) recommend careful and ethical use of in-depth and epistemic interviews, since they can increase the concerns of interview participants in 'deprivatising' their lived experiences. This can be avoided by the researcher acting as a non-judgmental mirror of the interview participants' feelings and beliefs with empathy and warmth (Brinkmann, 2007).

Thus, a consistent line of enquiry was undertaken with each interview participant through semi-structured questions, as outlined in Table 4.2, whilst remaining fluid to the order and mode of questioning (Rubin & Rubin, 2012). When appropriate, the researcher also enabled reflective pauses and did not discourage silences (Randall & Koppenhaver, 2004). Silence can be challenging for the researcher but also reminds us of the delicate balance and difference between 'hearing' and 'listening' which Rubin and Rubin (2012) endorse. Having conducted previous research with clinical practitioners around difficult lived experience issues and challenges (Dowson, 2019), the researcher had some prior experience of knowing when to, and when not to,

respond, follow-up or probe; therefore, silences were not discouraged where it was clear the participant was paused in thought and self-reflection. Similarly, the sequence of the questions was not the same for every interview, as it depended upon the nature and flow of the conversation and also the context of the situation(s) being described and elaborated during each interview.

4.2.5.4 Recording of data

Audio recording was undertaken using a high-quality dictaphone, and transcribed *verbatim* (Kvale, 1996), or 'word for word', by the researcher. The benefits of using a voice recorder are that the researcher can concentrate on listening, remaining focused and alert to the needs and cues of the interview participant (Bryman, 2016; Saunders et al, 2019). Enabling a speedy rapport with the interview participant was vital in helping them feel at ease with the physical presence of a recorder, which Bryman (2016) suggests can sometimes cause initial alarm when someone is confronted with a microphone (p483) despite having understood and consented to the process. Each audio recording data file was removed from the recording device and transferred onto the researcher's secure university personal file store. Interviews lasted between 20 minutes and 90 minutes, and a total of just over 30 hours of content was collected.

4.2.6 Organisation of data prior to analysis

Miles and Hueberman (1994) suggest that the methods and processes for analysing data should be as rigorous as the methods and processes used for collecting the data, regardless of the philosophical and methodological approaches. Thus, the general inductive approach outlined by Thomas (2006) is helpful in understanding meaning in complex data through the development of summary themes or categories from the raw data. The approach is inductive since it enables interpretations of raw data (Dey, 1993; Bryman & Burgess, 1994; Jain & Ogden, 1999; Collis & Hussey, 2013), and this non-

technical set of procedures is particularly useful in assisting the researcher to make judgements about what is important and what is not, therefore establishing clear links between the research objectives and the summary findings (Thomas, 2006).

Transcriptions of 40 audio recordings were undertaken by the researcher immediately following the interview. Transcription can be described as transforming the information provided orally from the interview participant into a written form (Kvale, 1996, 2007). This is again essential for both the outcome of the research and for the learning curve of the researcher, in determining their own style and approach (Kvale, 1996, 2007). The challenge of converting the raw data from interview transcripts containing rich, large, complex and context-bound data and information (Bryman, 2016; Easterby-Smith et al, 2018) is to create a more transparent format which allows the researcher to break down information before finding meanings from it (Creswell, 2013). This takes the form of coding, which begins with preparing the data before close reading of text, developing the information into categories, and refining and adding descriptors to categories, until segments of relevant and appropriate text are assigned into categories for further consideration. A summary of the essential steps can be found below:

- **Preparation** of raw data, also known as data cleaning – finding and eliminating errors, checking for incorrect, missing or duplicate values, ensuring same format for specific variables (Onwuegbuzie & Byers, 2014)

- Close **reading** of text, which enables the researcher to obtain a sense of familiarity with the content and begins the processes of deep(er) understanding. Given the self-transcription of all interviews, this additionally enabled the researcher to remember various social and contextual cues and memories from the interviews, which aided this process of familiarity (Kvale, 2007).

- **Creation** of categories, where the researcher identifies and defines initial categories or themes as a pre-analysis activity. Generally, high-level themes are likely to be derived from the research aims, and lower levels from familiarity, recognition and understanding (Thomas, 2006). This is a continuous and iterative process which the researcher should undertake, based on their knowledge of the topic and sensitivity for the language used by the interview participant (Kvale, 2007). Categories are created based on segments of text which are attached to them based on the researcher's identification or allocation of meaning (Thomas, 2006). The researcher used a combination of Excel and NVivo software to assist with the organisation and categorisation of data prior to data analysis. This was particularly necessary since the 40 audio and transcription files contained large amounts of data.

- **Refining** and shaping categories: assigning segments of text to more than one category, essentially starting to identify and build up the evidence for categories. This also includes further delineation of categories, refining descriptions of them, and dividing or merging categories and text, based on the continuous identification of the researcher's emerging insights (Thomas, 2006). This pre-analysis activity leads naturally into full analysis, which is described below.

4.2.7 Analysis of interview data

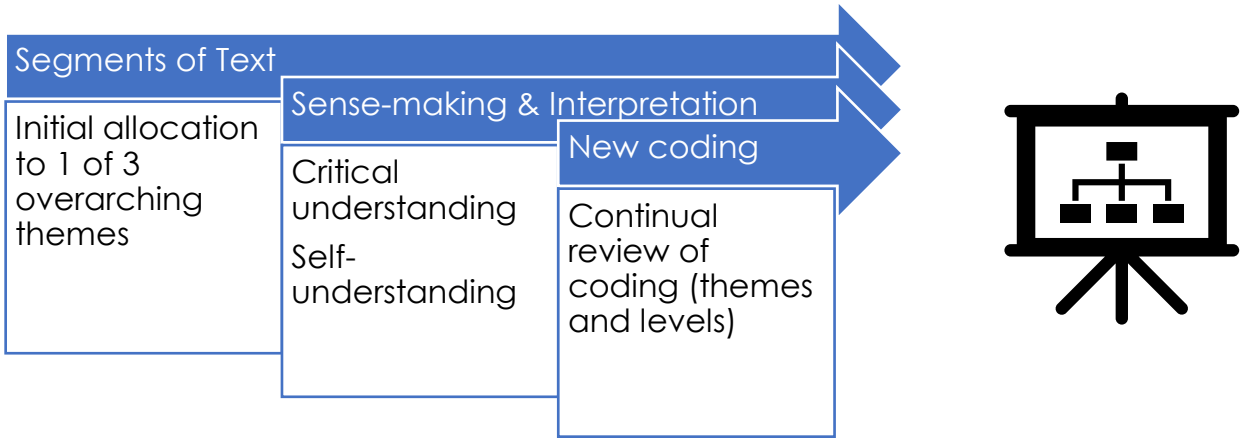
Content analysis was used initially to determine a sense of the overall dataset, such as the frequency of specific ideas, concepts, terms and other characteristics which helped to structure the initial categories (Allen, 2017). This was then followed by thematic analysis (Braun & Clarke, 2006), using a process of interpretation to go beyond the structure and magnitude to allow a deep and critical explanation of the data

(Kvale, 2007). Thematic analysis was employed to identify patterned meaning across a dataset, providing a systematic, accessible and rigorous approach to coding and theme development (Howitt, 2010). Its strength as a method is characterised by the fact that it is theoretically flexible and can be used in conjunction with a variety of theoretical assumptions and approaches, and as such has been re-named reflexive thematic analysis (Braun, Clarke & Hayfield, 2013; Braun & Clarke, 2020). Template analysis was undertaken as part of thematic analysis for structuring the data and providing direction (Saunders et al, 2019). The process requires establishing a very basic provisional list of codes based on anticipated responses and theoretical sensitivities, also known as *a priori* codes (Bulmer, 1979; Maxwell, 2013).

Although using *a priori* codes is frequently referred to as a deductive form of analysis, while building the codes during the analysis would be inductive, a third option would be a hybrid approach, where the researcher begins with a set of *a priori* codes and then adds to them as the data is examined inductively (Morgan, 2017). The researcher followed this hybrid approach and created an initial set of nine broad categories for coding, loosely based on the questions within the interview guide (Coffey & Atkinson, 1996). The researcher applied relatively descriptive coding directly to the data at the lowest levels, then similar codes were gathered into more conceptual categories. This hierarchical coding comprised broad or **high-level** themes first, comprising an *a priori* high-level theme, encompassing successively narrower and more specific ones, including any sub-themes (Bryman, 2016; Jackson & Bazeley, 2019). When no further codes could be identified (theme saturation), coding was deemed to be complete. Creswell (2002) suggests that, once this process is undertaken several times and the researcher feels it is complete, the interview data should appear condensed into three to eight categories. The categories, codes and themes that formed part of the eventual

coding hierarchy were subject to continual splicing and linking (Dey, 1993) as a way of fusing together of a set of codes under an overarching category or theme. This is illustrated in Figure 4.4 below.

Figure 4.4 Process of coding



The meaning of the text was structured in the form of segments of text to identify the themes and sub-themes and this formed the basis of the coding. The final step in the analysis comprised investigation and interpretation to complete the conversion from data to findings. This step includes interpreting the data from the perspective of the overall coding structure and determining or finding associations and relations between themes and meanings (Ritchie & Spencer, 2002).

The data was analysed according to two levels of interpretation (Kvale & Brinkmann, 2015). The first level, self-understanding, consisted of the meaning of the participants' responses. The interpretation can be described as a circular process that moved back and forth between the parts and the whole of the text, a process that Gadamer (2004) called the hermeneutical circle. In the second level, critical understanding, the researcher used common sense and a critical approach to the interpretation, keeping in mind not just the content of the participants' responses but the contextual content

surrounding it (Allen, 2017; Creswell & Poth, 2018). Seven iterations of coding were undertaken at specific times to reach the final hierarchy. A final total of 181 codes were identified, with 5 levels of hierarchy. This comprised three overarching themes, 7 high-level, 41 middle, 95 lower and 35 lowest-level themes for the 40 interviews (see Table 4.3 below and Appendix L for a full, detailed breakdown).

Table 4.3 Hierarchy of codes

FINAL Codes	Final Categorisation of Theme:	Conceptualisation	Implementation	Learning	Hierarchy level
3	Overarching	1	1	1	1
7	High	2	2	3	2
41	Middle	12	5	24	3
95	Low	19	57	19	4
35	Lowest	0	29	6	5
181		**34**	**94**	**53**	

A combination of software, NVivo and Excel was then used in order to structure, organise, extrapolate and illustrate these segments in selecting evidence. The goal was not to provide a synopsis of the text, but rather to locate parts of the text that best address the research question (Allen, 2017). It is important to note that coding is always reflective of the subjectivity and critical interpretation of the researcher, according to Braun and Clarke (2020). Thus, the final themes did not 'emerge', but rather they were 'discovered' by the researcher, who is positioned as active in the research process together with the data, the interview participants and the context (*ibid)*.

4.3 Case Study

4.3.1 Defining the case study

Stake's (1995) definition of the case as a "bounded system, a specific complex, functioning thing, an integrated system that has a boundary and working parts" (p2) is used as the definition for the case study. Merriam (1998) supports this view and further suggests that its *delimitation* is a defining characteristic, "…the case is a thing, a single entity, a phenomenon of some sort occurring in a bounded context." (p27). Merriam's (1998) distinction of case study research as particularistic, descriptive and heuristic aligns well with the constructivist, interpretivist orientations of the researcher. According to Harrison et al (2017), defining and bounding the case is not easy since many points of interest and variable can overlap. However, this is essential for focusing, framing and managing data collection and analysis (p8). This involves being selective and specific in identifying the parameters of the case including the participant(s), location and/or process to be explored, and establishing the timeframe for investigating the case (Merriam, 2009; Stake, 2013; Yin, 2018).

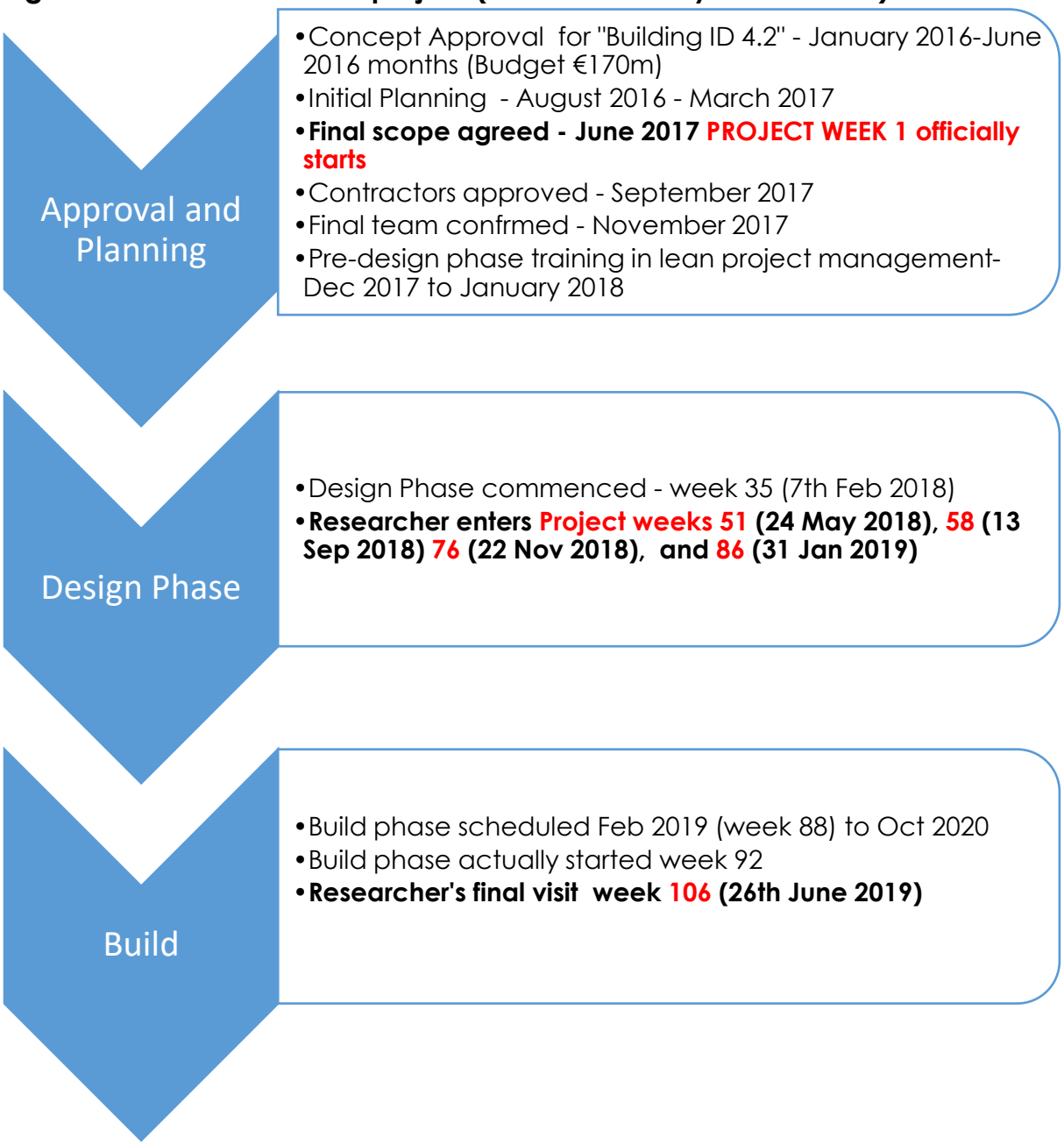
Since a case study requires in-depth methodological investigation and exploration of the particular nature of the programme, activity, process or individual(s) within a real-life context, it requires a clear unit of analysis to achieve the understanding of the phenomenon in question (Collis & Hussey, 2013; Stake, 2013; Bell et al, 2019). In defining the boundaries of the case, the **subject** is defined as the exploration of the phenomenon of LPM and what or how, this impacts on learning. The case identifies its **unit of analysis** at the project level, but also explores learning on the individual level, since data collection and analysis concerns itself with individuals as actors within this practice, including perceptions, social relationships, behaviours, actions and artefacts that occur and exist within the practice of implementation of LPM and learning. This is

facilitated or "bound" within the specific context of a project which is selected as the one likely to yield the knowledge sought, to highlight the particularisation and unique features of the situational context of the case in support of the research aim (Bell et al, 2019, p64). The **object or case for** the data collection to take place is the selected project, and as such serves as the analytical frame (Thomas, 2016), facilitating data collection and analysis process.

4.3.2 Description of the case

The LDMT project is a project to construct a new logistics and office building at the HQ of a well-established company that manufactures industrial engineering machines, tools and parts. The client company undertook a strategic decision to specifically employ lean philosophy and Last Planner System (Mossman, 2013) from the detailed design planning stage. This was the first recorded instance of this for the client company, which has used lean extensively within its manufacturing operations, and in the construction phase of previous projects, but not for the entirety of the design phase and construction of new builds. Figure 4.5 illustrates the specific timeline for this construction project and demonstrates the insertion point of the researcher within the timeline. Training and facilitation of lean principles were conducted by an external commercial lean consulting company which trained the project team during the approval and planning stages and continued to provide weekly facilitation throughout the design and construction phases.

Figure 4.5 Timeline of LDMT project (researcher entry dates in red)



The agreed goals for the successful implementation of lean within the design and construction phases were as follows:

- Speed up the project by six weeks
- Generate an integrated team between the construction project team and the separate (client contracted) mechanical engineering project team
- Improve the co-ordination processes in design and construction

- Create transparent communication and collaboration between the parties involved including the client organisation

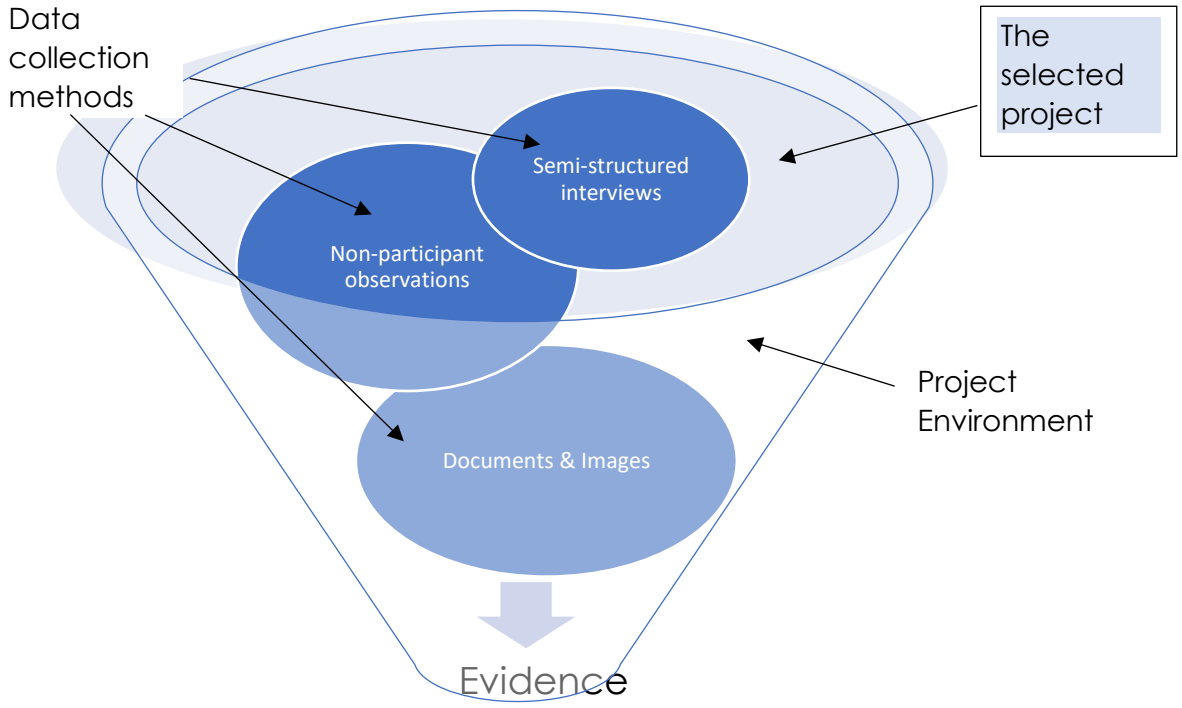
(Source: confidential contractual documentation of consulting organisation)

A design plan for the new build is available in Chapter Five (Figure 5.19) and represents the magnitude and detail of the proposed build that requires a multi-disciplinary team. The team is shown in Table 5.3 in Chapter Five.

4.3.3 Data collection methods

Multiple sources of evidence were collected to contribute to case study data, as illustrated in Figure 4.6 below. Interviews, observations and artefacts such as documents and photographs are amongst the most commonly used evidence sources in case study research, and where used together can create the conditions for rich revelatory insights that might not have been possible from single sources of evidence (Yin, 2018).

Figure 4.6 Case Study data collection process



The same semi-structured interview questions, style and format used for the Interview Study was also undertaken for interviews within the case. Non-participant observation is a data collection method used extensively in case study research in which the researcher enters a social system to observe events, activities, and interactions, with the aim of gaining a direct understanding of a phenomenon in its natural context.

As a non-participant, the observer does not participate directly in the activities being observed (Mills et al, 2010). As a method, it provides unique, contextualised insights into events and activities and the meanings that they hold for members of the setting, enabling the researcher to capture the dynamics of participants' interactions with each another and with their work environment, and to do so over time, observing processes as they unfold (Liu & Maitlis, 2010).

The collection and analysis of artefacts, namely documents and images, of the phenomenon in action can provide background information and may corroborate (or refute) observational and interview data, but they are useful in clarifying and perhaps explaining the situation at hand (Yanow, 2007, p. 411). Prior (2003) suggests that documents form a field for research in their own right, since they are situated, collective social products, produced and consumed in organised settings (p26.) How they function – and the dynamic involved in the relationships between their production, consumption,n and content – is considered an important part of social scientific research (*ibid,* p26). As a research method, document analysis is particularly applicable to qualitative case studies; as Merriam (1998) pointed out, 'documents of all types can help the researcher uncover meaning, develop understanding, and discover insights relevant to the research problem' (p. 118). This includes not only technical and non-technical content, e.g. reports, memos, plans, (Mills et al, 2006), but also data on the

context within which the participant operates, e.g. background information, historical insight (Bowen, 2009).

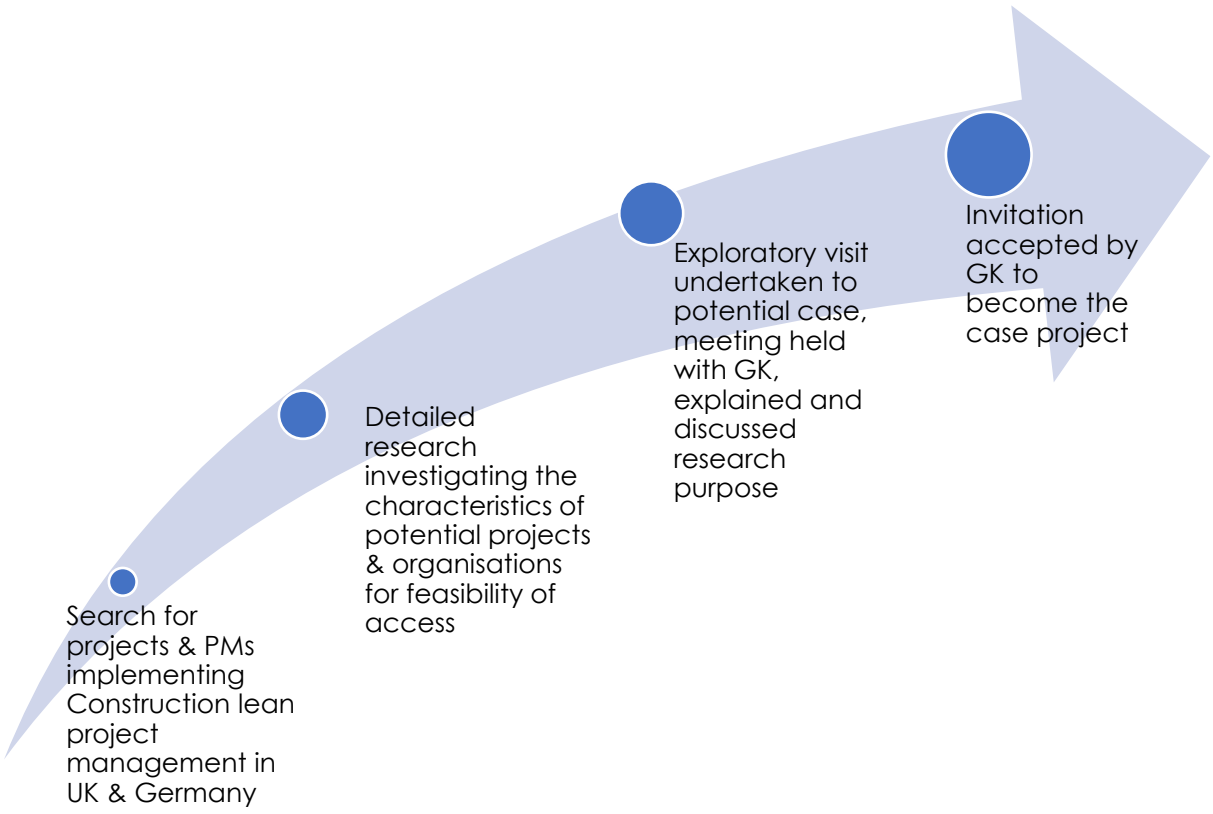
Whilst there are challenges, strengths, and drawbacks of multiple sources of evidence, gathering and analysing evidence from multiple sources, as opposed to a single source, is recommended for enhancing the quality of case studies (Yin, 2018). Collective alignment of these elements articulates a justifiable framework for the research study and cultivates trustworthiness in the methods used for construct and internal validity, reliability and credibility of the research findings *(ibid)*.

4.3.4 Selection process for the chosen case

Following ethical approval in May 2018, the researcher approached the selection process by drawing on the case study protocol (see Appendices). This guided decisions and actions, particularly when investigating potential projects. Extant literature, and advice and guidance from academic and professional colleagues steered initial thinking that the Construction industry might prove a suitable context for the case. To increase transparency, the Construction industry was selected as the researcher had little to no prior knowledge of the discipline (Liu & Maitlis, 2010) having never worked professionally within the construction industry. Background research into project-based organisations or consultants that were currently or had recently been involved in the project management of lean implementation was then undertaken. An initial search was undertaken on any news or blog items within the public domain, including social media and company websites. Since the first 12 interview participants were sourced from the UK and Germany for the Interview Study, the search was limited to these locations initially, with an option to extend recruitment and selection more globally as required. Several news items were found from registered companies within the UK and Germany and an introductory email sent to each named author. Subsequently, a

project implementing a lean approach for the design and construction of a new building in Germany was identified and approached. An invitation was then offered to the researcher to attend a project meeting as a guest observer. Following the conclusion of the meeting, the researcher had a conversation with the PM, who became the gatekeeper (GK) for the case study. As a contingency, the researcher still asked all potential and actual interview participants during May to December 2018 if they would also be interested in suggesting a project or organisation for the case study aspect, in the event this first project became unviable, or lost to study. The process of selection for the case study is outlined below in Figure 4.7.

Figure 4.7 Selection process for case study



4.3.5 Conducting the case study

Direct and open dialogue from the client organisation via the GK ensured relatively easy researcher access to investigate and explore previously inaccessible phenomena

over several points in time, which potentially offered the sought-after appreciation of the particular nuanced and dynamic situation (Liu & Maitlis, 2010) and rich or revelatory insights (Yin, 2018). Based on the timelines for the case study project overall, the researcher chose to visit the project at selected time points throughout its design phase, between May 2018 and June 2019. This is shown in red in the project scope and timelines in Figure 4.5 presented earlier. This is often referred to as a snapshot study (Thomas, 2016), where the time frame offering the opportunity to collect data and gather evidence is limited or restricted to a particular context or situation. Although the data collected encompasses elements of observation over a period of time, it is important to note that this is for the purposes of convenience of data capture rather than seeking changes over time (Thomas, 2016; Yin, 2018). This is also aligned with Merriam's (1998) approach, which suggests sampling occurs before data collection.

The case study collects and examines evidence for the case of what, and how, the practice of lean project management may impact on project learning. The perception that LPM may create possibilities for learning and collaboration, and in doing so potentially improve practice, is considered a "tentative proposition" until all data from each source of evidence is collected and analysed, at which point it will become an output of the research (Eisenhardt, 1989).

4.3.5.1 Semi-structured Interviews

All project team members were asked if they would like to undertake an interview with the researcher. All held or represented an official, documented role within the project, verified by the GK, and hence fitted the inclusion criteria, as outlined earlier in the interview study. The GK had already confirmed to team members that they were free to choose whether to be interviewed or not during the researcher's first visit and by

email. All subsequent arrangements to undertake interviews were undertaken by the researcher separately and privately with any participants, to protect confidentiality and anonymity within the project.

Interview participants

The table below shows demographic information for the participants in the four semi-structured interviews that took place between May 2018 and January 2019.

Table 4.4 Characteristics of interview participants within the case study

Interview participant Number	Gender	Role in LDMT Project	Internal/ External to LDMT Project	Employing Organisation Size	Current Job Title	Years in Profession	Industry Background
3	M	Lean Facilitator	External	SME	PM	0-4	Lean Construction Consultant
9	M	Project Leader	Internal	Large-Private	Senior PM	11-20	Construction Planner
17	M	Team Leader	External	SME		5-10	Structural Engineering
32	F	Project Manager	External	Large-Private	Senior PM	11-20	Construction Project Management

4.3.5.2 Non-participant observation

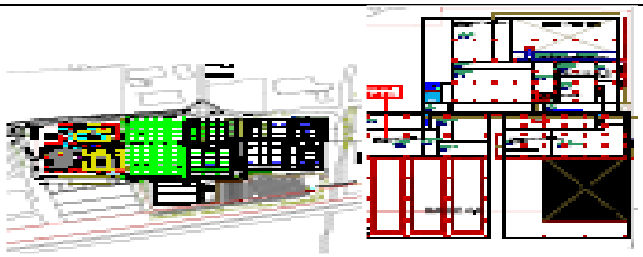
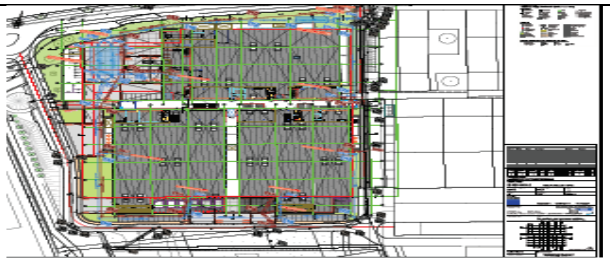
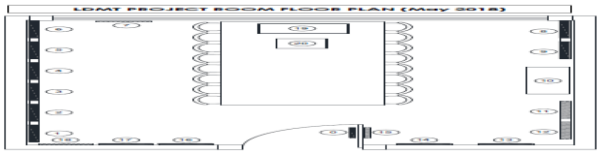
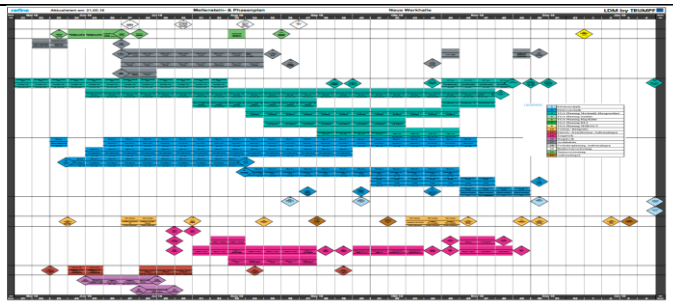
The researcher attended and observed four project meetings, affording the opportunity to directly observe what happens in the real-world setting of a live project implementing the phenomenon being explored (Yin, 2018). The purpose of the project meetings is a weekly progress check to discuss, reflect, and learn from the previous steps, and plan the next steps in the selected project. This is essentially undertaken by working through activities and agendas following the Last Planner System (LPS) (Ballard, 2000; Ballard & Tommelein, 2016), which facilitates this detailed level of progress and is underpinned by the principles of lean project management (Mossman, 2013; Zhang & Chen, 2016). The research focuses on the weekly meeting agenda, activities,

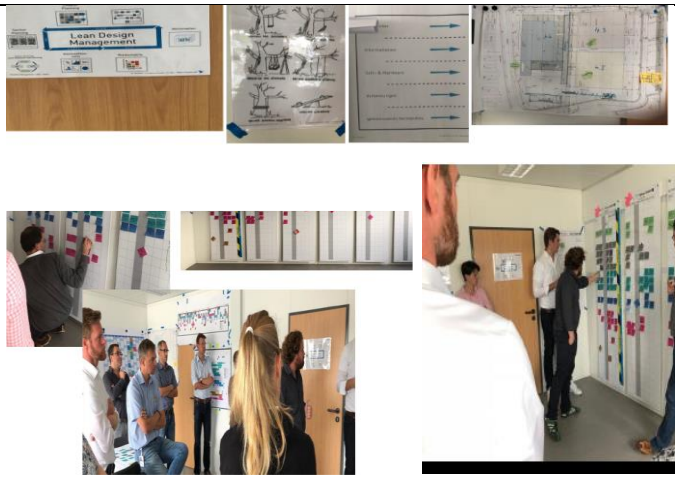
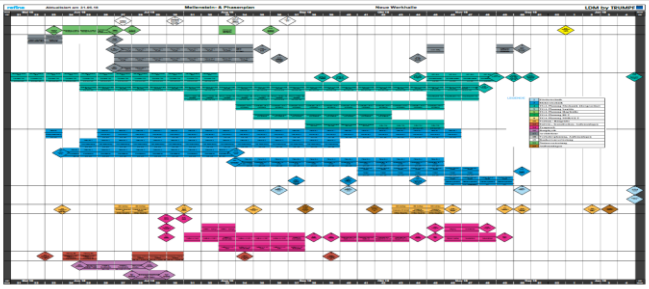
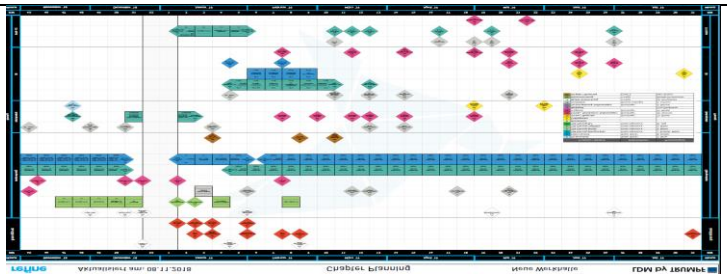
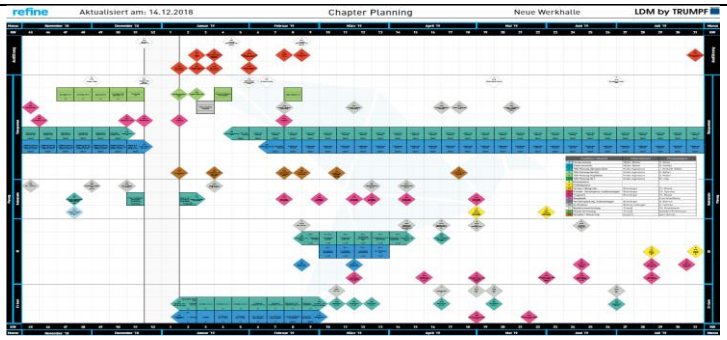
interactions and behaviours, decisions and documentation created during the meeting. Meeting participants understood and consented to the researcher's observation but did not interact directly with the researcher. Each observation lasted an average of two to four hours, was conducted in German, and detailed field notes including reflections were completed. Although the process of attending, translating, note-taking and reflecting on the same day was time consuming for the researcher (Saunders & Tosey, 2012; Yin, 2018), the immediacy of the data is a particular strength and is key to successful non-participant observation (Liu & Maitlis, 2010).

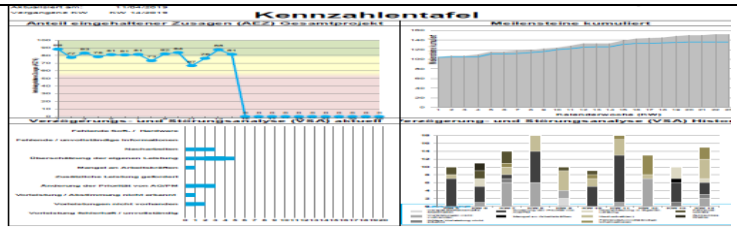
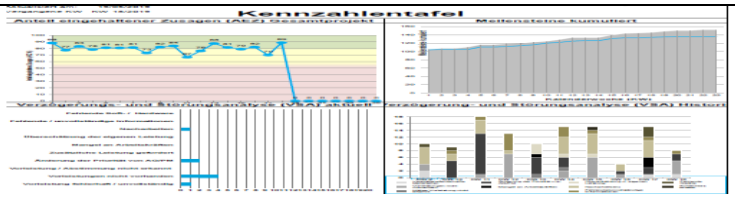
4.3.5.3 Data collection of documents and photographs

Suitable documents were collated at various time points and included documents that were generated at the weekly progress meetings, as well as background project documents, such as the architects' drawings, the client organisation's construction planning documents and spreadsheets. Documents were collected that formed part of the project ranging from the concept and approval phases through to the design and build phases (see Table 4.5). Similarly, photographs were taken by the researcher documenting the Project Room, depicting the physical layout of the room, and activities of team members during the non-participant observations of the weekly project evaluation and planning meeting to capture real-time activity. This is additionally a time-saving method for the researcher since scenes can be captured quickly and can also serve as a memory trigger when analysed together with notes (Thomas, 2016). The researcher was careful to take photographs at appropriate times during the meeting, and at other approved times to be as unobtrusive as possible.

Table 4.5 Documents and photographs included in the case study
(snapshot of images only, larger version in Appendices)

Document title & date	Thumbnail(s) and purpose of document	Author
Overall Concept Planning document 18th Jan 2016 Appendix N	Architect's design concept (18pp)	External Organisation (B-L)
Draft Area Plan for building 4.2 28th April 2017 Appendix O	 Construction Planning for building 4.2 (8pp)	Client Organisation (T)
Global Process Analysis (GPA) chart 7th June 2017, Appendix P	Visual representation of global planning of the whole project across all phases and stages	External organisation (R)
Detailed location plan – drainage systems 20th Feb 2018 Appendix Q	 Engineering planning	External Organisation (B)
Floor plan, Appendix R	 Floor plan showing contents of Project Room at LDMT Project	Researcher
Chapter planning chart (CP) 18th May 2018 Appendix S1	 Visual representation of the milestone and phase planning for a specific point in time until the current planned end date	External organisation (R)

Project Room photographs 25th May 2018, Appendix T		Researcher
Chapter planning chart 31st May 2018, Appendix S2	 Visual representation of the milestone and phase planning for a specific point in time until the current planned end date	External organisation (R)
Chapter planning chart 8th Nov 2018, Appendix S3	 Visual representation of the milestone and phase planning for a specific point in time until the current planned end date	External organisation (R)
Chapter planning chart 14th Dec 2018, Appendix S4	 Visual representation of the milestone and phase planning for a specific point in time until the current planned end date	External organisation (R)

Chapter planning chart 14th March 2019, Appendix S5	 Visual representation of the milestone and phase planning for a specific point in time until the current planned end date	External organisation (R)
Key figures tables (KZT) 11th April 2019, Appendix U1	 Visual display of key measurable criteria illustrating overall project progress	External organisation (R)
Construction site photographs 11th April 2019, Appendix V		Researcher
Key figures tables (KZT) 9th May 2019, Appendix U2	 Visual display of key measurable criteria illustrating overall project progress	External organisation (R)

Using directly generated project documents and photographs from the meetings facilitates a higher degree of reliability and validity and should enhance the confidence and trustworthiness of the data quality. These naturalistic documents were not produced for the purpose of the researcher as biased documents (Saunders & Tosey, 2012), but were genuine, live documents being used by the project team to implement the project. Thus, they can be used to confirm and enlarge the evidence

from other sources (Yin, 2018). The following table summarises the case study data collection method features and characteristics.

Table 4.6 Sources of evidence collected

Source of evidence	N=	How obtained (permissions received from GK)	Format
Semi-structured interview	4	Direct via participants	audio and transcription document files
Non-participant observations	4	Field notes and reflections from researcher during and following each project meeting attended	documents
Documents	11	Direct via project GK	electronic
Photographs	19	Direct via project GK	electronic

4.3.6 Preparation for analysis of case study data

Preparation for analysis of case study data was undertaken in two stages, as per the Interview Study. Transcriptions for interviews and non-participant observations were completed and uploaded to NVivo. The same coding process undertaken for the Interview study was repeated for each source of evidence, helping to facilitate thematic analysis as well as serving as a prediction (or otherwise) to be compared against the case study findings (Yin, 2018). Initial content analysis of each source of evidence was undertaken using textual and photograph segments, obtaining a sense of the overall nature of the data as single sources, and then combined to explore the potential case for LPM and project learning through thematic analysis.

4.3.7 Analysis methods for the case study

Stake (1995) defines analysis as "a matter of giving meaning to first impressions as well as to final compilations" (p71) and as such guides the researcher to analyse simultaneously alongside the data collection (p72). This is supported by Merriam's (1998) sense-making approach to data analysis, and she further suggests that analysis is not completed until all the data is collected and there have been several iterations of consolidation, reduction and interpretation (p178). Additionally, she focuses on the researcher's skills in collecting data, such as becoming an *effective* interviewer, a *careful* observer, *mining* data from documents, which can cause challenges for the (novice) researcher (Yazan, 2015). Thus the researcher requires strategies, techniques and skills which will help them to retain a focus on the link between data collection and theoretical propositions to "promote data validation and holistic coherence of the inquiry" (*ibid*, p14).One such skill is ensuring that the data is converged in an attempt to understand the overall case, not the various parts of the case, or the contributing factors that influence the case (Baxter & Jack, 2008; p555).

Yin (2018) suggests that there are five techniques for analysing case study data – pattern matching, explanation building, time-series analysis, logic models and cross-case synthesis (p223). Since the focus in the case study is on processes and outcomes in the investigation, this lends itself well to casting the 'how' and 'why' to be pattern-matched (Yin, 2018). With a single-case study, successful matching would be evidence for concluding that an original proposition is relevant. Although the case study is mainly exploratory and descriptive, the researcher is mindful that data could also give rise to explanatory content, where pattern matching "explains" a phenomenon to stipulate a presumed set of causal sequences, or "how" or "why" some outcome has occurred

(*ibid,* p228). This is known as explanation building, and is important for achieving depth of understanding, which may lead to critical insights (*ibid,* p228).

The case study also takes account of contextual variables, through the collection of demographic information at individual interview participant level, and observations from and within the project environment being explored. This requires the researcher to be aware of and understand the role such variables play, not only in terms of describing **what** levels and impacts of learning may be caused by the implementation of LPM, but **how, when** and **why** they occur, thus creating some insights into the specific context in which they may occur, or the direction or strength of potential learning outcomes (Yin, 2018). The researcher's consistent and continual iteration of the pattern-matching techniques against all sources of evidence is indicative of Yin's (2018) construct and external validity, Stake's (1995) data source triangulation and Merriam's notion of reliability and validity (Yazan, 2015, p150).

4.4 Quality of the Research

The value or quality of a piece of research is usually verified by using some form of quality check suited to the philosophical position of the study (Johnson et al, 2006). The concept of validity, reliability and objectivity originated from positivism and as such means different things for an interpretivist study (Bryman, 2016). Researchers have continually suggested establishing alternative methods and techniques for quality (Johnson et al, 2006; Symon & Cassell, 2012; Brooks & King, 2017; Bell et al, 2019). According to Creswell and Miller (2000), the strength or quality of qualitative research is achieved with reference to the accuracy of findings from the perspectives of the researcher, participants and reader. Lincoln and Guba (1985) emphasise the need for qualitative researchers to provide various audit trails, in a self-critical fashion, that allow audiences to make judgements for themselves as to the research's rigour. A suitable

and appropriate approach to evaluate quality (Bryman, 2016; Bell et al, 2019) comprises credibility, transferability, dependability and confirmability, which are outlined in the following section.

4.4.1 Credibility

Credibility relates to how believable the interview data may be (Lincoln & Guba, 1985; Miles & Hueberman, 1994; Bryman, 2016) with regard to how well or otherwise the interviewee's 'voice' is reflected and their perspectives communicated within the study data (Punch, 2001). Since the interview participants were involved in the first place, their input is considered essential for this process (Giorgi, 1988; Ritchie et al, 2003). Member checks to establish credibility allow individual interview participants the opportunity to check the contents of the interview transcript; any input following this could increase the credence of the data interpretation (Stake, 2013). The researcher limited member checks to accuracy of content of the transcriptions and offered participants the opportunity to correct factual inaccuracies. Seven interview participants followed up with the researcher to request copies: none made modifications to the content, one made minor translation accuracy modifications from German to English, thus fulfilling the credibility aspect of quality required.

4.4.2 Transferability

Transferability is closely linked to generalisability, which is the applicability of findings to other contexts (Lincoln & Guba, 1985; Remenyi et al, 2003; Ritchie et al, 2003; Bryman, 2016). To check potential application to other people, places, times and contexts, a 'thick-rich description' provides detail about the context of the research (Lincoln & Guba, 1985). This involves providing the greatest possible range of information, including behaviours, experiences and social actions, so that the reader can understand the findings (Geertz, 1973; Lincoln & Guba, 1985; Erlandson, 1993). This is

essential in making the findings meaningful and understandable to the reader and enabling them to make the "transferability" judgement where applicable in their own settings (Korstjens & Moser, 2018; Angen, 2000). Therefore, use of *verbatim* quotes and demographic information is provided in chapters 5 and 6, which include descriptions and details of the ideas, insights and interpretations of the researcher (Creswell, 2013). The research is not intended to be wholly generalisable, but conceptually and contextually specific to illuminate the phenomenon explored (*ibid*). This higher level of analytical generalisation (Yin, 2018) is achieved by providing a supportive argument or case, which may reveal new revelatory insights about the conceptualisation and utility of LPM, and any proposed relationships between LPM and project learning.

4.4.3 Dependability

Qualitative research focuses on describing participants' experience as accurately as possible (Sandelowski, 1997), rather than using numbers *per se* to describe the phenomena of interest. Clearly defined research design and operations can help ensure dependability (Guba, 1981). This is underpinned by the researcher's Code of Ethics which govern the research set down by the researcher's university. The researcher has fully complied with governance including a physical audit trail, which can be checked for the correct storage and access to research-related documentation, such as email trails, interview transcripts, protocols, risk assessments and consent forms, as well as electronic sources.

4.4.4 Confirmability

Confirmability is concerned with the aspect of neutrality, or the degree to which other researchers could confirm findings (Lincoln & Guba, 1985). This includes establishing that the data and interpretations of the data have been clearly derived from research sources *(ibid.)* Bryman (2016) suggests that this is "the extent to which the investigator

allowed his or her values to intrude" (p49). Johnson and Waterfield (2004) explain that qualitative research takes the view that "reality is socially constructed by each individual and should be interpreted rather than measured, that understanding cannot be separated from context." (p122). Angen (2000) suggests that the interpretive approach is the instrument through which the topic is revealed, and as such is already intrinsically linked between the researchers' own understandings, experience and sensitivities as well as those of the participants in a co-operative endeavour (p390). The research does not aim to achieve confirmability as it is an exploratory study to gain and present new insights, but the transparency of approach and the existence of an audit trail as outlined above can facilitate the required trustworthiness and quality of the data sources (Guba, 1981; Johnson & Waterfield, 2004; White et al, 2012).

4.4.5 Verification

Researchers can employ verification techniques as a process or act of evaluation of accuracy (Creswell, 2013). Angen (2000) suggests the process to evaluate the truth of the findings includes "a chain of interpretations that must be documented in order for others to judge the trustworthiness of the meanings arrived at in the end" (p390). This engenders a level of trustworthiness and confidence that can be perceived as quality (Bell et al, 2019). Triangulation offers an acceptable and appropriate view of verification in qualitative research (Yin, 2018). In this research, two separate but connected studies were undertaken. The Interview Study used a single method (semi-structured interviewing) but sourced a multitude of different and varied participant voices and perspectives. Data was collected from different spaces (sites, locations, organisations) from multiple individuals with different but similar roles within a specific, purposive context – the practice of LPM (Angen, 2000; Anfara, et al 2002).

In the case study, multiple sources of evidence contributed to data through three different methods (interviewing, observational, artefact collection), to potentially corroborate the same finding (Patton, 2015). According to Yin (2018), any case study findings or conclusions are likely to be more convincing and accurate if it is based on several different sources of information, following a similar convergence (p172). The multiple sources of evidence essentially provide multiple measures of the same phenomenon (*ibid)*.

The data collection methods for the Interview and Case Study were appropriate to answer the research question. Together the data collected for each study contributed to one overall dataset, which was analysed thematically as a consistent thread running through the research. Thus, the consistency of data collection techniques, and the variety of sources and methods employed together with the diversity represented should enable a high level of confidence and trustworthiness in the research findings. This is consistent with the aim of phenomenological qualitative research in dealing with experiences and meanings and "to capture as closely as possible the way in which the phenomenon is experienced within the context in which the experience takes place" (Giorgi & Giorgi 2003, p. 27).

4.5 Ethics

Ethics in research refers to the moral principles and values that researchers need to follow to ensure their research is conducted honestly, accurately and transparently (Bell et al, 2019; Ghauri & Grønhaug, 2020). As with any type of research, business and management research requires consideration and application of ethical principles; according to Neuman (2011), "Ethics begins and ends with you, the researcher" (p143).

4.5.1 Ethical approval for Interview study

Since data collection, analysis and reporting includes human participants and the use of their data, ethical approval was sought and granted by the LJMU Research Ethics Committee LJMU (Reference: 18/LBS/008) prior to any recruitment or data collection activity. Documents relating to the ethics process can be found in the Appendices and include written consent forms, participant information sheet and a demographic questionnaire. All potential and actual interview participants received this information, provided by email or in person prior to the interview taking place, in line with the conditions of the ethical approval. Interview participants were made aware of the purpose of the research and how the interviews might contribute towards the research, what the interviews would entail and approximately how long they might take.

4.5.2 Informed consent for Interview study

Getting respondents to sign a consent form or securing approval from a research ethics committee is just the beginning of ethical activity. As Miller and Bell (2002) remarked, ethical considerations should form an ongoing part of research, so that considerations come into play before, during, and after research. The participant information sheet additionally contained procedures regarding any decision *not* to proceed following initial consent and to withdraw from the study, re-iterating that interview participants were free to withdraw at any time, without the requirement for a reason to do so. All participants were asked to sign a consent form which related to their decision to proceed at the outset, with audio-recording, the taking of notes during the interview itself, and the possible use of anonymised and unattributed verbatim (Kvale, 1996) quotes in the thesis and for journal articles. Similarly, by completing and signing the demographic questionnaire (Appendix B), the interview participants acknowledged that capturing the contents of their data was important for review, contrast and

comparison to other participants, and recognition of themes, patterns or trends which may help to explore and answer the research question of the study. However, the researcher re-iterated the nature of informed consent and checked the understanding of the interview participant again briefly prior to commencing each interview, regardless of any verbal intent to sign following the interview or having already done so.

4.5.3 Confidentiality and anonymity for the Interview study

Bell et al (2019) suggest that the issues surrounding confidentiality and anonymity extend beyond the ethical and include legal considerations. In the age of strengthened data protection (GDPR, 2018), participants must be assured of protection of their personal data, privacy and consent, but also have to right to "be forgotten" regarding their personal and sensitive data (*ibid*, Art. 17). The types of data considered personal and sensitive under the existing legislation include name, address, photos, an IP address, genetic data and biometric data which could be processed to uniquely identify an individual (*ibid*, Art. 29). Such data was able to be used within the research by way of consent form completion, with an assurance that data would not be able to be traced back to individuals in any form of dissemination or output, including but not limited to publications, blogs, presentations and the thesis.

In research, it is standard practice to use pseudonyms to preserve the anonymity and confidentiality of participants and organisations (Allen, 2017). However, although pseudonymisation is also addressed to clarify some pitfalls and misconceptions, it is not a method of anonymisation, but rather merely reduces the 'linkability' of a dataset with the original identity of a data subject (EC, 2014, p3). For data to be truly anonymised, the anonymisation must be irreversible (GDPR, 2018). As such, personal data that has been rendered anonymous in such a way that the individual is not, or is no longer,

identifiable is no longer considered personal data (GDPR, 2018; ICO, 2020). The principles of anonymity and confidentiality were followed, by the use of initials and numbering for individual interview participants, with related electronic files downloaded and saved onto the researcher's secure university system, which was password protected and only accessible by the researcher. Physical documents such as copies of the signed consent forms and demographic questionnaires were stored in a locked, secure cupboard at the researcher's university.

4.5.4 Ethics for the case study

The case study employed the same ethical principles as the interviews and was in line with LJMU ethical approval and good practice. The support and enthusiasm of the GK was instrumental in researcher access to the project, with an open invitation to visit and/or make contact by email or phone whenever it was required. Out of courteousness, the researcher always checked with the GK that it was still acceptable to visit the project in advance of the scheduled dates in case of any changes in circumstances. Since the project already had different visitors coming to observe (students, trainees, new employees of participating organisations within construction industry), the presence of the researcher at meetings was not unusual or problematic. Following consent from the GK, the researcher briefly introduced the purpose of the case study at the first observation in May 2018 and the GK then followed up with an email to the project members to introduce the researcher on a more formal basis, including contact details and relevant information sheets (see Appendices). The GK additionally granted access to any project documents the researcher requested and consented to photographs of the meetings in line with ethical guidelines. The researcher confirmed full anonymity for involved organisations, the project name and any interview participants. This included blanking out of any logos apparent in

photographs and charts used in the research, and anything else which could potentially identify participants and their organisations.

4.6 Chapter Summary

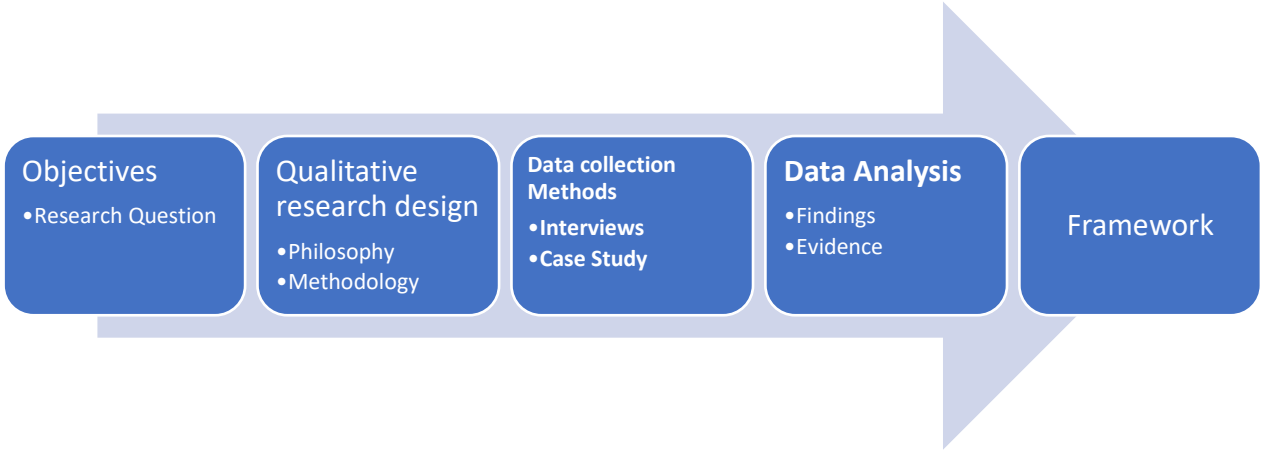
This chapter has presented methods underpinned by methodology and philosophy in order to answer the research question. The selected methods were chosen as the most appropriate ones to explore the research question of what and how can the implementation of lean project management facilitate project learning, based on the specific objectives.

Objective 1 of the research was to identify and assess baseline knowledge and understanding of the practice of lean project management and project learning. The chosen method of in-depth semi-structured interviewing with 40 practising professionals was the most appropriate method for determining this. Reflexive thematic analysis was employed to analyse this rich source of data. Contextual demographic data was also collected in order to determine any themes or patterns occurring, which additionally addresses Objective 3.

Objective 2 sought to explore further the lived experience of this phenomenon through a single, holistic case study within a specific and dynamic situation (a construction project), with multiple sources of evidence collected to cross-verify and validate findings. The methods chosen were semi-structured interviews, non-participant observation, and document and photograph review, analysed again by reflexive thematic analysis. The case study method was chosen as it was deemed the most appropriate to allow potentially rich and revelatory data from in-depth exploratory study which could allow additional issues, relationships and processes to emerge as well as contextual insights within the specified industry (Objective 3). Final findings were generated from reflexive thematic analysis using an interpretive and inductive

approach to data analysis, including analysis and assessment of any contextual data and variables which contributed to the findings. Finding evidence and examples rooted in robust research that may support, illuminate, or provide further insight is essential in supporting clear and deep understanding of the phenomenon of lean project management and its relationships with learning. The intended output of the research is to create an illustrative framework to demonstrate the utility of lean project managements and its impacts on project learning, which is Objective 4. The findings and subsequent illustrative framework form the basis of the following chapters. Finally, this chapter has outlined the detailed processes, sequences, and deployment of each method, with a view to generating confidence in the robustness and rigour of the enquiry, from design to data collection and analysis. All methods were undertaken in line with ethical approval and are fully compliant with all relevant research governance. The following summary diagram illustrates how the methods contribute to the overall research design framework and the output that is intended to result from this research.

Figure 4.8 Summary of research methods



CHAPTER 5: FINDINGS

5. Introduction to Findings

This chapter presents the findings obtained from the Interview Study and the Case Study as contribution towards evidence to achieve objectives 1, 2 and 3 of the research. Key findings are presented through illustrative figures, images, data from statements, observations and reflections, following the approaches, methods and processes for data collection and analysis as outlined in chapters 3 and 4. The following section presents key findings from the Interview Study, followed by the Case Study findings. Finally, a summary of the chapter is provided in section 5.3.

5.1 Interview Study

5.1.1 Overview of demographic data

Before reporting on the findings of the data collected, an overview of the demographic detail for the interview dataset is provided below in Table 5.1 (full details in Appendices). This aims to give the reader a sense of the characteristics and nature of the dataset in order to build up a picture of the sample population overall as well as characteristics of featured attributes.

Table 5.1. General characteristics of interview participants

Interview Participant Number	Gender	Project Type	Country	Organisation Type	Current Job Title
1	F	Construction	Germany	SME	Senior PM
2	M	Construction	Germany	SME	CEO/MD
3	M	Construction	Germany	SME	PM
4	M	Construction	Germany	Large- Private	Senior PM
5	M	Construction	Germany	SME	PM
6	M	Construction	UK	SME	Senior PM
7	M	Manufacturing	Switzerland	Large- Private	Senior PM
8	F	Health & Medicine	UK	Large-Public	PM
9	M	Construction	Germany	Large- Private	Senior PM
10	F	Construction	Germany	SME	PM

11	M	Construction	Germany	SME	PM
12	M	Construction	Germany	SME	Senior PM
13	M	Construction	UK	SME	CEO/MD
14	M	Petrochemical	Global	Large- Private	Senior PM
15	F	Health & Medicine	UK	Large-Public	Senior PM
16	M	Utilities Management	UK	Large- Private	Senior PM
17	M	Engineering	Germany	SME	Senior PM
18	M	IT	Global	SME	CEO/MD
19	M	Engineering	UK	SME	Senior PM
20	F	Transport & Logistics	UK	Large-Public	Senior PM
21	M	Engineering	UK	Large- Private	PM
22	M	IT	UK	Large-Public	PM
23	M	Construction	Germany	Large- Private	Senior PM
24	M	Construction	Germany	Large- Private	Senior PM
25	M	Construction	Germany	Large- Private	Senior PM
26	M	Construction	Germany	Large- Private	Senior PM
27	F	Construction	Germany	Large- Private	Senior PM
28	M	Construction	UK	Large- Private	Senior PM
29	M	Construction	UK	Large- Private	Senior PM
30	M	Construction	UK	Large- Private	Senior PM
31	M	Construction	Germany	Large- Private	Senior PM
32	F	Construction	Germany	Large- Private	Senior PM
33	F	Engineering	UK	Large- Private	PM
34	M	Construction	Germany	Large- Private	Senior PM
35	M	Facilities Management	UK	Large-Public	PM
36	M	Social Enterprise	UK	SME	CEO/MD
37	F	Nuclear	UK	Large- Private	PM
38	F	Construction	Germany	Large- Private	Senior PM
39	M	Construction	Germany	Large- Private	Senior PM
40	M	Construction	Global	Large- Private	CEO/MD

The distribution of participants is based on purposive sampling and hence is restricted to those locations where the researcher's network is more established. The near-even distribution between the UK (16) and Germany (20) enables some comparisons to be made later where relevant. Although over 60% of participants are currently employed within the Construction industry, it can be seen that the rest work in diverse industries.

The generally wide distribution and spread of profile ranges above suggests a high degree of confidence and reliability in the data collection methods and processes undertaken by the researcher. In terms of organisational profile, the following table demonstrates a high number of unique organisations represented within the dataset:

Table 5.2 Organisational profile

Size of interview participant's organisation	Number of interview participants	Number of distinct organisations
Large – Private	22	13
SME*	13	7
Large – Public	5	4
*Definition of SME as per EU definition at https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en	**40**	**24**

There are some key points to note when reading the data tables within the current chapter and the Appendices. The decision to include data on current role as well as current job title was deemed important to understand breadth and depth of roles played across current practice. This is particularly important where interview participants have more than one role, e.g. a CEO can also be employed as a project manager, LPM trainer and/or advisor.

It is also important to note the total number of years' experience in the interview participant's profession as well as length of service within current role. For example, an interview participant could have been employed for a short time within the current organisation, but nevertheless have many years' experience in his/her profession.

Interview participants across the dataset experienced varying numbers of projects. It was important to capture total numbers across the whole dataset as well as for each individual participant, to enable full understanding of the dataset. This breakdown of

information is included in the Appendices, but the average number of projects experienced by interview participants is 7.75.

Over 95,000 words were analysed from the Interview Study, which yielded 2367 unique coding references, or "segments of text". Extracts of these segments are referred to as "statements" within this research. A final total of 181 codes from 40 interviews was generated. An initial coding structure based on the first 10 interviews was undertaken using relatively broad descriptive categories to the data at the lowest levels. This hierarchical coding comprised of three *a priori* overarching high-level themes; Conceptualisation of LPM, Implementation of LPM, and Learning, largely based on extant literature and the researchers' experience as PM professional. These high-level themes as shown in Figure 5.1 were subject to continual splicing and linking (Dey, 1993) as a way of fusing together a set of codes under each theme. Coding encompassed successively narrower and more specific sub-themes (Bryman, 2016; Jackson & Bazeley, 2019). Nvivo Pro (v12) was used to assist with developing, refining and finalising a coding structure. The final coding structure of 181 codes enabled the identification of topics, ideas and patterns. To obtain the final coding structure a cleaning process was undertaken which involved removal of any duplicates and creating or merging of relevant codes that had emerged throughout analysis. This iterative process eventually led to the production of a final coding structure of 181 codes which was checked to ensure relevance of the content (text reference) to the code it had been attached to. When no further codes could be identified (theme saturation), coding was deemed to be complete. This rigorous coding process, in combination with the documented data collection process, ensured reliable and valid results from this qualitative study.

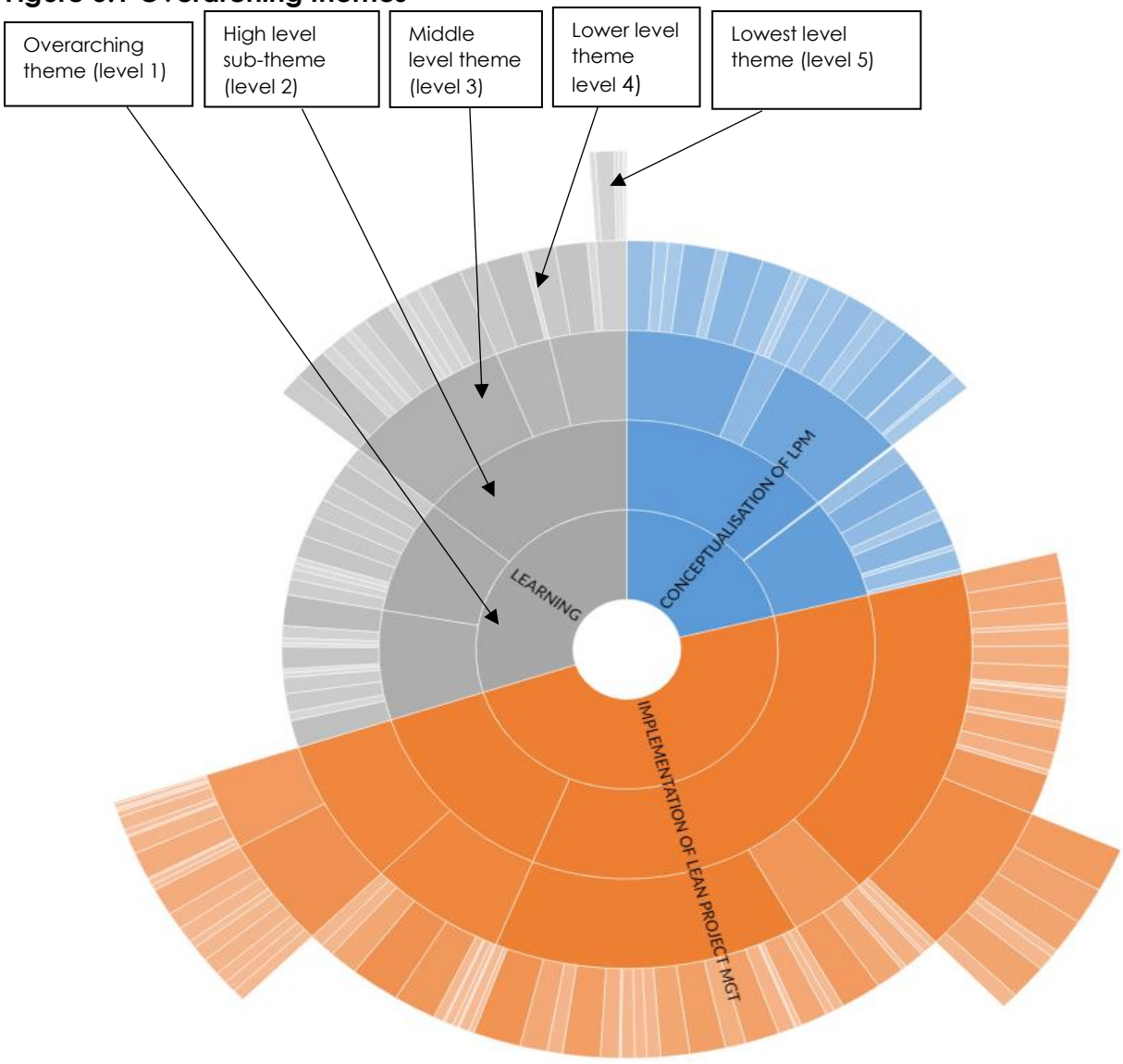
Key findings relating to these themes are presented in the following sections of this chapter, and detailed tables relating to the coding journey, the size and the structure of the coding hierarchy can be found in the Appendices.

Including this data provides contextual information to enhance understanding of the dataset and therefore the phenomenon being explored.

5.1.2 Overview of themes

The figure below presents an overview of the three high level themes of Conceptualisation of LPM, Implementation of LPM, and Learning, together with the numbers of levels (or sub-themes) that were created following analysis of interview data. The lowest Each theme is represented by a colour and the number of levels prevalent within that theme can be seen. The difference in shading and size of the segments is relative to the number of codes that were attributed to the descriptive category identified. For example, the darker the shading, the higher number of references or "text segments" were attributed to that theme or sub-theme. However, this is for information only, to gain a sense of the nature of the distribution, rather than in terms of importance, or ranking. As illustrated below, the highest number of codes were attributed to Implementation of LPM (n=94), followed by responses that were coded to Learning (n=53), and then Conceptualisation of LPM (n=34). These shall be presented in turn, and evidence to support themes will be indicated.

Figure 5.1 Overarching themes

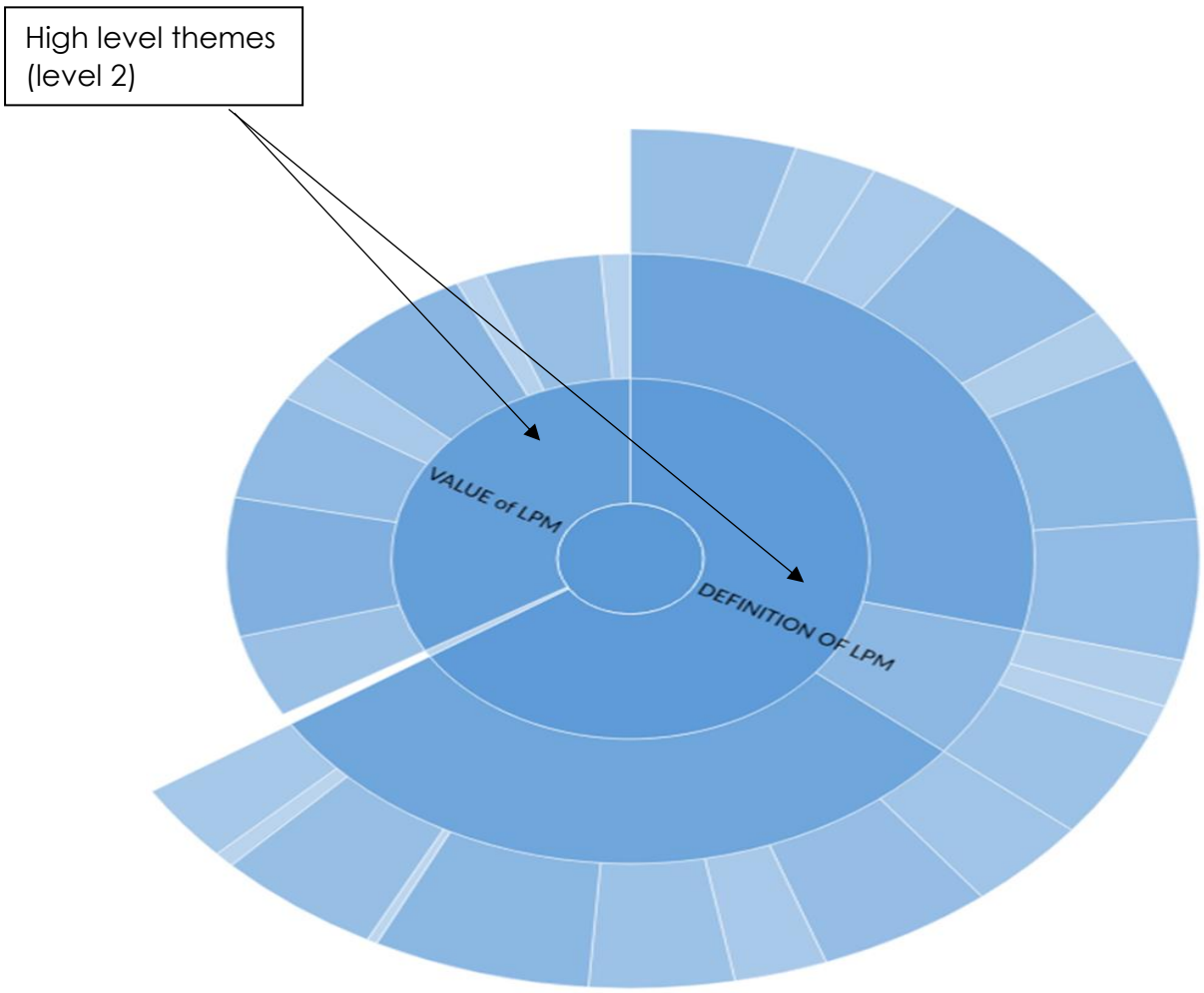


5.1.3 Conceptualisation of LPM

Conceptualisation refers to the process of breaking down and converting research ideas into common meanings, often used to develop an agreement among a user community, as a route to framing meaningful concepts (Sequeira, 2014). The research aims to find a meaningful frame for the concept of LPM, which is generally understood (although not necessarily or explicitly agreed) by the interview participants based on their perceptions and experience of practising LPM. Four hundred and eighty-three

analysed statements from interview participants were attributed to the iterative coding structure as outlined in Chapter 4, which led to an understanding of the meaning of the concept of LPM. This identified two distinct high-level sub-themes in terms of the perceptions of its value and definition. Value of LPM relates to the worth of LPM as articulated by interview participants, whereas the definition was an attempt to formally define the term LPM. The high number of statements able to be coded may also be demonstrative of the level of comfort and ease felt by participants, enabling them to express and articulate themselves, as demonstrated by the number of levels and segments, illustrated in Figure 5.2 below:

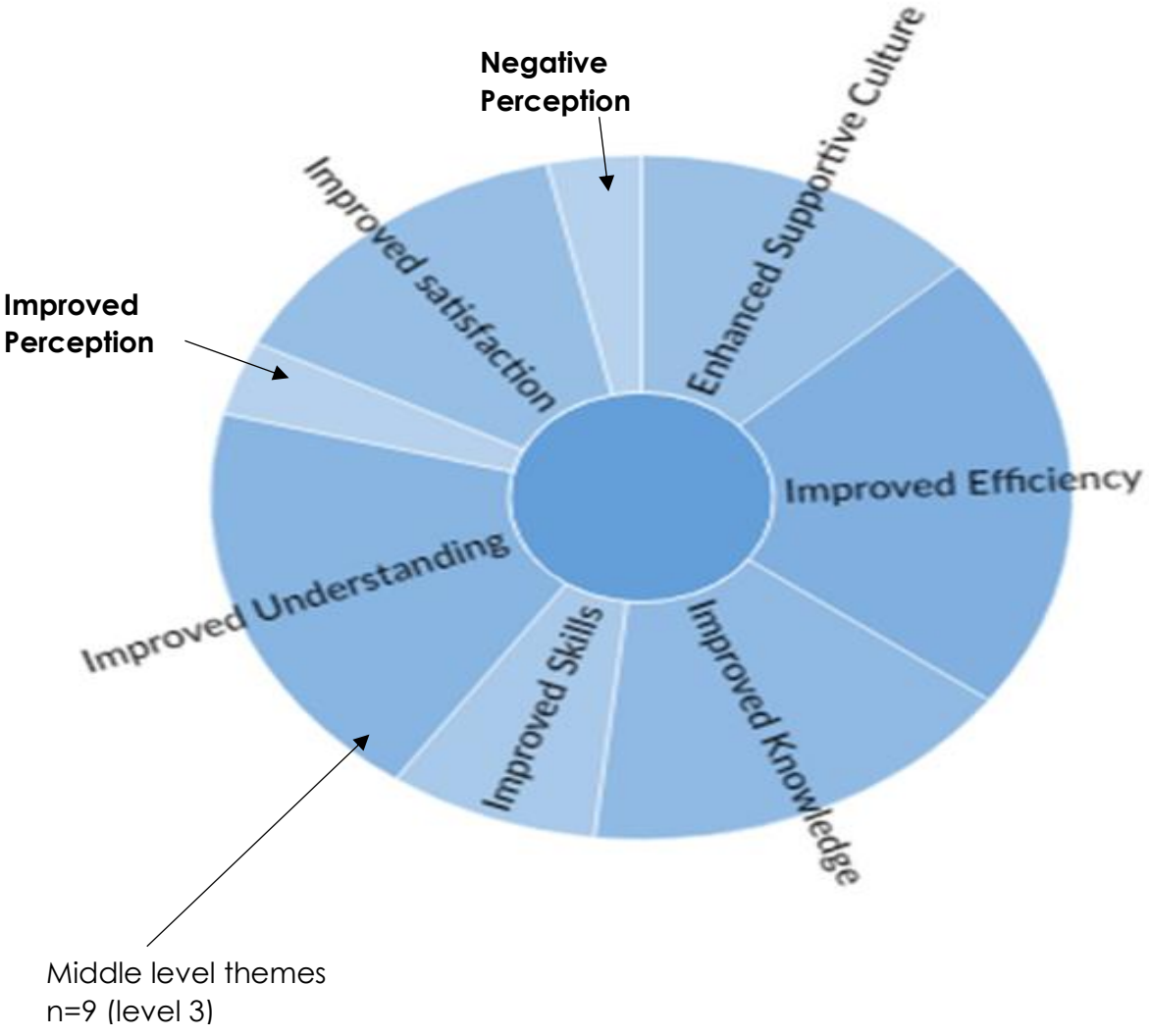
Figure 5.2 Conceptualisation of LPM



5.1.3.1 Value of LPM

Interview participants shared their thoughts on the value of LPM as they reflected on their general experience of working within project management in conjunction with lean working. One hundred and sixty-three statements generated eight distinctly positive descriptive categories, which are middle level (level 3) themes: improved efficiency, improved understanding, improved knowledge, improved supportive culture, improved satisfaction, improved skills, and improved perception. This is shown in Figure 5.3 below and indicated by the statements that follow. This is the lowest level or sub-theme within the high level theme of Value of LPM.

Figure 5.3 Value of LPM (high level theme)



Improved Understanding:

"When the team does some project evaluation, they will get the progress of the project, because they understand the project now, they find a way to handle the situation and the milestones. They can connect better with every person and other tasks. They don't only connect to their own tasks on the wall, but all of the tasks where they don't have the responsibility, but they get a better understanding of the whole project." (I10, German Construction PM)

Improved Efficiency:

"For sure I see improved efficiency most in terms of the lack of waste now in different situations on different construction sites." (I12, German Construction Senior PM)

"A big recognition that I'd see in projects, especially government IT projects, overrun, overspend, not delivering the original ambition – that is why we switched to the lean and agile approach. The level of efficiency and effectiveness in that productivity now is because you are always "on", no time is wasted." (I20, UK IT PM)

Improved Satisfaction and Improved Perception:

"It [LPM] proved valuable enough to reach the finish, not just employ it selectively, to get a problem solved, but from inception to completion. It [LPM]was a valuable vehicle for the client to open and run the facility." (I28, UK Construction Senior PM)

The (one) negative perception was articulated as follows:

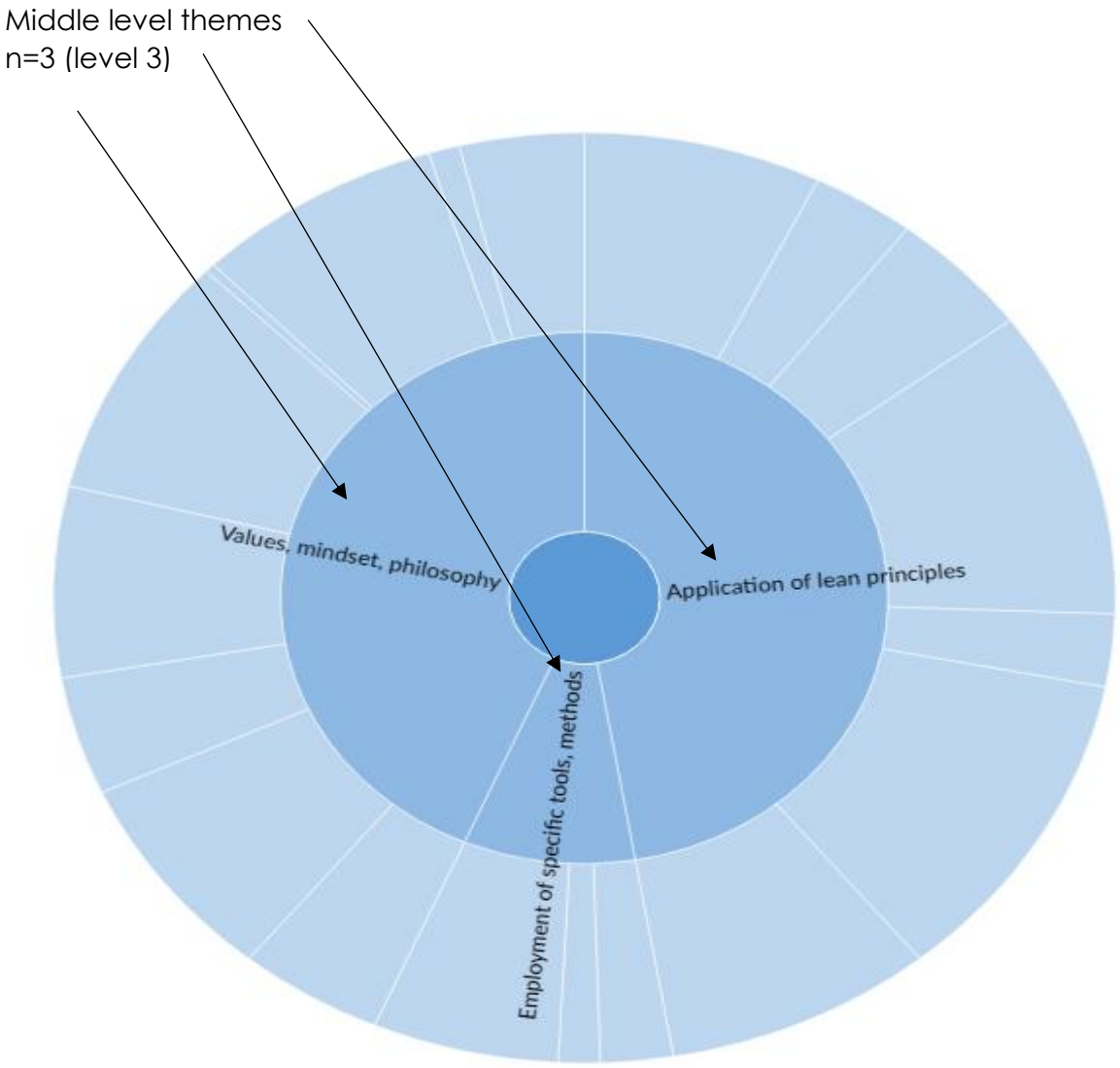
"I've always thought that meetings could be an incredible waste of time, it takes these people out of circulation, and so that's another side that you see. It's a conflict." (I16, Global Petrochemical Senior PM)

This interview participant was keen to point out the negative impact of the concept from a resource perspective, indicating that the time taken up by meetings is a potential waste of resources.

5.1.3.2 Definition of LPM

Interview participants were directly asked to define their understanding of LPM, in their own words. Findings revealed three further categories, or middle level sub-themes: the application of lean principles; the employment of tools and methods: and values, mind-set and philosophy. This is illustrated below in Figure 5.4 and outlined further.

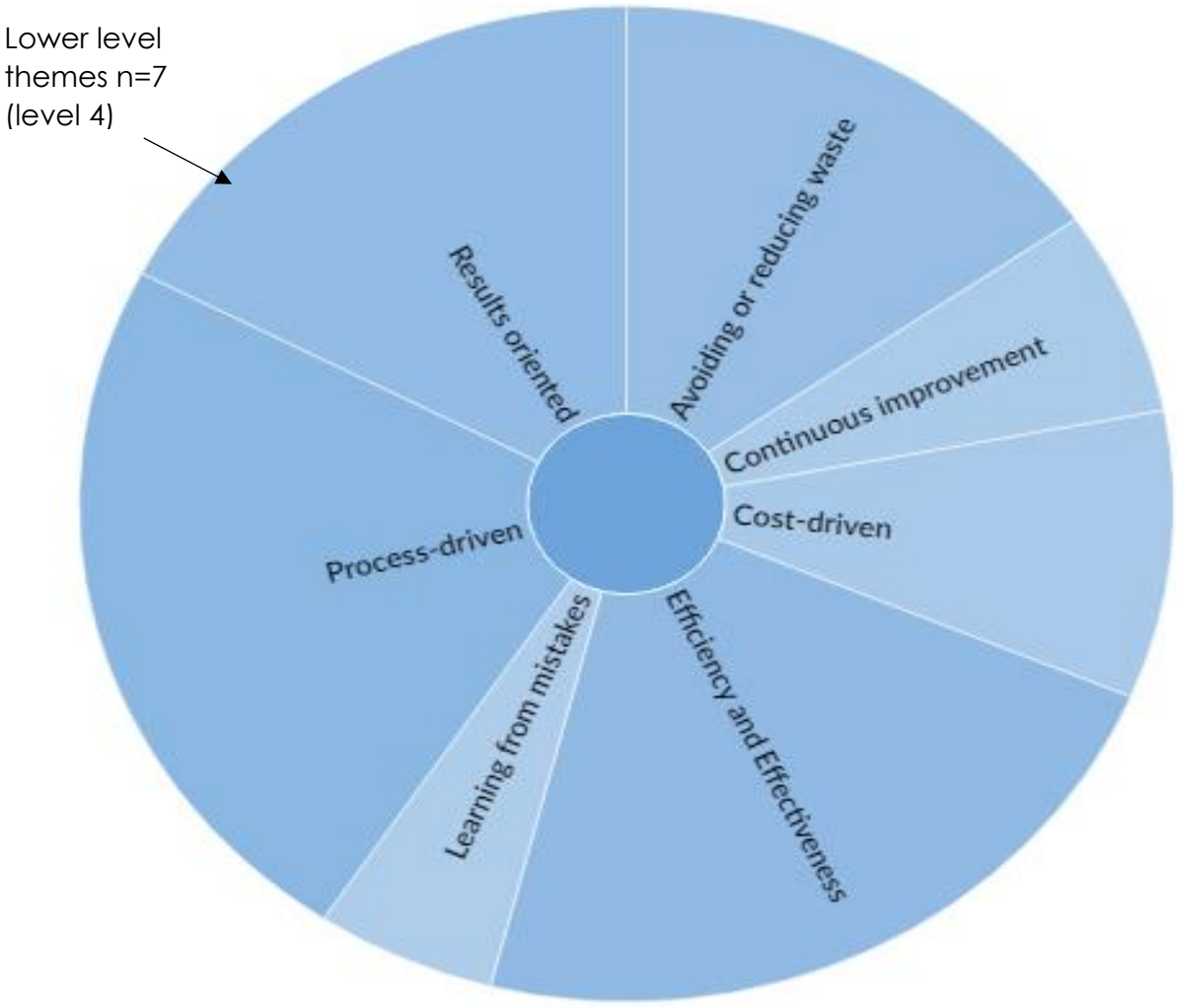
Figure 5.4 Definitions of LPM (high level theme)



The application of lean principles

Lean principles are generally perceived as those which are distinctly different to traditional PM principles. Statements by interview participants were categorised into eight distinct groupings: avoiding or reducing waste, continuous improvement, cost-driven principles, efficiency, effectiveness, process-driven, results oriented, and the principle of learning from mistakes, as illustrated in Figure 5.5.

Figure 5.5 Application of lean principles (middle level theme)



Statements that best express these views are provided below:

Process-driven:

"Lean allows you to effectively see every finite end, and nuts and bolts." (I22, UK IT PM)

"Lean means, for me, to have stable processes, a clear overview of what is coming next in the project, and the processes running smoothly and flowing so we see a real progress in our time schedules." (I4, German Construction Senior PM)

Process driven and results-oriented:

"So it's [LPM] identified certain gaps, quality checks, improved certain day-to-day business processes, giving information to trigger an action or a follow-up." (I8, UK Health & Medicine PM)

Results-oriented:

"In this case, it is a very specific approach for production to achieve plans, complete quality audits." (I7, Swiss Manufacturing Senior PM)

Avoid waste and Efficiency & Effectiveness:

"Lean is to capitalise on creating value as well as stripping out the waste and the different processes, to have people thinking in this mind-set, so we work efficiently, with time benefits, and the value that comes in from the quality of the impact that results." (I37, UK Nuclear PM)

Efficiency & Effectiveness:

"It's up to date based on what is actually going on at the site, because people scan their cards on site and this is instantly uploaded into the plans, so no-one has to go back [to the office] and update it. It's immediate and live." (I27, German Construction Senior PM)

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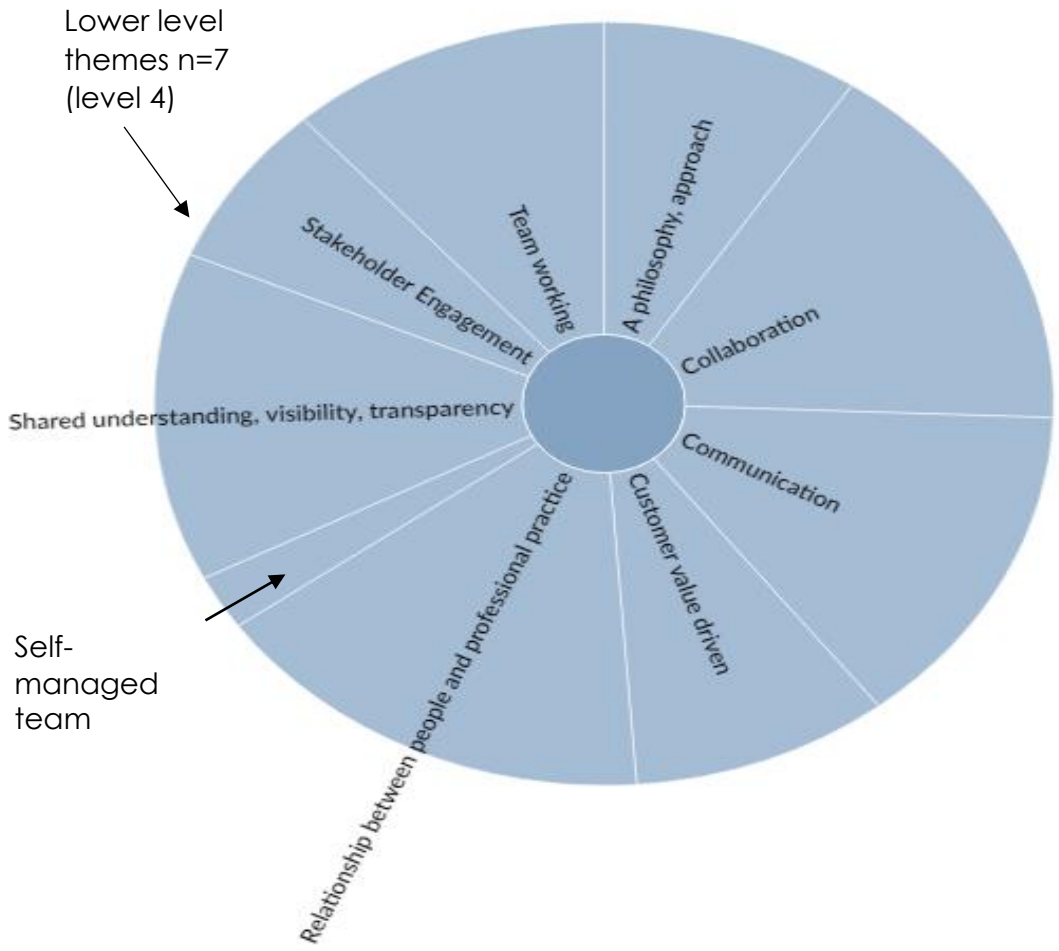
> "Lean project management is about completing the whole task in the shortest period, in the most productive way." (I29, UK Construction Senior PM)

Statements were generated from a wide range of attributes from across the dataset, with no discernible pattern or trend for age, industry, role or location. Efficiency and Effectiveness appeared to be an overriding feature or aspect of the application of lean principles; this often appeared as a directly spoken term and also by way of justifying or expanding the experience of interview participants. Note also the statements that were attributed to more than one distinct category.

Values, mind-set and philosophy

Values, mind-set and philosophy refer to the consideration and inclusion of individuals and project teams, including the relationship between people and processes, shared understanding, visibility, transparency, collaboration, stakeholder engagement, communication and team working. The high number and range of statements that pertained to values, mind-set and philosophy is highlighted in the figure below, which incorporate a number of social and behavioural attitudes and activities.

Figure 5.6 Values, mind-set and philosophy (middle level theme)



The following statements provide evidence for the **relationship between people and professional practice**, but additionally include characteristics that indicate the importance of **team working** in order to achieve effectiveness in project working:

> "You not only have an interface, you are in one team and we together, or we each other… influence one another, positively, and that's collaboration, that's lean-specific, because we each value the customer, and not only the real customers but everybody in the project, and that's really a cultural change. You are not the enemy, together you are really one team." (I2, German Construction CEO)

> "…to make people understand to plan the processes from the end. Lots of people, they are looking [at] the project, that's my

> experience, and they see a huge mountain which they have to climb and then they start to make the mountain more, more and more high, and to make it so high that you are not able to climb it anymore. That's my experience, and if you see the problems from then you make it into small parts, it's much more easier to find solutions. So, you start with the end and work backwards with planning, so it's more like little hills, rather than big mountains. That's my personal philosophy!" (I4, German Construction Senior PM

The following statements reflect the importance of behaviours, particularly **communication and collaboration of stakeholders**, to support the lean processes:

> "Cultural behaviours is a massive part of it. Lean, for me, it's about people, not process." (I13, UK Construction CEO)

> "I think it's listening and giving the opportunity for project team members to listen and get their feedback throughout the process." (I15, UK Health & Medicine Senior PM)

> "Here you are involved in developing the schedule and you have more influence on the specific steps and you bring them into action during the preparation of the schedule. It helps to reduce the number of conflicts within the team. I think that's more about co-creation, the co-creation of the schedule." (I17, German Engineering Senior PM)

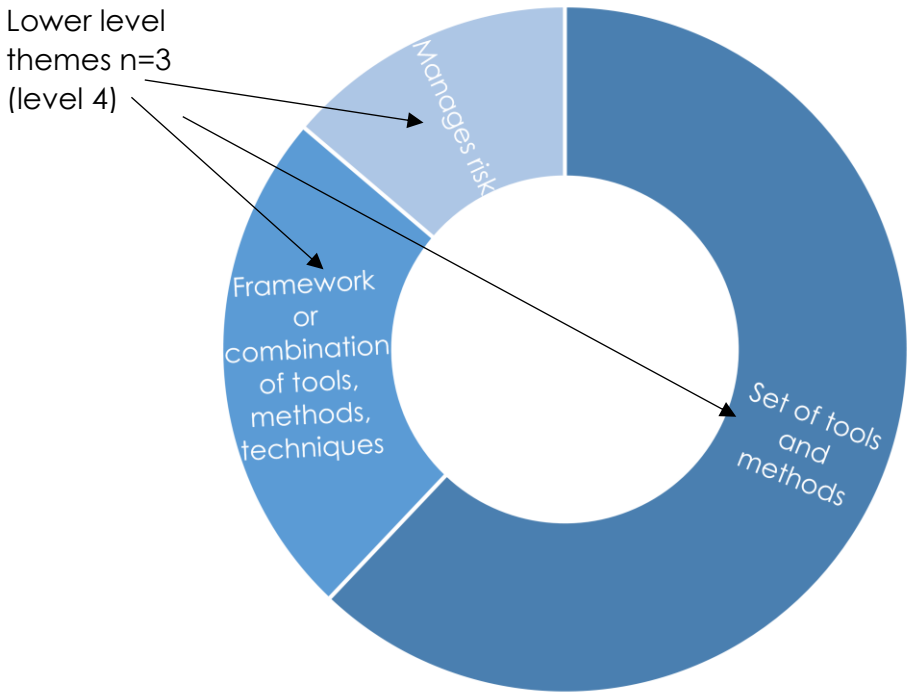
> "The project leader and the analysts, the customer, the developers, and the tester, so everyone who would touch part of the process will be at the end of the process." (I22, UK IT PM)

It is clear that values, mind-set and philosophy are important to interview participants who focus on and are driven by the application of lean principles to deliver customer value aspects of project delivery as well as a recognition of what can be achieved by self-managed teams and team working in general.

Employment of specific tools and methods

Interview participants also defined LPM by explaining the employment of specific tools and methods, for example, managing risk. LPM was employed by interview participants in a combination or framework of various tools and methods, used in implementation for their own individual needs as well as for project team activity purposes. Categorised as lower level themes, as illustrated in the figure below, and the statements underneath:

Figure 5.7 Employment of specific tools and methods (middle-level theme)



> "It was really project meetings, project plan, and phase gate and decisions when progress needed to be made." (I15, UK Health & Medicine Senior PM)

> "…to implement parts of the lean toolbox, of lean tools, to integrate it into my daily work as a Project Manager." (I31, German Construction Senior PM)

> "We do lean management, well, Lean Project Management, in Construction, just for construction projects for our clients, who are external. We understand it as a method, in order to find problems and solutions within construction scheduling, or also together with and for participants' planning." (I32, German Construction Senior PM)

5.1.3.3 Summary findings for Conceptualisation of LPM

Based on the findings following articulation of LPM and its value to practitioners as shown above, LPM can be conceptualised in terms of its general ability to improve and sustain efficiency, connecting practitioners with each other by applying essential lean processes, employing established lean methods and tools, and adopting values-based philosophical approaches. This appears to be relevant to the individual practitioner themselves, and also what was perceived to be important for other practitioners to increase knowledge within the project environment. The widespread prevalence of these statements across several different demographic attributes suggests that LPM is indeed an appropriate and meaningful concept that is generally understood and accepted, thus establishing a foundation for its suggested utility and value as a concept.

5.1.4 Implementation of LPM

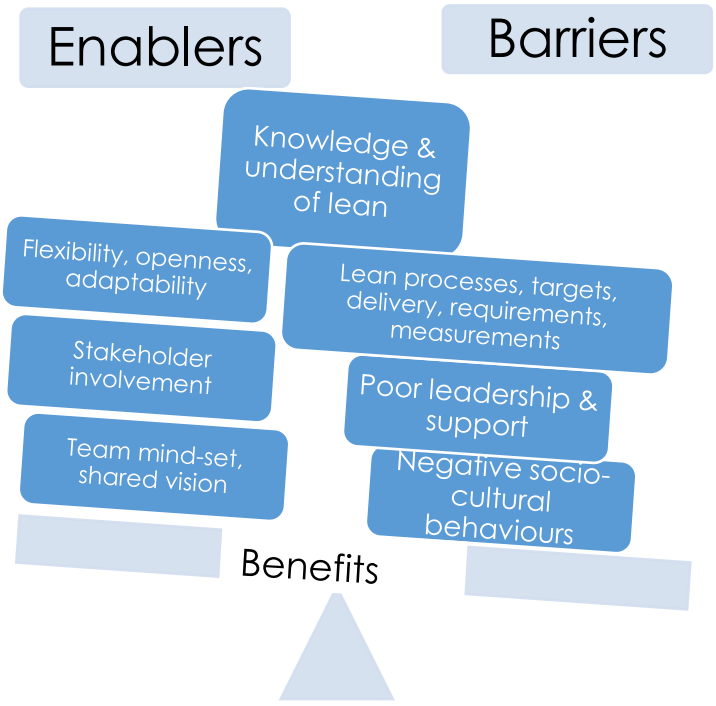
Interview participants described factors and features of LPM implementation, including their perceived barriers, benefits and enablers, and the way in which progress was recorded and measured in their experience and practice. This enabled their specific and unique lived experience of the phenomenon of LPM to be understood and analysed. This provided an opportunity to obtain a deeper and broader sense of implementation generally as well as the possibility of noting, comparing and contrasting any similarities and differences according to demographic attributes. Analysis of

findings revealed key features and factors of LPM implementation which, again, were able to be categorised into 94 specific codes that made sense of the amount of contributory data (in excess of 1200 statements). This again suggests that interview participants found it relatively easy to articulate their experiences of implementation, providing the researcher with rich, thick descriptions to analyse. The full coding structure that comprises the overall theme of Implementation of LPM is also provided in the Appendices.

5.1.4.1 Factors of Implementation of LPM

Following description of the experience of implementing LPM, analysis led to creation of a further three naturally occurring categories, or, Barriers, Benefits and Enablers. These are presented and outlined in the following sections, and the following diagram illustrates these middle-level sub-themes and illustrates typical aspects.

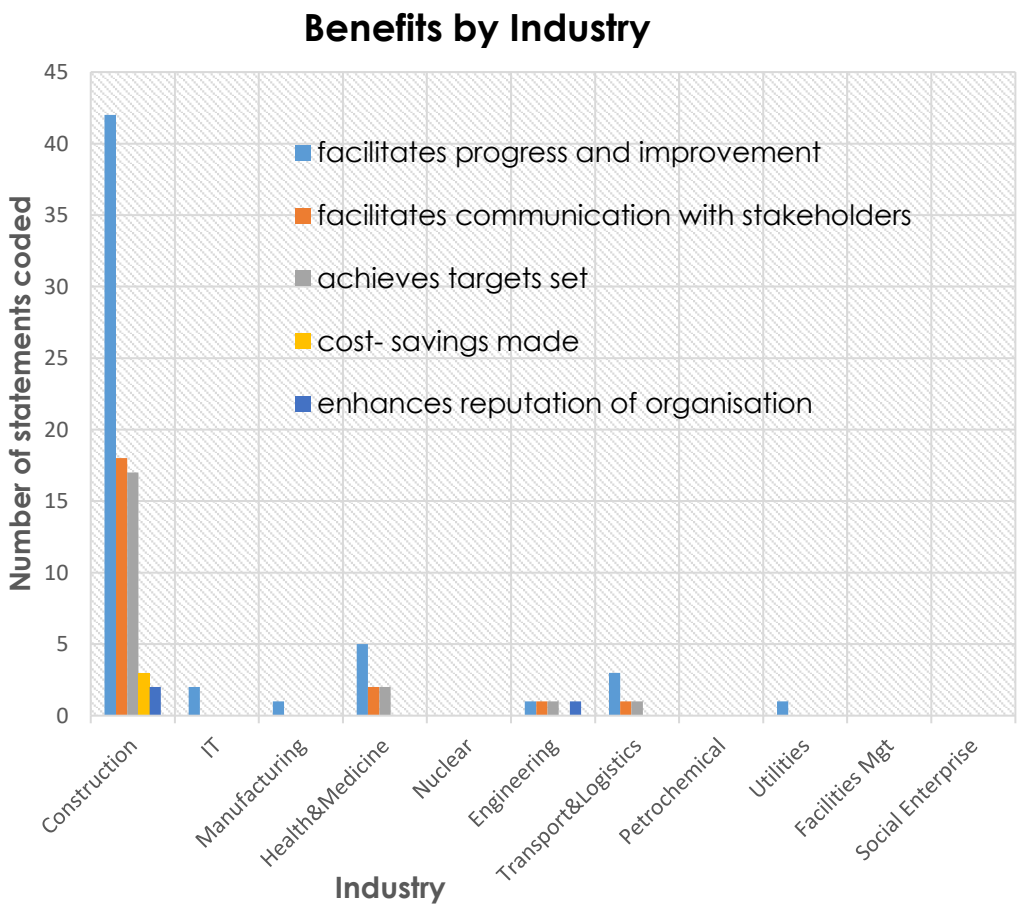
Figure 5.8 Factors of Implementation of LPM



Benefits of implementing LPM

A wealth of rich data was obtained providing evidence for the perceived benefits of LPM. LPM was considered to be facilitating progress, improvement and communication with stakeholders, enhancing the reputation of organisations that implement LPM, as well as a way of generating cost savings and achieving targets set. Facilitating progress and improvement is a clear benefit to interview participants and, again, a wide distribution of demographic attributes across age, gender, country, organisational size and industry was found. There is a sense that this is featured across a number of different industries, although more prevalent in Construction, as seen below in Figure 5.9.

Figure 5.9 Benefits by Industry



However, interview participants from outside of the Construction industry also described the benefits of LPM in terms of facilitating progress and improvement more explicitly:

> "…bringing in the right people at the right stages, and the right number of people." (I8, UK Health & Medicine PM)

> "If one part of the company is doing a lean approach to project management, that's naturally going to send little shock waves through the rest of the organisation and all people see it and think: 'Oh that's quite an interesting idea.' You can embed those people to understand and feel comfortable with it so they gradually go and think about it." (I19, UK Manufacturing CEO)

> "We're in the infancy stages in this organisation, but we've used lean and agile in my team, we've asked, 'Where's the best practice being done, what can we copy?' Definitely around decision-making: if we had gone down the traditional approach we would still be feeling the stakeholder interference and external pressures. This way, my team just crack on and just deal with things." (I20, UK Transport & Logistics Senior PM)

> "It's part of everything – instead of islands, there's what they call 'fit teams'; so designers, architects, structural, mechanical engineers usually get their lean processes to work differently, but LPM brings the buy-in, because people round the table feel like things are happening, if you want to do things smarter, easier." (I29, UK Construction Senior PM)

Barriers to implementing LPM (middle level theme)

Rich data was obtained for this theme with a multitude of barriers described by interview participants. Key lower level themes that comprise this middle level theme are detailed below. The most frequent and vocalised barrier related to socio-cultural and behavioural aspects, poor leadership and support from senior managers, and missing

or lack of knowledge and understanding. This appeared to be something which interview participants felt was particularly prevalent within their immediate project environment as well as generally for the concept of lean project management. These are further outlined below.

Socio-cultural and behavioural barriers (key lower level theme)

Analysing the distribution and spread of socio-cultural and behavioural barriers revealed that the overwhelming majority (32 out of 40 interview participants) had provided over 170 unique coding references to this category, suggesting its significance within this dataset. This is illustrated by Figure 5.10 below, which highlights the type and distribution of socio-cultural and behavioural barriers across the dataset. Note that these were featured across all demographic attributes and included descriptive statements that pertained to resistance to change, fears of change, negative perception of lean concepts, old-fashioned mind-set, not feeling valued and the perceived steep learning curve that lean might require. The best expressions in support of this theme are presented below, and these comprise the lowest level of thematic analysis:

> **Resistance to change:**
> "There's no culture, and where there's no culture there's no change, and therefore there's no preparedness to change. Yes, being prepared to change, in our point of view. There's no appetite." (I2, German Construction CEO)

> "I think one of the biggest barriers is that we have always had 'heroes' in projects, who would save situations in projects, from disasters, challenges and so on. So, this could be the PM, the PL [project leader] or even the CM [construction manager], and the whole concept of lean PM is to change that concept, so there is no one person who solves the problems, there is just one team. So, it could be that those people feel threatened by the fact that their role is redundant, which it is not, they have another

role, but they don't feel – because they have been doing it for so long, forever, for years – that they have to do other things. They have a new role, they have to do other things, they have to change things, and do new things, so I think that it is one of the biggest challenges." (I27, German Construction Senior PM)

"But if I have individuals who don't want to do it, and are not willing to support the process, then the whole thing fails. So, if I've got subcontractors who are pushing, then the site manager is also important, but then can one perhaps... but it is difficult. If I've only got the site manager pushing, and the subcontractors don't want to participate, then I can forget it." (I38, German Construction Senior PM)

"There is still a culture of, 'It's not my job'." (I8, UK Health & Medicine PM)

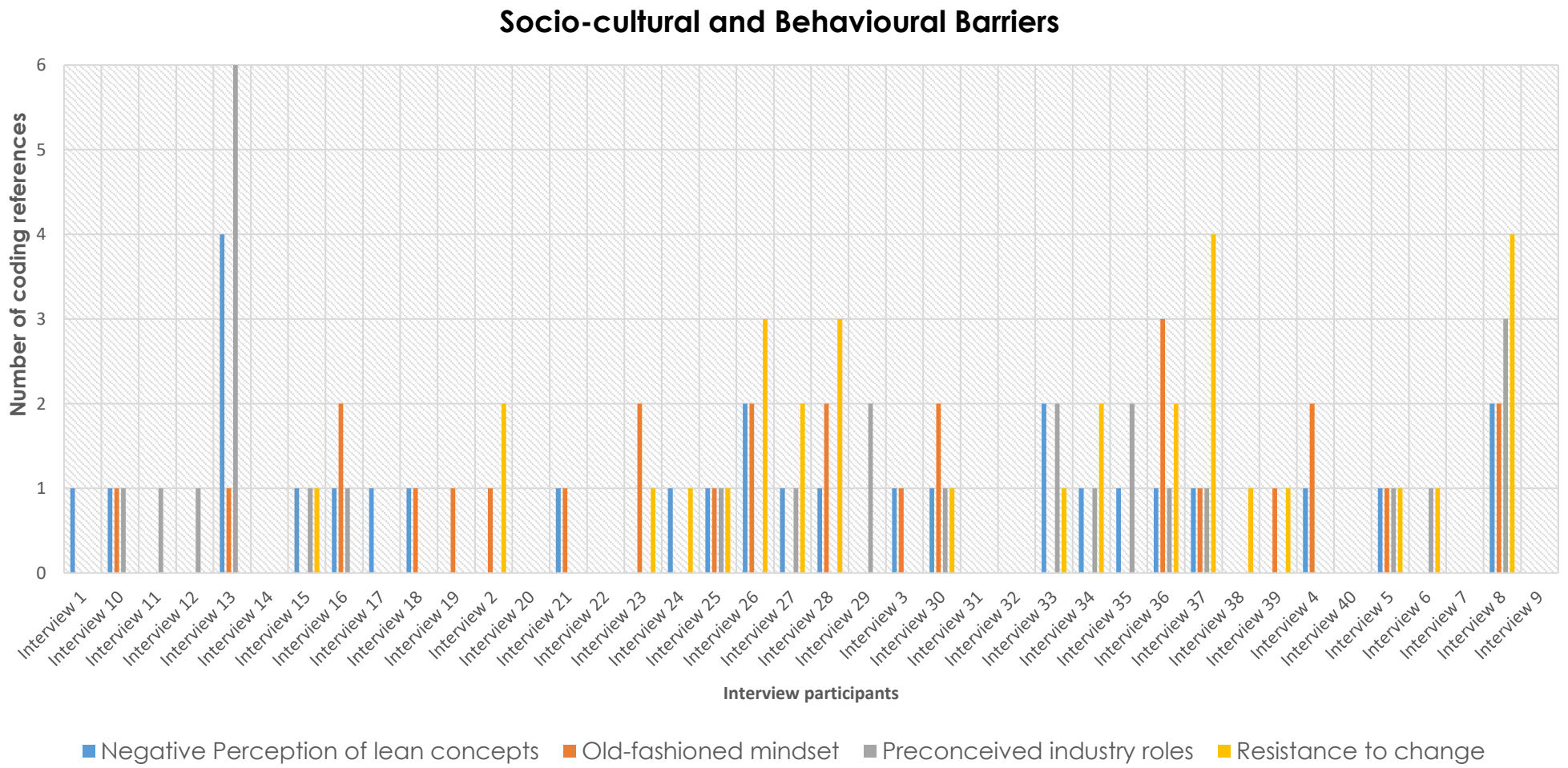
Fear of change:
"Our barriers, people are afraid, frightened about this, and it is all about change management; it is all about people management." (I25, German Construction Senior PM)

Negative perception of lean concepts:
"It's kind of that pre-conception that people think, when you say lean, that means you want to cut people out, you want to cut jobs, you want to cut back, and that's the way you're going to do it. Oh yes, we've seen it all before, yes, here it just means this…" (I33, UK Engineering PM)

Old fashioned mind-set:
"There is always that one person who doesn't want to participate, play along, and doesn't want to see the benefits because he is always doing it that way, specifically in construction, because there's a lot of hard-minded people that have been working in the industry for a long time, 20, 30 years' experience." (I26, German Construction Senior PM)

"But I think the problem is people just always do things the way they've done it. People become 'experts', especially if they've been somewhere since they were 16, they know the systems and procedures inside out, but they know *their* systems and procedures inside out, but don't know there may be other ways of doing stuff, and getting them to think outside the box is difficult, because they become 'experts' and it almost, like, becomes a sort of a disincentive to doing other things, change the way you do things, because you have built up this expertise." (I36, UK Social Enterprise CEO)

Figure 5.10 Socio-cultural and behavioural barriers articulated by interview participants



Poor leadership and support from senior managers (key lower level theme)

Senior management leadership and support is important to interview participants, and statements from across age, location and organisational size were noted, as demonstrated by the following:

> "If you want to have a sustainable change, they have to understand the philosophy, its relevance to leadership in projects and for leadership, you need to have leaders in projects. At this stage, many leaders have not enough time, they have no focus, and that's the point why there's no leadership, there's no culture, and where there's no culture there's no change." (I2, German Construction CEO)

> "What we find is that it's only now we're getting engagement from our own local senior managers, it's a bit embarrassing to hear them say, 'Oh I hardly ever use it!' in the meeting." (I8, UK Health & Medicine PM)

> "There's a lot of consultants in construction [who say,] 'It's my way or no way', and it doesn't quite work that way." (I13, UK Construction CEO)

> "They [senior leaders] create other barriers themselves, to communication – inherently, in the way they operate." (I19, UK Manufacturing CEO)

> "…because the whole system stands and falls with the project leader and with the trade manager." (I23, German Construction Senior PM)

> "I've learned this by experience: you need your managers to buy in. If they do not buy into it, that's a problem, and you need to address them and convince them otherwise." (I28, UK Construction Senior PM)

> "I've also seen the way workers are treated sometimes, by management, because they woke up on the wrong side of the bed or because someone further up the food chain was chewing their butt for not getting the job, or whatever. But it more falls on the supervisors. The supervisors are responsible for the ones beneath them, but you don't get anything out of them for yelling, screaming and shouting." (I40, Global Construction CEO)

The statements above elicit an impression of disappointment by individual interview participants, who on further analysis are operating at all levels of seniority and experience. Such interview participants appear to expect an effective level of leadership that will impact positively on their own individual practice, and the development of the profession, as well as facilitating project success. There is an assumed, or anticipated expectation of the presence of effective leadership and support from senior managers, and this is clearly suggested to be lacking. Additionally, there is an expectation that other individuals who have the ability to lead are not always recognised as such by those in more senior positions, as suggested by the following interview participant:

> "You know if the groundwork is already there, the ones who are seeing things day in day out, the ones with the expertise. It's not always the leaders with the best ideas. It's just utilising everyone's strengths and be[ing] willing to change and be a bit more agile." (I38, UK Nuclear PM)

Missing and lack of knowledge and understanding (key lower level theme)

A significant barrier of missing or lack of knowledge and understanding was indicated across all demographic attributes. To be clear, "missing" knowledge and understanding was deemed by the researcher to mean that there was some presence or sense of understanding of lean but it was incomplete, whereas a "lack" of

knowledge and understanding assumes a complete absence of knowledge and understanding of lean. Statements included content which expressed perceptions of **general lean** principles (such as those outlined in the Conceptualisation theme), as well as those **specific to LPM**, e.g. processes, targets, delivery, measurements, requirements, and methods relating to implementation of LPM within projects. Statements included descriptive content that related to missing and lack of knowledge and understanding for both aspects interchangeably, hence they were categorised as one sub-theme. The following statements best demonstrate this barrier:

> "…and the thing is, everybody talks about lean but nobody knows what it is, so that's another thing. It's more than missing background, it's missing knowledge. They come over to me afterwards and say, 'We didn't understand why we do this.' Yes, they don't know about lean!" (I1, German Construction Senior PM)

> "I think if you would ask my colleagues from the team here, they wouldn't say, 'Oh, I'm following the lean procedure.' They do not recognise that they follow the lean procedure." (I17, German Engineering Senior PM)

> "Once they understand why you're dealing with lean methodology in project management and beyond, they'll start to slowly come to an understanding. It's quite siloed in the methodology and the understanding." (I22, UK IT PM)

> "…another one is making it relevant to construction, or trying to show people how it's relevant, because they immediately think it's like in manufacturing." (I33, UK Engineering PM)

A distinction was made in terms of the type of support perceived to be required on the part of senior managers; in the following statements, it appears that a general recognition of lean, and the knowledge and understanding of its processes and

procedures, is helpful to practitioners. This is evidence across all industries within the dataset:

> "First and foremost, the decision-makers at contracting organisations, if they don't really understand it, or they aren't bothered, or they've not got time, then that's a major blocker there and then. A lot of people only do something in lean because they've heard someone else say it, 'We must be lean.' Only because they've heard someone else say it. That type of person is a problem. It has to be someone who knows what they are doing." (I6, UK Construction Senior PM)

> "There is this whole misconception, they don't understand the mechanisms behind the process, and the input that a good facilitator and person understanding the lean principles can bring to the process." (I13, UK Construction CEO)

> "I'm not convinced that the people who put these proposals together know what they're doing, that's the problem. It becomes apparent, you know when you read some of these specifications." (I14, Global Petrochemical CEO)

> "He didn't know what he was talking about, but he was in charge, there was no-one else we could call. You see the difference? Someone that doesn't know can change things! The biggest barrier I've noticed over the years is, if the upper project manager doesn't understand how a job needs to be done, or gets done, there can be difficulties further along the food chain. Whether that be within the company itself, or the governmental agencies you're working for – they sometimes have ideas that have no bearing on reality. Unfortunately, there are people introduced along the chain that don't have the experience to be in the chain." (I40, Global Construction CEO)

The descriptions above and range of examples that again originated from different levels of seniority and length of service, indicate that the absence of knowledge and understanding of lean is considered a significant barrier to effective LPM implementation.

Enablers of LPM (middle level theme)

Although interview participants were directly asked to identify specific *barriers* to implementation of LPM, they also reflected more generally through open discussion with the researcher. Often these discussions were led by the interview participant as a significant and particular response, or as a follow-up, or as a counterargument to the previous discussion on barriers following their own reflection on their responses. Similarly, it was noted that perceptions were also voiced as a way of justifying what benefits LPM could be brought to bear. This data led to the natural creation of a third Implementation factor, Enablers, which were expressed as aspects of implementation that interview participants saw as being responsible for engendering the (desired) effective and successful implementation of LPM, not just the desired project-based outputs. Importantly, interview participants were not suggesting necessarily that enablers actually existed in their current practice, but that they were important enough to mention, and be considered as essential in further developing the practice of lean project management. In a similar way to aspects noted from Benefits and Barriers, Enablers also comprised general socio-cultural and behavioural characteristics of individuals. This includes aspects relating to knowledge and understanding, and aspects relating to project environment, such as the extent to which lean tools or methods could (or had potential to) have an impact on effective implementation. Key lower level sub-themes (level 4) are presented below:

Team mind-set and shared vision was a particularly significant perception, based on the number and range of responses expressed across all demographic attributes:

> "These things we go through with the whole team every month, and it's basically like a kind of a health check, and we know

which stage the project is actually in. Like, if it's already started, or someone has requested a project from us, it is making clear what it is all about, in terms of monitoring our projects." (I7, Swiss Manufacturing Senior PM)

"…so, the most important thing when you manage a project in the lean way, is to make sure everybody comes to the same understanding, to bring everybody together round the table to discuss problems, issues, tasks, and they can discuss face to face what steps they need to take. Because they are talking about the same things then and they are all in the same place at the same time doing the same thing. Which you don't get in an email, plus you can't tell in an email if someone is really listening to you." (I10, German Construction PM)

"Whether the lean awareness workshop or actually a collaborative planning session on this project, or a good plan to put risk management type processes in this journey…if you show people this works as well as it involves the structure. But then, think about the organisation's objectives: what are you trying to achieve? What's the industry trying to achieve? What's our customer expecting? How do we get them on board?" (I13, UK Construction CEO)

"When you got to this new project, so it was already shared understanding of the process and so they didn't need to learn again and make the same mistakes." (I23, German Construction Senior PM)

"The other is that I think it's easy to hide your mistakes without ever people finding out, then blaming them, other people, for the mistakes they've made, or the problem you've caused. Through lean you are supposed to become very transparent; it becomes, all of a sudden, very transparent, and people might get scared, but they should know that the concept of lean is not to point the finger and say, 'You made a mistake, which I found and can solve.' I guess these are the downsides or challenges, in my view." (I27, German Construction Senior PM)

Evidence from the statements above suggests that team mind-set and shared values cut across levels of seniority and are seen to affect, and be affected by, the prevalence or scarcity of working in this way within the general project environment.

Stakeholder Involvement

Stakeholder involvement was an important Enabler across the dataset, again attributed by a wide range of interview participants. Stakeholder involvement includes sharing, wanting to understand and work with stakeholder perspectives across the various project environments, as supported by the following statements:

> "From time to time, more and more people realise they should be part of the project and sometimes we just start with a small part of the project, or a small team, and then, in the next part, other parts of the project will realise they should join." (I5, German Construction PM)

> "I think that there are some clear advantages in the lean procedure but it always requires that all the other project team members are also working more or less the same way." (I17, German Engineering Senior PM)

> "So, at the end of each two weeks, we do a show and tell where all key stakeholders are invited. We show what we've developed in the previous two weeks." (I20, UK Transport & Logistics Senior PM)

> "I think it got a bit boring for those static people who were always delivering but it was new for the customer, and I think it was good for the customer to go, 'Actually, you know what they do there?!'" (I22, UK IT PM)

> "We can develop as many tools as we want [but] if we don't get the people to communicate [with] each other – and I think communication is the main part, at least how we implement Lean construction management at projects. Because, when

> they are communicating and when they are collaborating, the waste is getting eliminated and automatically." (I23, German Construction Senior PM)

> "We made a conscious effort to get everybody involved. Everyone understood what other trades were doing, what the sort of the sequence was, what the key interfaces where, what the stage gates were. So, from that perspective, there was a lot better understanding. Being able to demonstrate that and being able to share that back with the rest of the team, and the benefits that were there, and you could see it from the beginning and all the defects, and that helped with the handover process." (I30, UK Construction Senior PM)

Such statements extend beyond stakeholder engagement: involvement suggests a conscientious decision to include and involve different individuals, which appears to extend beyond a superficial "must-do" or box-ticking exercise, but one which is essential to the smooth running of projects at different stages, as well as for ongoing sustainability.

Knowledge & Understanding of Lean

Perhaps not surprisingly, knowledge and understanding of lean was one of the most important Enablers (top 3) which also matched as one of the most important Barriers. PMs' perceptions and experience were that knowledge and understanding of lean was a key underpinning factor in the effective implementation of LPM:

> "It's also a catalyst for development, it's true, you can now develop the product itself as well as the outcome. It's a basic tool you can play with now, but you can also develop your own knowledge." (I8, UK Health & Medicine PM)

> "Each time they use it, everybody could learn from everybody and altogether they make an effort, and then the project progresses." (I10, German Construction PM)

> "A lot of the main contractors understand that we should be doing lean and, yes, they're on different stages of the journey within transformation or whether it's just project level. But a lot of [the] supply chain now are very much responding to this. I have a lot of supply chain members saying, 'Lean is going to work on my project, so I'm doing this as a main contractor' because they see the benefit of it now. They understand the benefit of it." (I13, UK Construction CEO)

> "I love it when people start using terms! When you bring a term like PPC, yeah, they are like, 'PPC today is like this, and this, and this [sounds animated and happy].' And when you used the term, it was like, 'Yep, you're in.' It's exciting when they are explaining it to others, too, not only in lean construction but elsewhere, not just in projects, but when you start hearing 'material pool request' or 'MAR' or 'MPP' or 'GPA', it's like really cool; they start explaining it to someone else and you hear them say, 'Yeah, the MPP, I do it like this… [sounds happy and animated] and the PPC like this…….'." (I26, German Construction Senior PM)

A genuine and real sense of excitement from interview participants was sensed by the researcher on hearing statements such as the above. It is clear that, once people understand the benefits of lean working in projects, they have a desire to become knowledgeable and learn more about how it can benefit the projects they are involved in. These statements appear to connect strongly with the statements in response to Benefits perceived, and as a way of responding positively to Barriers faced.

Supportive culture

Supportive culture is considered to be one of the most important Enablers, again, dominated generally by the Construction industry, but, interestingly, after Construction, the most vocal interview participants came from UK Heath & Medicine and Manufacturing:

"People are maybe feeling more confident about how lean is used and maybe that's why they don't have that blame culture… it seems that lean makes people more accountable." (I1, German Construction Senior PM)

"…just by showing them, and making them reflect on that a little bit, they start to learn their processes better because they know the reasons why they can't fulfil their planned processes." (I3, German Construction PM)

"We said, 'Look the decision's already been taken to roll this out and we're first, so, but it doesn't have to be a pain barrier.' Now if we can help, we will. 'Yes,' we said to people, 'we're here for you, we're not running away.' So we said, 'Anything you want to tell us, tell us, we'll try and structure it.' So, we put basic feedback sheets on the wards, for anything, problems, ideas, issues. We tried to encourage reps from each area, or ward, to be involved when we were rolling it out, we had super-users and key champions; it's not an onerous role, it could [be] as simple as re-setting someone's password, but it is a sharing of responsibility on an ongoing basis." (I8, UK Health & Medicine PM)

"We had a project management approach to culture change. We had the Kanban, just in time, and that [was] obviously followed on by the Six Sigma. I think it was certainly evolving, only, I think it was getting people ingrained in culture and one thing then introducing something else and building on that knowledge, until you're at a point where everybody is at a certain level in the organisation, understands about 5S, understands about Six Sigma, understands about project management, and it's just the done thing and it's not unusual." (I15, UK Health & Medicine, Senior PM)

"The first stage of development to lean is to get the culture; if that's not right, you might as well throw good money after bad, if you like, if you're trying to develop lean. The minute you can start getting culture, you have that connectivity there, you will naturally grow and develop new processes, new ways of doing things better. People need to see, people need to talk [to] you, people need to understand, and that's what drives communication, can drive improvement, because people feel comfortable talking about it, even if it's something negative. If

> you have a problem, you need to resolve it." (I19, UK Manufacturing CEO)

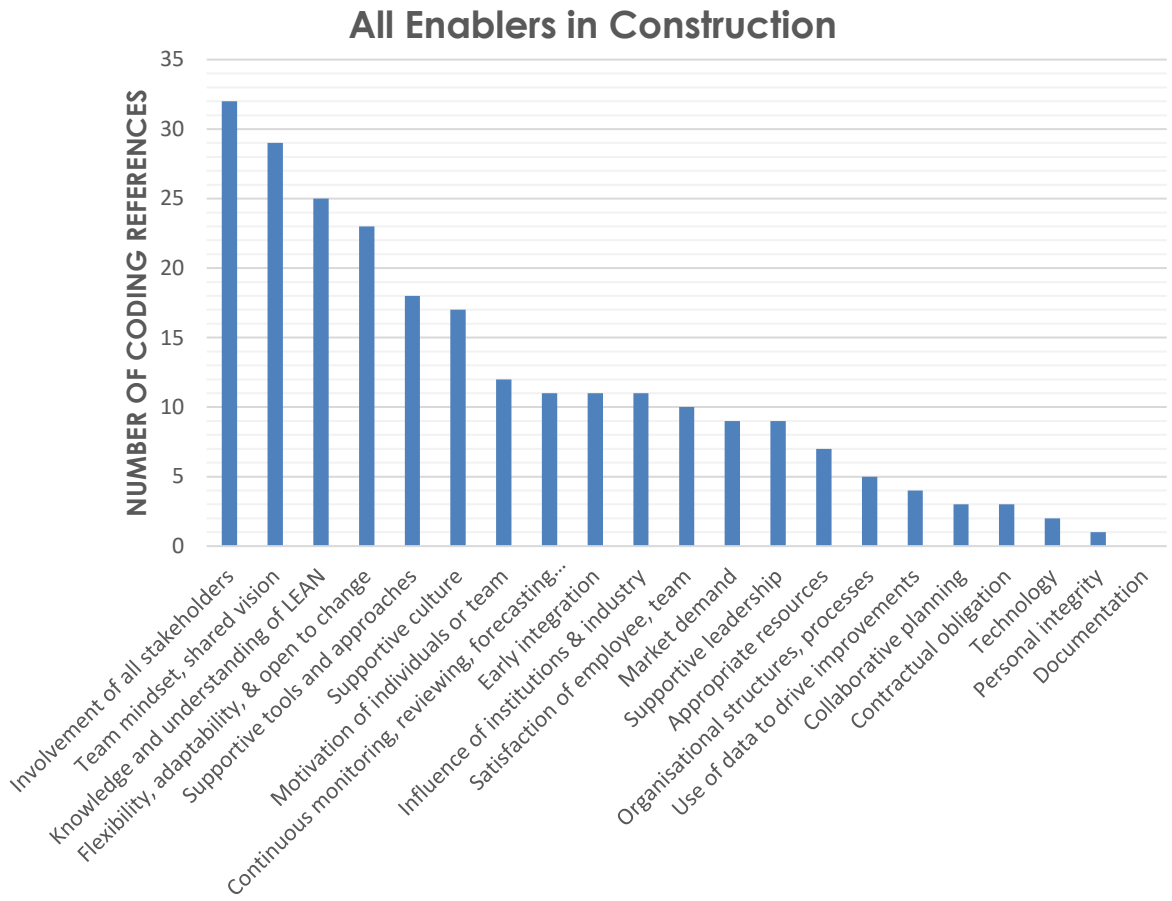
> "if the Construction Manager, or the customer, is convinced, then the belief also gets to be transferred to the participants, and this then builds up a community." (I32, German Construction Senior PM)

The statements above suggest that supportive culture is an important enabler for individual as well as team behaviours, extending beyond the immediate project to the wider project environment and organisations.

Enablers in Construction

Given the industry's prevalence within the dataset, a further analysis of all Enablers in Construction was undertaken. This is illustrated in Figure 5.11 below, and appears to be dominated by three distinct groupings, socio-cultural and behavioural enablers, followed by project environment-related enablers, and, finally, of least importance, enablers relating to tools, resources and methods.

Figure 5.11 All Enablers in Construction

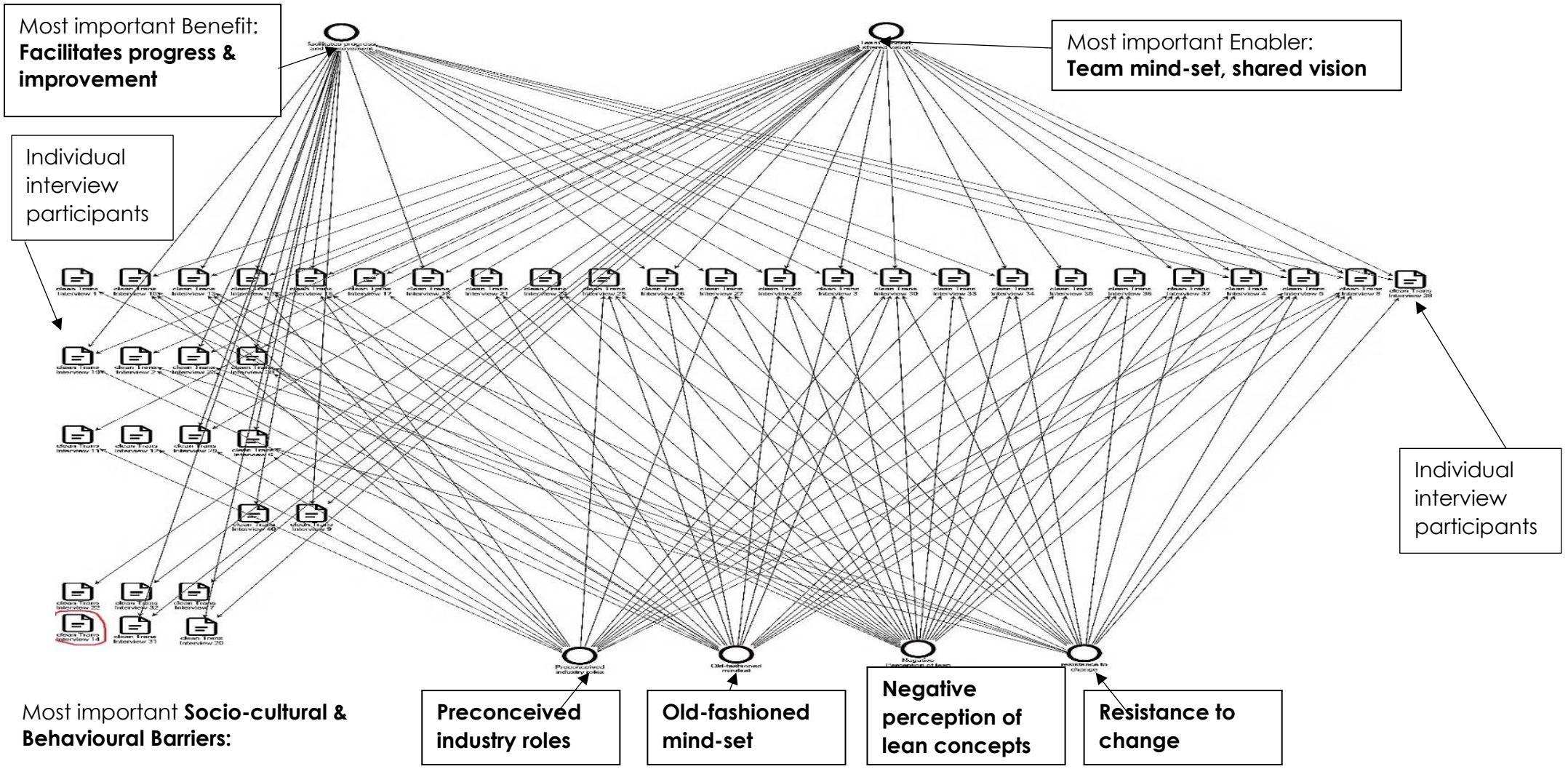


Note that very few coding references were attributed to the use of data to drive improvements and technology, despite the prevalence of Building Information Modelling (BIM) within Construction. Similarly, many of the organisations represented within this dataset work with other organisations that are still on their lean journey, using traditional approaches such as documentation; however, no coding references were assigned here. What is notable is that there appears to be a trend or pattern relating to **socio-cultural and behavioural** enablers, based on analysed statements. Coding for all 40 interview files was cross matched against the implementation factors of Benefits, Barriers and Enablers, to explore the extent to which these were coded within

and across these implementation factors. The illustration below shows the extent to which 39 out of 40 interview participants perceived these **socio-cultural and behavioural** factors of implementation to be of particular significance.

The clear outlier (red-circled) contributed no coding references to any of the top codes regardless of Barrier, Benefit or Enabler, otherwise the intensity of cross matching of files to these codes can be clearly seen from the illustration above. The fact that socio-cultural and behavioural aspects are prevalent across both Barriers and Enablers, indicates not only a general significance to practising Project Managers, but also the role that implementation of LPM can play in enabling the benefits perceived, and potentially reducing barriers.

Figure 5.12 Benefits, Barriers and Enablers of LPM implementation by interview file

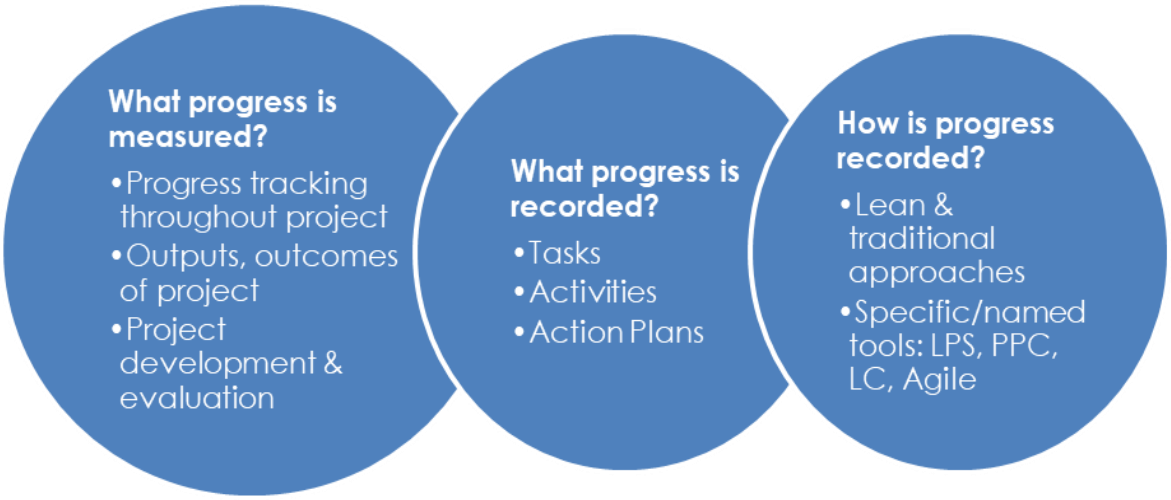


5.1.4.2 Features of implementation of LPM (high level theme)

This section outlines and presents the features of implementing LPM based on interview participants' responses to direct questions concerning how progress is measured and recorded in lean projects. Although interview participants were asked to describe how the ***progress*** of implementation worked, they often began by describing the actual implementation or operationalisation of the projects they were working on. Measuring aspects of control, time, cost, quality, waste, productivity, etc., is outside the scope of this research, so, although this did situate the context of the practitioners, and additionally supports and strengthens the earlier concept of LPM, it did not always specifically answer the question of how to tell if implementation was progressing and, if so, how this manifested in terms of the measuring and recording of progress.

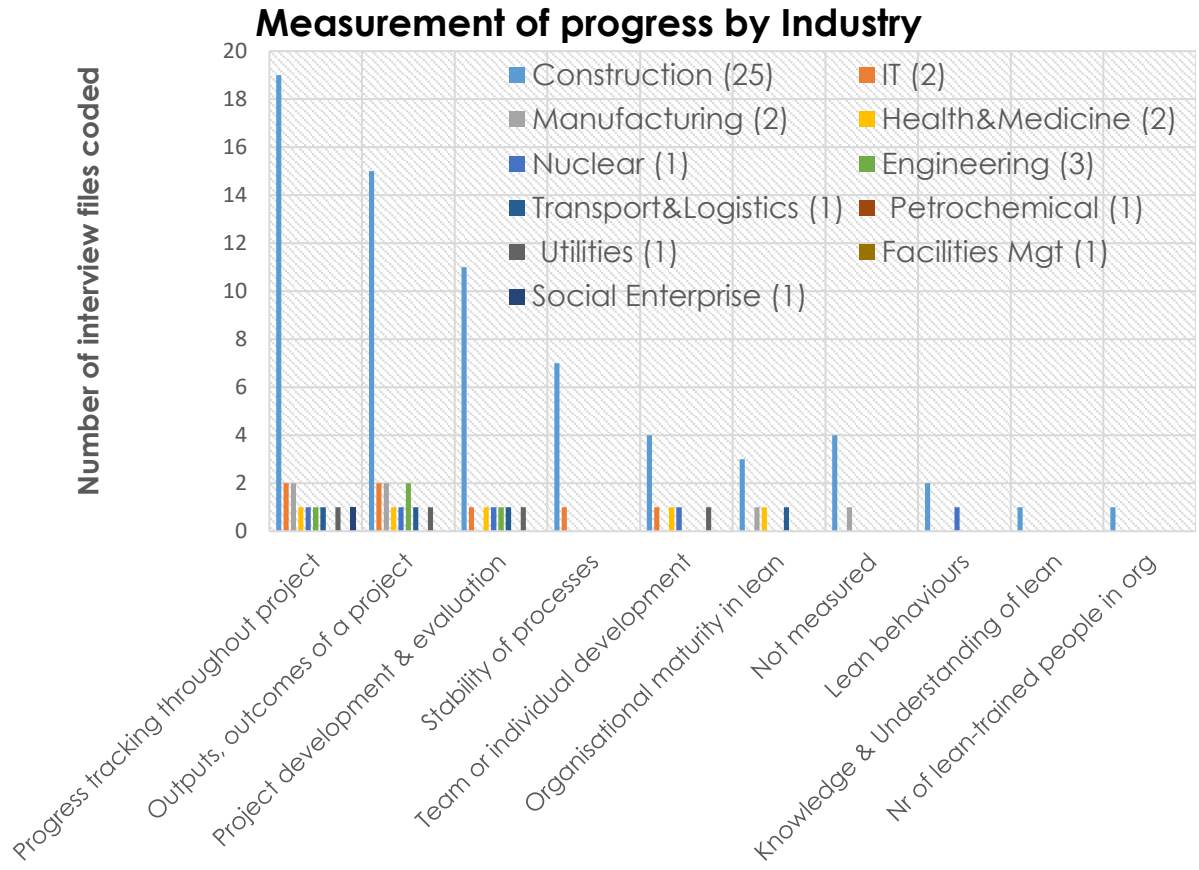
Therefore, the type of progress reported by interview participants focused on tracking progress throughout a project or at the end of a project, described as project outputs or outcomes (as illustrated by Figure 5.13).

Figure 5.13 Features of implementation of LPM



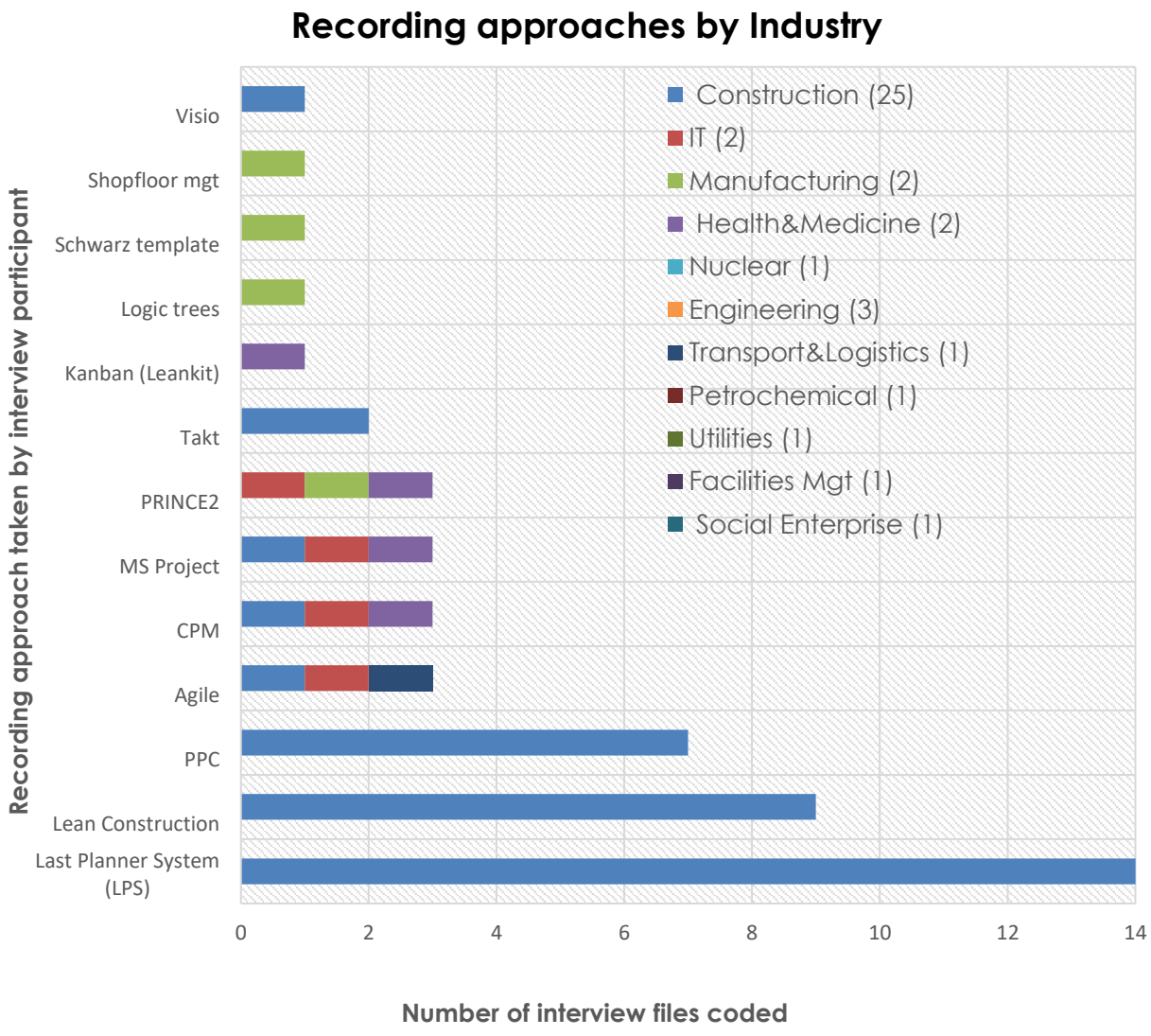
Project development and evaluation were also important to interview participants but progress that corresponds to the individual, team or organisational development is less frequently recorded and measured, or not measured at all. Progress relating to the numbers of lean-trained people in the organisation, knowledge and understanding of lean and related lean behaviours is recorded and measured in a very small number of organisations, according to the dataset. From an industry perspective, it is apparent that the Construction industry measures progress in a variety of ways, with more of a focus on tracking progress throughout the duration of a project, and less focus on measuring progress relating to individual and organisational knowledge and understanding of lean. This is illustrated below.

Figure 5.14 Measurement of progress by Industry



Recording of progress was also described in a variety of generic and specific ways by interview participants and their statements were categorised accordingly. The following figure illustrates the different ways of recording and the distribution by industry:

Figure 5.15 Recording approaches by industry



It can be clearly seen from the above figure that the Construction industry records progress through a multitude of tools and approaches, but mainly in a lean approach through LPS, Lean Construction, PPC, Takt and Visio, as would be expected. However, despite the low numbers of interview participants in other industries, the variety of both

lean and traditional approaches is noted, particularly within Health & Medicine and IT industries. Traditional recording approaches such as PRINCE2, CPM and MS Project are used by a smaller number of cases across Construction, IT and Health. Traditional recording approaches included anything paper-based, spreadsheets, charts such as bar charts and Gantt charts, and action planning, with task breakdown scheduling the most popular amongst this dataset, particularly amongst Construction, followed by Engineering and IT. Using a lean or traditional recording approach was mainly industry-led; for example this was often as part of lessons learned processes for individuals and teams, but also as part of organisational development. The following statements demonstrate this:

> "…using key things like visual management recording techniques to make sure people understand." (I13, UK Construction CEO)

> "…on the traditional waterfall, and part of the monthly reporting process is to capture any lessons learned during the period. There's a process by which they're disseminated. So, everyone in the project manager role can learn from those lessons." (I20, UK Transport & Logistics PM)

> "Well, again, it's also about the lessons learned. Going back, very document heavy, typical waterfall method. Use of PRINCE2, MSP, and then moving into agile." (I22, UK IT PM)

> "They are still doing things at stage-gates, very traditional, you could still wait months, years." (I37, UK Nuclear PM)

Recording approaches that were employed in both categories included the use of action plans and PPC, often using both paper-based and electronic formats in parallel. This was usually a deliberate decision for either time efficiency or for different audience purposes, rather than for purely measurement purposes:

> "We needed everything to be seamless, so that you didn't get to a weekly meeting and say it was a Tuesday, and the guy says, 'Oh I did that last Friday.' Everyone knows at any time point. So, it's updated live and, as soon as anyone chooses to view it, they can see it's done or they get a notification if something has been ticked off. We did it so every trade got a colour, they could easily filter it if they wanted, they had it live on their phones." (I29 UK Construction Senior PM).

> "Very often, progress is measured in very traditional... especially on construction sites – we see what is done and then we document the percentage of completed work at the site and then compare it again with, kind of, Gantt charts. So, this is progress and fulfilment in terms of lean; measuring it in terms of lean is a thing where I think we don't have the right answer for it, because we still have to rely on traditional PM tools." (I31, German Construction Senior PM)

> "We use Last Planner System, we don't use Takt planning, and how is it recorded and measured? Hmm, actually, we document every consultation, check and review the status in the next consultation." (I32, German Construction Senior PM)

> "At first, paper when you are in the meetings, and the action plan is paper-based anyway, and then you can disseminate that to the enterprise, organisation-wide, whatever, PM to PMs." (I37, UK Nuclear PM)

Based on the above evidence, it appears that choosing a specifically lean approach to measuring and recording progress is done based on the initial need for progress tracking for a particular project, and gradually moves towards measuring and recording the factors that underpin lean project management, as benefits of the lean approach become more widely realised. Aspects including knowledge and understanding, a generally improved supportive culture, and associated socio-cultural and behavioural characteristics such as accountability are considered most prevalent by interview participants when reflecting on factors and features of lean project management.

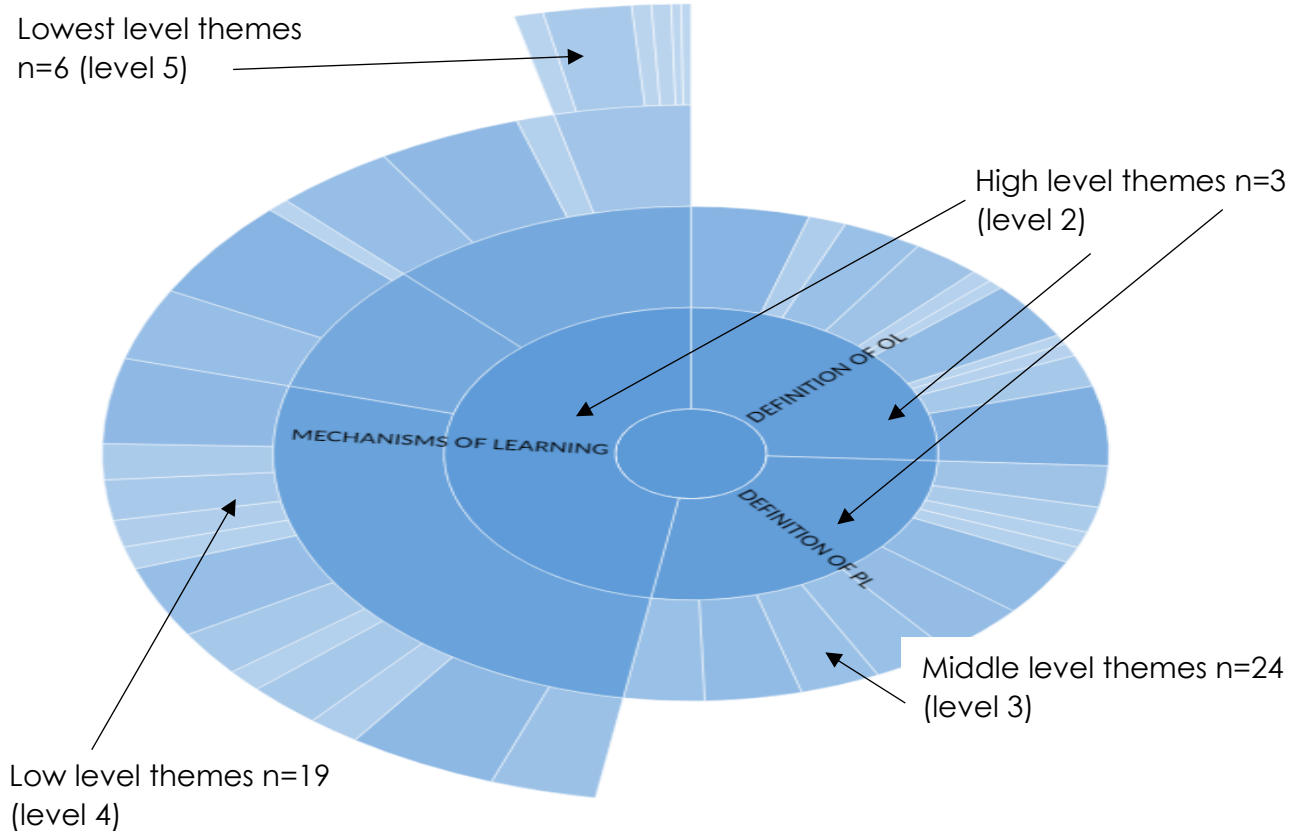
5.4.1.3 Summary findings for Implementation of LPM

Evidence from statements clearly indicates the presence of a number of Barriers, Benefits and Enablers which affect implementation of LPM. It can be seen where there are Barriers, these are also opportunities for Enablers. Benefits are closely aligned with interview participant perceptions of the value of LPM, and the prevalent perception is that barriers need to be reduced in order to realise the benefits. The type of progress being measured relates to planned tasks and activities, as might be expected, but also focuses on the way in which projects are developing, the stability of processes and some (lower) levels of evaluation in terms of individual development, team or organisational maturity. This is facilitated through the use of visual as well as more traditional paper-based means, which ensures that data and information is available to all, at different stages and phases on the project. The factors and features of implementation of LPM appear to be connected by socio-cultural and behavioural elements, which is regarded as essential for effective implementation.

5.1.5 Learning in LPM

In general, interview participants felt comfortable sharing thoughts, perceptions and opinions on aspects of learning within LPM, as evidenced by the high number of coding references (n=644). However, they were less willing to share their personal demographic data with regards to qualifications and levels of training, as illustrated by the high amount of missing information in these areas (see Appendices). The following section articulates definitions of project and organisational learning, followed by the description of specific mechanisms of learning in practice to understand how the theme of learning was created. The figure below denotes the high numbers of interview participants willing to share experiences of learning within LPM, through description and explanation of the mechanisms of learning (as indicated by the number of segments and levels).

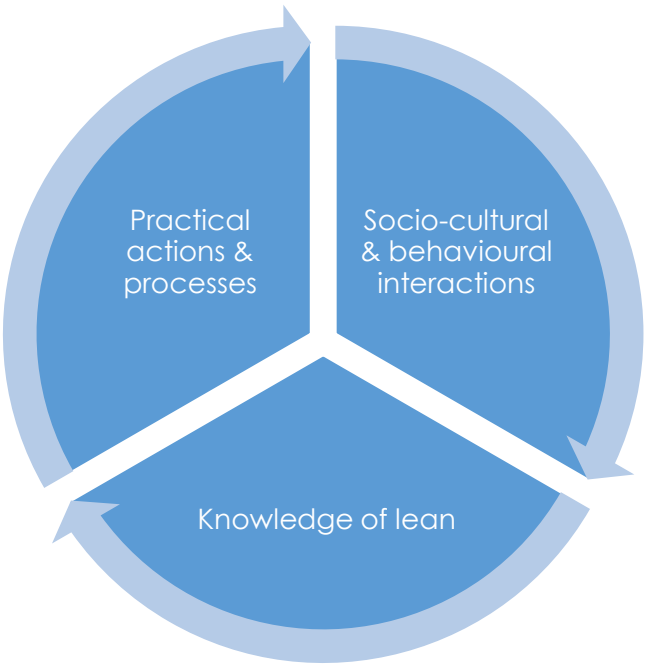
Figure 5.16 Learning in LPM (overarching theme)



5.1.5.1 Project Learning

This sub-theme explored the definition of project learning, in which a high number of coding references (n=168) gave rise to 10 different descriptive codes, in response to the question: What is Project Learning? However, rather than detail each one separately, three distinct elements of project learning began to emerge following analysis, which comprised multiple elements of the descriptive codes across and between each code. These elements formed a natural categorisation again: practical actions and processes of project learning, socio-cultural and behavioural interactions, and knowledge of lean. The existence and interrelationships between these three elements that were apparent from statements from interview participants led to an understanding of Project Learning as a cyclical process. This is illustrated in Figure 5.17:

Figure 5.17 Project Learning



The multi-directional arrows represent the continuous and ongoing nature of the occurrence of these three elements. **Practical actions and processes** include the

scheduled weekly meetings throughout a project's duration, discussing the current project's progress. Information that has been obtained from project KPIs forms part of the content that is discussed, and this facilitates the necessary practical action required.

> "So, reflecting back on the whole process from start to finish, but what I would hope is learning through project meetings should be part of any project. Because then you could have even more efficiency, you could reduce cost, you could use time resource more efficiently." (I15, UK Health & Medicine Senior PM)

> "I work with a team as well, trying to make sure that I take any lessons learned into a new project – so we do have a lesson learned meeting on what we learned on this project." (I16, UK Utilities Management PM)

> "…on the traditional waterfall and part of the monthly reporting process is to capture any lessons learned during the period. There's a process by which they're disseminated. So everyone in the project manager role can learn from those lessons. Now we have this collection of lessons learned and dissemination of information. And that's very effective." (I20, UK Transport & Logistics PM)

> "We certainly do take those learning points and we carry [them] forward and instil [them] on site." (I28, UK Construction Senior PM)

> "It's not only in lean projects, but in all of our projects; it's a thing, a point of lessons learned, so constantly make lessons learning, after important phases of the project, and adjust, maybe, things to keep on track and, in context of the lean philosophy, the continuous improvement of, maybe, also only small things, but maybe try to continuously improve the working environment." (I39, German Construction PM)

Note how the statements above reflect not only the importance of project learning for immediate action, but also consider further potential to sustain lean principles such as avoiding resource waste and generating cost-savings.

Socio-cultural and behavioural interactions are required in order to facilitate the practical actions and provide the learning opportunities. These include reflecting on individual and project-based experiences, mistakes, problems and issues raised, for the purpose of progressing the immediate project. By interacting as an individual with the team, sharing any best practice, but also by reflecting on things that have gone wrong, this is considered to be a mechanism for quickly responding to issues that may hinder current progress and additionally generate future opportunity for improvements:

> "So, what we try to do is, at least within the consultancy, is breakfast sharing; this is a regular event where we present and share our project learning from each other." (I7, Swiss Manufacturing Senior PM)

> "Learning is giving support, because, when any new project comes in, it's change and we don't know everything, so learning can only happen with the support you give to people, so people feel they can ask questions." (I8, UK Health & Medicine PM)

> "I think that the principle of greater communication allows you to learn because… you're sharing ideas and everyone will have experience of something that went wrong that they learnt a lesson from a more collaborative approach, you tend to that, you build up better relationships so you're more likely to share that information than traditionally. As a business owner, our focus is not a finger-pointing exercise, it's not there to blame anyone, [we're] quite happy it happened, and the benefit is to learn from that and make sure it doesn't happen again." (I30, UK Construction Senior PM)

Knowledge of lean as an essential element of project learning was expressed by the following interview participants:

> "Learning in the project, like in terms of content, what's the learning about in topics, that's touched upon in the project and then there's, of course, learning about the methodology, how to

> manage projects, what to look out for." (I7, Swiss Manufacturing Senior PM)

> "So, I think that, in that sense, every time we make projects with lean methodologies, then the principles are learned. People learn more about lean as they are undertaking the project." (I11, German Construction PM)

As well as the need to have a basic level of lean knowledge, it is apparent from these statements that LPM offers an opportunity for learning *about* lean, in addition to using lean knowledge to effectively implement LPM.

It was noted that, although these statements originated from different industries and levels of seniority, there is one commonality: all originate from the UK. Analysing in more depth each of the UK-specific responses, it was noted that interview participants employed in large public organisations placed more emphasis on collecting information and sharing best practice than on interacting with teams and lean processes. However, interview participants employed in large private organisations and SMEs understood project learning to mean practical interaction with lean processes, best achieved by learning from experience. No interview participants from Germany or Switzerland had any negative perceptions of learning.

According to a number of interview participants, there is a perception that project learning does not happen or is not implemented correctly. Nevertheless, it is important to include these perceptions to aid deeper understanding of project learning:

> "Yes, [learning] from one project to another [does happen], but I would say that's rare, that is very rare. It's an ideal rather than the norm. It's just lost." (I6, UK Construction Senior PM)

> "I would challenge 70, 80% of the project managers down there carrying out projects. No. They will start exactly the same way

> that [they] started last time. Look at halfway in the projects and get these laughable moments like: 'Oh! We had it last time.' There is very little learning other than, maybe, kind of like total learning during a project. You would think: 'Oh! We should think about that next time around.'" (I19, UK Engineering CEO)

> "We used to capture the lessons learned, but we didn't really do much with them." (I20, UK Transport & Logistics PM)

> "In reality [in] the industry I work in, it does not happen, ever. Those lessons learned pieces are always lost." (I21, UK Engineering PM)

> "You notice that the people you work with, especially colleagues, some colleagues do learn from mistakes. You know everybody makes mistakes, whether it's learning from that or learning about the environment you are working in or that you understand the different clients that you work with, but you always try and learn from where people went wrong, understand, learn from your mistakes, but sometimes I think it's just a nod to the process and people don't take on board what's happened." (I35, UK Facilities Management PM)

Although these statements suggest a generally negative perception in terms of a lack of project learning, there is still an essence of expectation that it could happen and that, as a minimum, the lessons learned processes do still occur.

5.1.5.2 Organisational Learning

Interview participants were asked directly, what is your understanding of the term "organisational learning", and this generated rich discussion, followed by a number and range of emerging definitions. Tables in the Appendices show the full range of codes developed from descriptive analysis in response to this question. It was clear that articulating this term was more difficult for many of the interview participants than project learning. The meaning of the term was often understood by interview participants as the formal organisation of learning, for example, the process by which the organisational entity learns, through the provision of both formal training courses

and informal workshops or learning events that are focused on individual learning. This included making tools, models and techniques available to all through knowledge creation and sharing. Activity and task-based "learning by doing" was a common thread and this too was considered as a vital mechanism for continuous improvement. This was cited as a purposeful link between and across projects, as well as from projects to the organisation. This was an action-based process which partially stemmed from a foundational knowledge base and additionally led to a tangible output of increased knowledge, as demonstrated below:

> "I think they learn to find a solution for the steps, the tasks and activities, earlier. They begin to discuss some tasks and find a better way to create and apply solutions and ways and methods. With lean, they learn to find these solutions and not just thinking on their own stuff, so the others could bring input… although it's not their specific responsibility, or task, exercise; people are more willing to help find and create solutions to problems and they do this together." (I10, German Construction PM)

> "So, I think that, in that sense, every time we make projects with lean methodologies, then the principles are learned. People learn more about lean as they are undertaking the project." (I11, German Construction PM)

> "When people start using tools without people telling them to use them, so they get into the routine of doing that, doing certain things, then you know people are learning. Learning would be if you see that philosophy in practice; so, not just writing the cards but talking about them, being transparent, not just doing the steps because that's the method, but talking about the problems now or seeing that in two or three months there will be a problem, and you hear people saying, 'Hey guys, let's look at this problem.'" (I27, German Construction Senior PM)

> "If a lean manager is coming in on a project and you go practical with information you got, and you used the philosophy and the tools – so they might not all be lean but they might still be helping you to improve your thinking and to have success as

> a team in your organisation; you are all going in the same direction." (I12 German Construction Senior PM)

> "Organisational learning for me is to make sure that the same message and principles and levels of learning are appropriate for the organisation at different levels of the organisation going through their journey." (I13, UK Construction CEO)

> "You've got set frameworks that are in place that ensure that you facilitate some form of learning whether you execute them or not. I think the answer is human behaviour and culture." (I22, UK IT PM)

> "How should we talk with them to convince them that lean is a good way, so, yes, for sure, but this is more em… emm… in an intrinsic way and not organised." (I25, German Construction Senior PM)

> "…definitely include contractors and participants in our planning and ask them to participate actively in lean." (I26, German Construction Senior PM)

Some interview participants articulated that organisational learning was for them an outcome, part of an evolving journey, a cultural shift for the organisation, which was positively inferred. It was intimated that organisational learning was, or should be, part of efficient operations management, an indication of purposive strategic organisational development.

> "...this works very well in this project, we try it now in other projects. Or we try to use our new knowledge in our office structures, things like this." (I9, German Construction Senior PM)

> "[OL is] something that is ingrained in the organisation. I think, until something is ingrained in second nature, it's not learned by the organisation. So, to me, it's something part of a culture, organisational learning." (I15, UK Health & Medicine Senior PM)

> "Having worked in a large multi-national organisation, it happens and is embedded in the culture. It is entwined within. It is on top, it is driven from top down, basically." (I21, UK Engineering PM)

> "We highlight what is good; if a project is doing something good that seems like it moves us forward as a business, that is highlighted, and whatever we are doing on that will be disseminated; others will learn from it." (I29, UK Construction Senior PM)

> "It's the responsibility of, like, myself and the senior management and the board to make sure that's then cascaded out elsewhere. So, it's kind of a joint thing really." (I33, UK Engineering PM)

Two important and connected aspects were implied by interview participants in contributing to the quality and direction of learning from project learning to organisational learning: the **pursuit** of continuous improvement (CI) and the **efforts** made by individuals at all seniority levels to implement CI.

> "Learning is part of our organisational culture at [company], because we are a company that is based on knowledge, and so there is a background, a landscape, let's say, which is only for serving learning, different steps. The project learning and the organisational learning, it needs both, and with our own learning it's the same. We need experience in projects and we need learning inside the organisation to share, to develop and to learn from each other." (I31 German Construction Senior PM)

> "Organisational learning has to be a continuing effort, and a programme of the organisation, whether it be governmental or whatever part of whatever company is doing the work. If they're going to succeed, and continue to succeed, it has to be an ongoing... almost like on the job training: you keep everyone up to speed on what's going on." (I40, Global Construction CEO)

5.1.5.3 Mechanisms of Learning

Mechanisms of learning as the final high-level theme are defined as the ways in which project learning occurs. Although statements from interview participants often relay

the content (or "what" is learned), situating learning within specific projects and their environments, this research is less concerned with "what" is learnt, but rather focuses on the *process* of project learning to better understand project learning specifically within lean projects and LPM. Thus, this research is interested in finding out **how** project learning occurs, **when** and by **whom**, and seeks to better understand these mechanisms. Questions relating to these mechanisms of project learning were answered descriptively with relative ease, as interview participants described their experiences of project learning.

How does learning occur? (Middle level theme)

Statements that best describe the nature of learning through concrete examples are presented below. These can be differentiated between formal and informal processes of learning, although some appeared to be a blend of both. Formal mechanisms included officially organised and scheduled project evaluation meetings with agendas (in addition to scheduled weekly project progress meetings) and internal training workshops. These often tended to use figures and statistics, for example, changes in PPC over time, as an initial focus for learning.

Informal mechanisms of learning also included provision of meetings and workshops, though the expectation in terms of attendance was generally lower. Often these were quick, perhaps due to the time pressures on participants, and agendas tended to be less formal – participants would not necessarily know what the subject was in advance of attendance. Often a specific problem or issue was presented for group discussion; for example, an observation of practice (positive or negative) or experience with specific clients was shared.

Regardless of the formal or informal nature of project learning, interview participants intimated that the purpose of the learning was for individual benefit, whether for self or others. From a location perspective, it was noted that interview participants from Germany and Switzerland felt that learning was best achieved through informal mechanisms, such as talking through problems and issues, although they also accepted and responded well to formal mechanisms such as the use of KPIs, as reflected by their statements:

> "During the workshops, together with my colleagues, I want to know what problems people have faced and how they went about them." (I7, Swiss Manufacturing Senior PM)

> "Also, learning would be if you see that philosophy in practice, so not just writing the cards but talking about them, being transparent, not just doing the steps because that's the method, but talking about the problems now or seeing that, in two or three months, there will be a problems and you hear people saying, 'Hey guys, let's look at this problem.'" (I27, German Construction Senior PM)

Those based in the UK and globally perceived formal mechanisms of learning as generally negative:

> "So, you'd have chitchat and those with any questions, summary, and then small group activities. So, that was a highway approach to learning." (I14, Global Petrochemical Senior PM)

> "The more formal processes, procedures, standards and changes, they are relatively non-agile." (I18 Global IT CEO)

> "We're keen on data, and they [senior management] like turning out information, but, again, we're quite immature on [the] knowledge management aspect." (I20, UK Transport & Logistics PM)

CHAPTER 5: FINDINGS

Interview participants from Health & Medicine and Construction were most able and vocal in describing the process of how project learning occurs, highlighting a blend of both formal and informal mechanisms, connecting the lean principles of efficiency and improvement through collaboration and communication with others.

> "I collect the sheets weekly and then co-ordinate a monthly meeting for both wards where we share practices based on the ongoing experience of using the new system. It's like an unofficial self-help group. We were the second clinical location online, but the ones that came on board later, [name] and [name], they are flying now because they haven't had to do a lot of the design, implementation, testing – we've done it all and they have learnt from us, and other people's mistakes. And that's how it should be, really. Great, so do it, and now share that success with the rest of us, you know, ask how did X manage that, can it be replicated, what does it mean for Y." (I8, UK Health & Medicine PM)

> "Being able to demonstrate in terms of sort of monitoring quality, being able to share that back with the rest of the team, and the benefits that were there, and you could see it from the beginning, and all the defects, and that helps with the handover process, the principle of greater communication allows you to learn because… you're sharing ideas. I think you tend to learn more from mistakes – things go wrong more than things go right – because I suppose you have to go back and do something. Everyone will have experience of something that went wrong that they learnt a lesson from a more collaborative approach you tend to do that, you build up better relationships so you're more likely to share that information than traditionally." (I30, UK Construction Senior PM)

> "How do we have to change things or justify things or just to make small changes to get better results, and this is very much a learning." (I31, German Construction Senior PM)

> "The risk always is that learning can be forgotten quite quickly if you aren't careful. You realise it for that project; you say, 'Oh, that looks quite significant', but then it becomes just back to business as usual if you're not careful, so it is about then trying to find the processes to mean you embed that learning going

> forward on other projects, or on that project if it repeats, or within the whole organisation if its applicable." (I33, UK Engineering PM)

The statements generally suggest an emphasis on the socio-cultural and behavioural aspects of learning, in anticipation of perceived positive benefits brought about for self and others. For these participants, learning appears to be valued as an ongoing mechanism to facilitate positive change more widely as well as intended project outputs.

When does learning occur? (middle level theme)

Over half (55%) of the dataset perceived learning to occur on a continual ongoing basis, throughout the duration of projects, and 38% stated this occurred specifically at the end of projects. Given the experience and number of LPM projects represented within the dataset, this number is to be expected. A small number of individuals deemed learning only to take place at the start of the next project, without it having occurred previously, as the following statements demonstrate:

> "The project had been "live" in [location] for 2 years, so they'd learnt from that experience, of it being a miserable failure and how long it took for the implementation. So our project plan did take that into account." (I8, UK Health & Medicine PM)

> "I feel that the reality is, when you get the project brief, you hit the ground running, and then you start to move on that prior lessons learned before we start something." (I21, UK Engineering PM)

> "The lean benefits aren't shared, as far as I'm aware, and the lessons learned... when a new project starts, they all just go into the database, and they'll get historic use, just to run through it, I think." (I37, UK Nuclear PM)

> "We are looking at how badly projects have been run and can we actually improve the next time round; here, that idea of learning lessons is actually more than just project management methodology." (I19, UK Manufacturing CEO)

Within the Construction industry, interview participants in Germany were more likely to perceive learning occurring on an ongoing basis as well as at the end the end of the project, whereas their UK counterparts generally saw learning as either ongoing OR at the end, but not both.

> "It's a little bit of both: at the end they will see what they have learnt and, during the implementation of lean, they will learn how to use lean and how they could make an effort of this." (I10, German Construction PM)

> "Well, at the end of the project, the organisations learn, from the people who are doing the project, but also during each weekly meeting, because of the reasons that people are maybe talking about, problems, improvements and so forth." (I11, German Construction PM)

> "In the project itself it's a continuous learning and a continuous improvement, so we do our meetings and after the meetings we give us feedback and tell us what should we do the next time better." (I25, German Construction Senior PM)

> "It's not just general feedback, for example, at the end of a project and then drawing your learning for the next project; the PMs and Lean Consultants in such a lean project, they try to improve themselves, their techniques, their approaches from week to week, and try to see, 'OK, what is working, not working, what and how can I do it better?'" (I31, German Construction Senior PM)

> "Well, for me personally, every day is a school day. I'm learning all the time." (I13, UK Construction CEO)

> "At the end, you learn success over failures." (I30, UK Construction Senior PM)

Who "does" the learning? (middle level theme)

As expected, the majority of interview participants felt that everyone does, or is responsible for, learning, with no particular discernible patterns found with respect to demographic attributes of age, gender, country, industry or organisational size:

> "The people who are transparent, they learn much more than the people who don't want to show what they are doing. We learn from these people much more, and with them." (I1, German Construction Senior PM)

> "All the team members learn. At the beginning, it's the Facilitator or Moderator who's teaching the lean during the weeks and, each time they use it, everybody could learn from everybody and altogether they [make] an effort, and then progress." (I10, German Construction PM)

> "Everyone is learning. As a lean manager, you are learning what you could do differently on the next workshop or project. As a stakeholder of a process, you are learning probably to do the work with less waste, so everyone has his own part to play in this learning experience." (I12 German Construction Senior PM)

> "So, what you want to know next time, you want to make sure is everyone on board, are the team happy doing what they do, note do they think they could improve the process thereby maybe shortening the length of the project time, maybe by eliminating some of the barriers that we had." (I15, UK Health Senior PM)

> "There is a responsibility to learn from each and every programme that you want to take. If you are going to stay within the confines of the same organisation and we want to do another project, expect to affect that." (I21, UK Engineering PM)

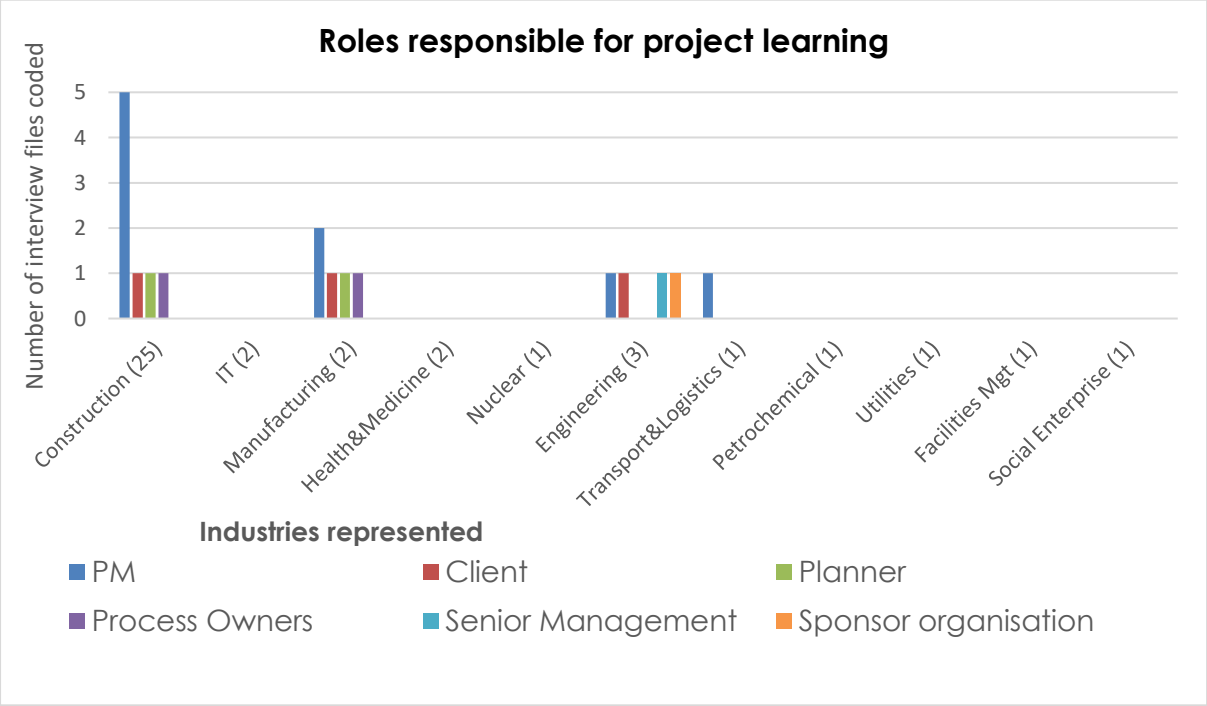
> "…it depends on each person. I don't think it depends on the role. I mean, everyone wants to [do] their job [well], they generally want to be recognised for what they've done [well], but it depends." (I26, German Construction PM)

There is a sense that the interview participants include themselves as individuals within the "collective" effort, rather than just assuming responsibility belongs to everyone else. As I31 put it:

> "Each individual must be prepared or ready to learn and improve his own work and the individual in the project." (I31, German Construction Senior PM)

Where specific or named roles were mentioned, the Project Manager was deemed the role most responsible for any project learning. This was perceived across four industries, as Figure 5.18 illustrates:

Figure 5.18 Roles deemed most responsible for learning by Industry



Further insight is provided below with regards to perceptions regarding the role and nature of the PM in learning in Construction, Manufacturing, Engineering and Transport & Logistics:

> "…it's the PM, or LPM, or Lean Consultant who is very much… who has more control over the process than the others, so it is on their side to make the right decisions and to reflect on the meetings, reflect on the methods, reflect the tools, the techniques that are applied to see, 'OK, where can we change it?' It's the Manager who has to foster and water the plant." (I31, German Construction Senior PM)

> "Hm… I would say it's the PM who is responsible for executing it. Otherwise no-one does it." (I34, German Construction PM)

> "…Project Leader or the Lean Manager who is implementing the methodology." (I39. German Construction Senior PM)

> "…another element of our learning, we do storylining."
>
> Researcher: "Is that between the lean consultants only or the project managers, or people working within the projects?"
>
> Participant: "Just consultants and internal trainers, not always, but usually just consultants. So, we also have refreshers and masterclasses, workshops where we could focus." (I7, Swiss Manufacturing Senior PM)

> "…whereas the project managers and the teams would only see... it's only really possible for them to take that learning onto their next project. They would, maybe if they were the ones carrying it out, they would also need to report that back." (I33, UK Engineering PM)

> "On both the traditional waterfall and part of the lean monthly reporting process is to capture any lessons learned during the period. There's a process by which they're disseminated. So everyone in the project manager role can learn from those lessons." (I20, UK Transport & Logistics Senior PM)

From the above statements, mechanisms of learning appear to be both formal and informal in nature, with learning that forms part of essential ongoing project processes as well as following a project's conclusion. There is an emphasis on the increased level of communication, collaboration and informality required to achieve learning within a project. According to this dataset, reinforcement of positive socio-cultural and behavioural characteristics of oneself and others is important in facilitating successful project outcomes. However, where this happens, there is an increased likelihood of better overall levels of knowledge and learning of lean principles as well as project learning.

5.1.5.4 Summary findings for Learning

No significant patterns or trends were detected in terms of industry-specific prevalence. However, comparing statements from Construction industry interview participants in Germany and the UK, there is one initial notable difference. Although learning is important, it appears to be more project-specific according to interview participants in the UK. In contrast, German Construction interview participants implementing lean as a tool or technique for facilitating project progress do not consider this to be a "one-off" learning. That is, once the knowledge and (generally positive) experience of LPM is in place, its implementation is encouraged moving forward, by planning earlier, bringing in more team members and more frequently. This suggests the *outcomes* following the processes of learning appear to be of additional importance to those participants in Germany.

5.1.6 Overall Summary Findings for the Interview Study

Forty interviews were analysed and led to the creation of three overarching themes, supporting the utility of lean project management through exploration and expression

of its conceptualisation, implementation and learning within LPM practice. Evidence in support of these three themes has been provided by the context of individual practice, based on the identification and assessment of lean project managers' baseline knowledge, understanding and experience (Objective 1). Through semi-structured, in-depth interview questioning, the researcher explored the experience of LPM and project learning with interview participants, who provided a wealth of contextual data, articulated by thick, rich descriptive statements (Objective 2). As a combined dataset, interview participants operate in the UK, Germany, Switzerland and a range of global locations in their day-to-day PM practice. Eleven different industries contributed to this rich data, across a range of ages and levels of seniority, comprising a total experience of working in project management of just under 180 years (Objective 3).

Thus, in addressing the objectives, the findings from the Interview Study suggest that there is an understanding and acceptance of the concept of LPM and a generally positive appetite for its implementation across industries. Additionally, implementing LPM as a project or organisational approach appears to increase individual knowledge and understanding of *lean*. The findings suggest that the level of knowledge and understanding of lean is an important factor for effective implementation of LPM at the project level. An individual's learning by doing, through the implementation of LPM, enhances the levels of knowledge and understanding of lean. This indicates that a relationship between LPM and learning does exist and can potentially benefit individual, project and organisational outcomes. The next section investigates this more fully, and presents findings that further support Objectives 1, 2, and 3 through the Case Study, which explores the relationship between LPM and project learning.

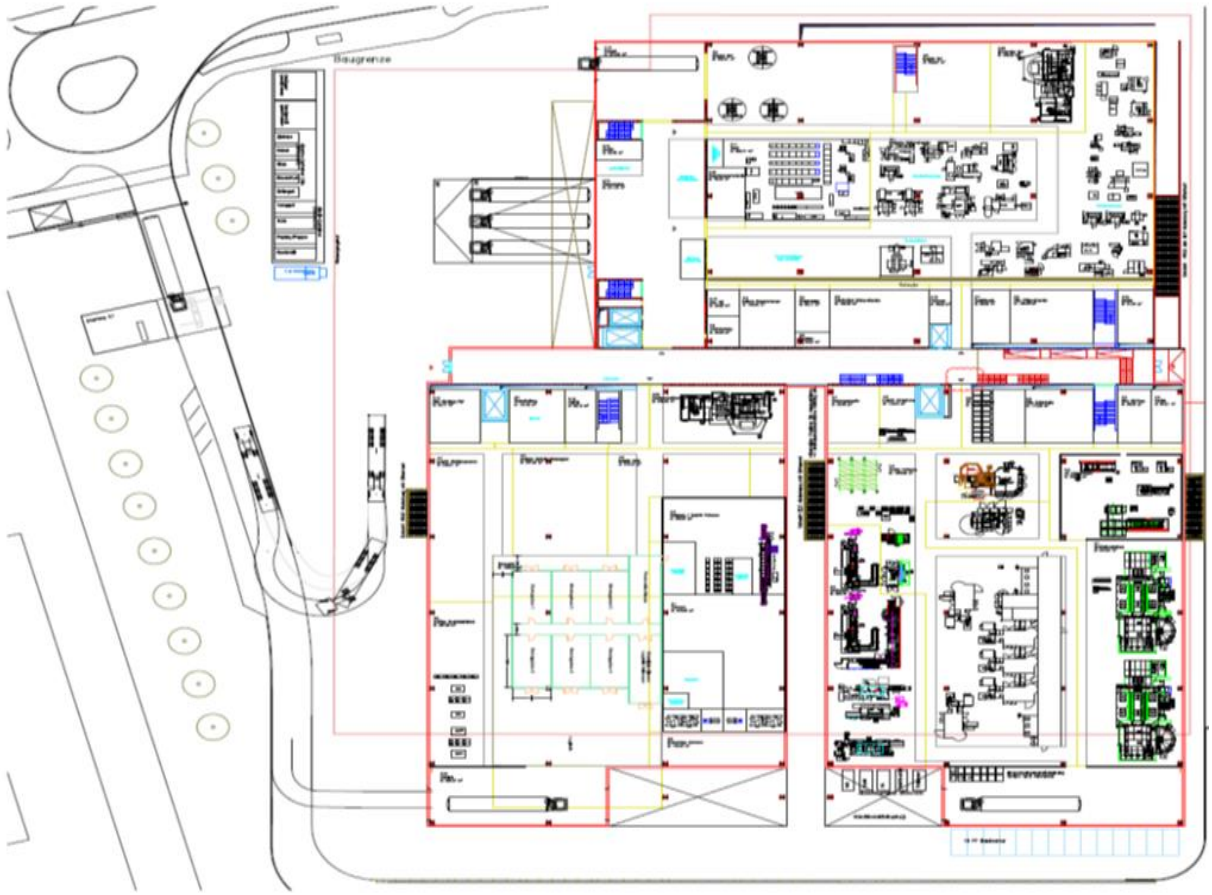
5.2 Case Study

In addressing Objectives 2 and 3, a deep dive into how learning may be facilitated was undertaken through a purposively selected case where LPM was being implemented for the first time within a construction project for the client organisation. A description of the case project (the LDMT project) has been provided in Chapter 4, section 4.3.4, and this has already introduced the tentative proposition that the implementation of LPM may facilitate project learning. In the following section, the case is presented for this proposition, using data from multiple sources of evidence which together support the case. Further evidence to support the earlier themes of conceptualisation and implementation is also provided in this section. However, the main focus of this section remains the exploration of the nature of any relationship between the implementation of LPM and how this may facilitate project learning within the context of the LDMT project, as demonstrated in the next section.

5.2.1 The LDMT project (the case)

Contextual data is presented below with respect to the background of the LDMT project. The illustration and the table below (Figure 5.19 and Table 5.3) depict the design plan for the new build and represent the magnitude and detail of the proposed build, which requires a multi-disciplinary project team.

Figure 5.19 Design plan for new build



Source: LDMT project (2017) (not to scale)

A multi-disciplinary project team was created at the end of December 2017, comprising several unique functions, currently represented by eight different organisations (Table 5.3 below).

Table 5.3 Project Membership of the LDMT Project

Colour	Function/Trade/Discipline	Organisation Owner	Process Owner
1			
2	**Lift Engineering**	M-B	OO
3	**Electrical Engineering**	M-B	BS
4	**Building Services Engineering (overall)**	K-I	JK/DM
5	**Building Services Engineering - Sanitation**	K-I	GM
6	**Building Services Engineering - Heating/Cooling**	K-I	DM
7	**Building Services Engineering - Ventilation**	K-I	MJ
8	**Fire Protection**		
9			
10	**Shoring/Construction pit**	B	TM
11			
12	**Execution/Implementation**		
13	**Drainage, Sewerage, outdoor facilities**	B	CS
14	**Structural Engineering**	B	TM
15			
16	**Building Physics**		MS
17	**Traffic planning, external facilities**	B-L	DR
18	**Architecture**	B-L	AL
19	**Client representation**	T	CK
20			
21	**Clean room planning**	CRC	MP
22	**User representation**	T	FS/MF
23			
24			
25	**Control/Procurement**	E	HG

Source: LDMT Project (2017)

The maximum number of functions required for the design phase is 25, each represented by a different colour and number. Designation of functions and their corresponding identifying numbers and colours is shown as at May 2018. Some functions also have specialist sub-functions, e.g. 1-3 (Blue, General Engineering, represented by the company M-B), which is distinct from Building Services Engineering (4-7, Green, represented by the company K-I). Note that no supplier organisation has been identified for the Execution/Implementation function as this is not relevant until later, and that some functions require only one number/colour, e.g. Architecture, User

Representation. Process Owners and their employing organisations are indicated by initials and form the initial project team membership. Some fields are left blank intentionally, e.g. 20, 23, 24, to allow any contingency or specialist functions to join that may be required as time progresses.

The initial project artefacts outlined above set the foundation for exploration of the relationship between LPM and learning within the case. The following sections present findings in support of the case, through the three themes of Conceptualisation, Implementation and Learning.

5.2.2 Conceptualisation of LPM

Multiple sources of evidence are presented below which suggest agreement with the earlier definitions and value of LPM found in the Interview Study, namely the articulation of LPM as the application of lean principles. The following evidence from four case study interviews and four non-participant observations supports the positive value and conceptualisation of LPM:

> **Improved Perception, Improved Satisfaction:**
>
> "We have much less problems in the lean project. We can use the whole knowledge of the whole team, and this is what the project learned: that we don't forget to talk to all the necessary trades." (I9)

> "The schedule is completely prepared by the team itself not by project management from the specific [person] responsible for project management only. Here, you are involved in developing the schedule and you have more influence on the specific steps and you bring them into action during the preparation of the schedule. It helps to reduce the number of conflicts within the team. I think that's one of the basic things." (I17)

> "We understand it [LPM] as a method, in order to find problems and solutions within construction scheduling, or also together with and for participants' planning. Things just work in this project.

> We can focus and we get the answers very quickly because we are very fast in results, for the special field of planning, so this is not measured, it's a feeling. Everybody who is part of the planning team is very positive because everybody is very fast in planning, he doesn't repeat the same things and we don't have so many emails, we don't have to read all the protocols." (I32)

Improved Efficiency:

> Only relevant topics are discussed at each weekly meeting – time is not wasted going "off-agenda" and the process, although it happens more regularly [weekly], times are adhered to. All data is a "moment in time" that is written up in terms of updating the e-copy of the MPP, rather than a paper document that is created. (Researcher's Reflection following 1st Observation)

Enhanced Supportive Culture:

> During planning for the next two weeks, there was much discussion, and trades were checking with each other if their tasks were affected by others or created an impact on others. There was a real sense of collaboration and intent noticed during conversations. (Researcher's Reflection following 2nd Observation)

> During this discussion, which only a few people can contribute to, others have side conversations. Others that join in this discussion also move round the room. When issues are presented, process owners move to where the conversation is happening. E.g., another trade team leader has been on site and is asked to confirm/validate a point; he moves to the location of the conversation and doesn't talk across the room. (Researcher's Field Notes during 4th Observation)

These findings clearly distinguish LPM from more traditional and linear methods of project management, illustrating the value of LPM as a method and a process to facilitate increased knowledge and understanding of the project and its processes. LPM is defined by and valued as an efficient application of lean principles, demonstrated by satisfaction with the lean processes as well as the ability to reduce potential wastes and costs. Together with images and documents relating to the

implementation process of LPM via the LDMT project, a contextual boundary is formed relating to the phenomenon of LPM and learning as it is experienced by project team members.

5.2.3 Implementation of LPM

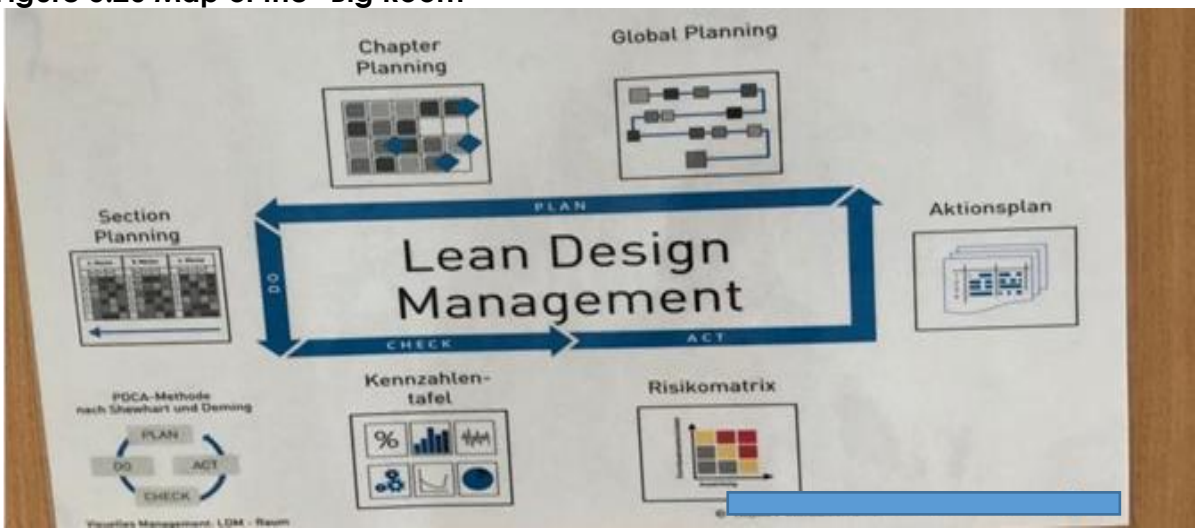
Implementation of LPM within the LDMT project is characterised by project team interactions through collaborative discussion, communication, reflection and evaluation. This is demonstrated through the provision of the researcher's field notes, reflections and images from non-participant observations. The following images and documents were taken during non-participant observation data collection and analysis, at various time-points between May 2018 and May 2019. The images displayed depict behaviours and actions of the project team which not only build up a rich picture of the phenomenon under exploration but support perceived benefits and enablers of implementation of LPM through collaborative planning, evaluation of progress and review.

Images relating to well-established lean principles (such as reduction in waste, costs, efficiency) are shown only for contextual knowledge and understanding; the existence of such principles is acknowledged by the fact that the Last Planner System is already in use by the LDMT project and as such underpins its (effective) implementation. Evidence presented within the current theme focuses on exploring **how** LPM implementation may facilitate learning, rather than specifically **which** lean principles are implemented.

As indicated earlier, one of the key themes of implementation is collaborative planning. The image below shows the location of pertinent processes necessary for effective implementation of LPM, or a visual map of the "Big Room", providing the context for the documents and charts in use. The images that follow enable a sense

of the Big Room seen through the strategic placing of essential project documents and charts on the wall beginning at the top right (Global Planning, Chapter and Section Planning), moving left and down to Risks, KPIs, Actions. This also coincides with a reminder of the circular Plan, Do, Check, Act (PDCA) model (also shown in the bottom left of the image), re-iterating the non-linear aspect of lean project management. The strategic physical placing of these documents in the Big Room is an important aspect in LPM implementation and the processes each week follow this same pattern.

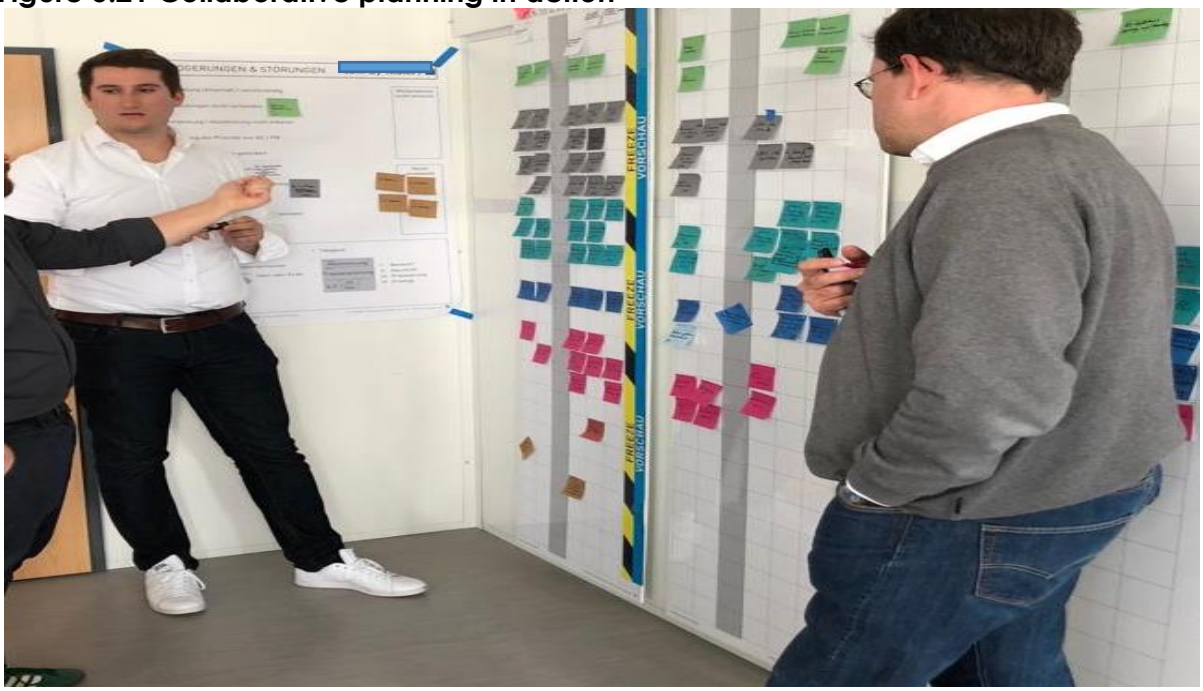
Figure 5.20 Map of the "Big Room"



Source: researcher's photographs

Documents and charts are fixed on the wall and are present throughout the duration of the project. These are static, available for viewing at any time. Only the charts that hang each week on the "6-week" walls and the KPIs are temporary, updated each week, providing a snapshot in time of planned versus achieved activity. The figure below (Figure 5.21) illustrates two types of LPM implementation activity – on the left of the image, a fixed "Delays and Faults" chart and on the right, the "6-week wall".

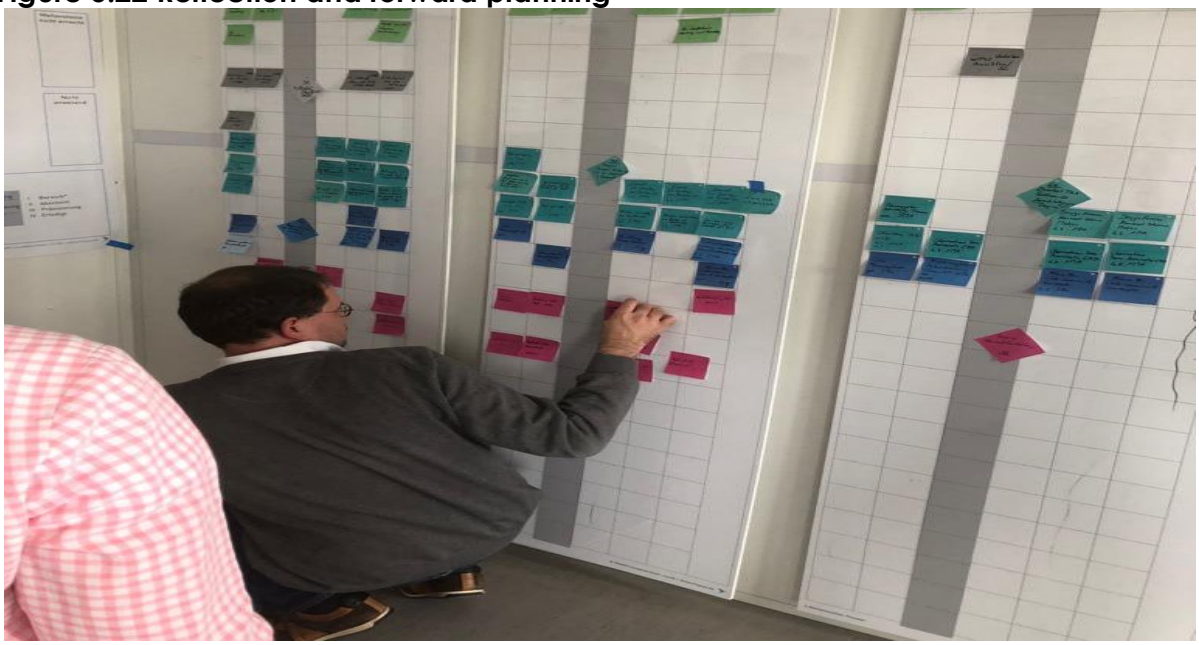
Figure 5.21 Collaborative planning in action



Source: researcher's photographs

In the above image, the project team member (off-frame), indicating towards the wall (representing Grey post-it notes), discusses the impact of an activity that has not been achieved This Week (1st wall chart on left) with the Lean Facilitator (white shirt). This can also be seen on the Delays and Faults Board, just behind the Lean Facilitator. Another project team member (grey jumper) looks on and listens as this may affect his team's work (Pink Post-It notes) next week. Having listened to and reflected on his colleague's reports about what the Grey team plans to achieve Next Week, this project team member then places his trades Pink Post-It notes on the wall, as shown by the following image (Figure 5.22)

Figure 5.22 Reflection and forward planning

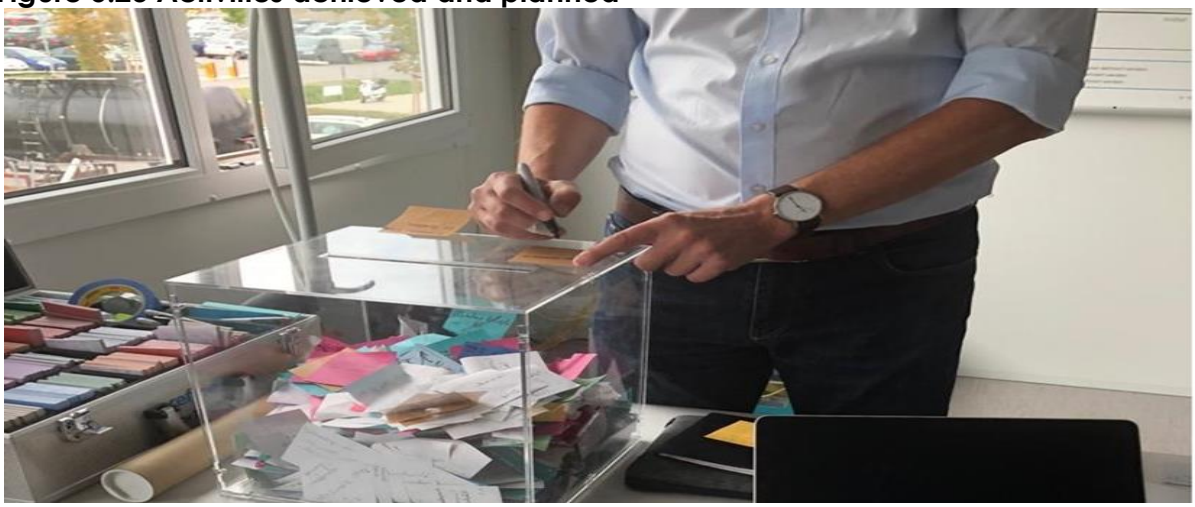


Source: researcher's photographs

In the image above, another team member (wearing a pink-checked shirt) also observes where the Post-It notes are being placed; this team member is employed in the User Representation function. Whilst her team has no planned activity in the coming week, she needs to be aware of the timelines from other trades' Post-It notes.

In the following image (Figure 5.23), two activities can be seen. The half-filled glass Post-It notes box indicates which tasks and activities have already been achieved from the start of the project. A member of the Brown team (External Facilities) plans tasks for the week ahead by writing his team's tasks on Brown Post-It notes, prior to placing them on the Next Week Look Ahead chart on the 6- week wall.

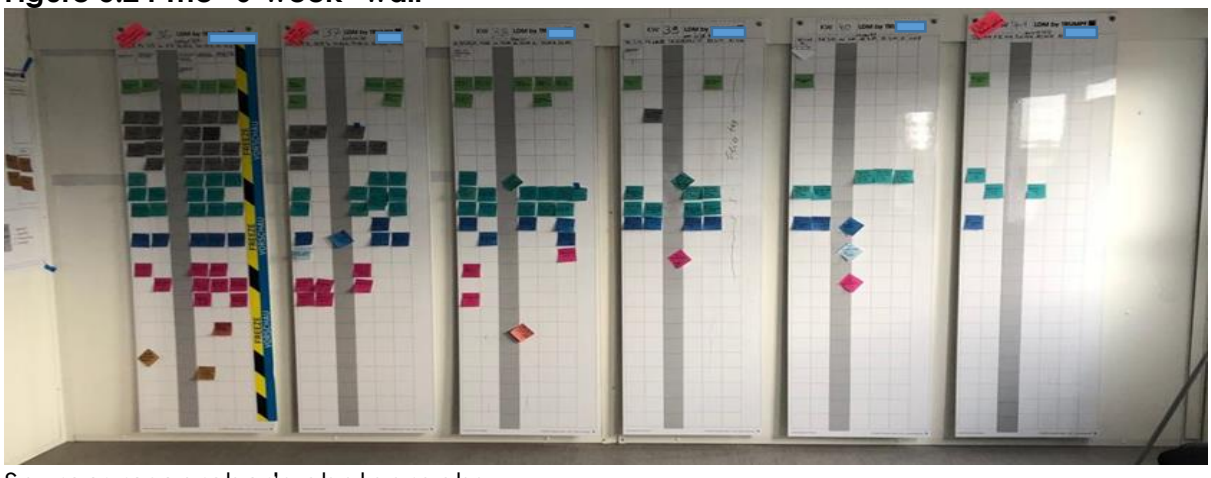
Figure 5.23 Activities achieved and planned



Source: researcher's photographs

The following image shows the 6-week collaborative planning wall; the photograph was taken prior to evaluation of "This Week" (far left). Note the magnetic strips "Freeze" and "Vorschau" (Look Ahead) are placed at the right-hand side of This Week. The activity about to be discussed in the Big Room is to report and evaluate what was achieved This Week, and the physical act of placing these visual strips was helpful in keeping the group on track in discussing this particular time-point (Researcher's reflection following 1st Observation). As would be expected, the majority of Post-It notes appears on the far left, as this is the focal time-point.

Figure 5.24 The "6-week" wall



Source: researcher's photographs

The following two images were taken during the first and last observation time-points:

Figure 5.25 Achievement of tasks and activities

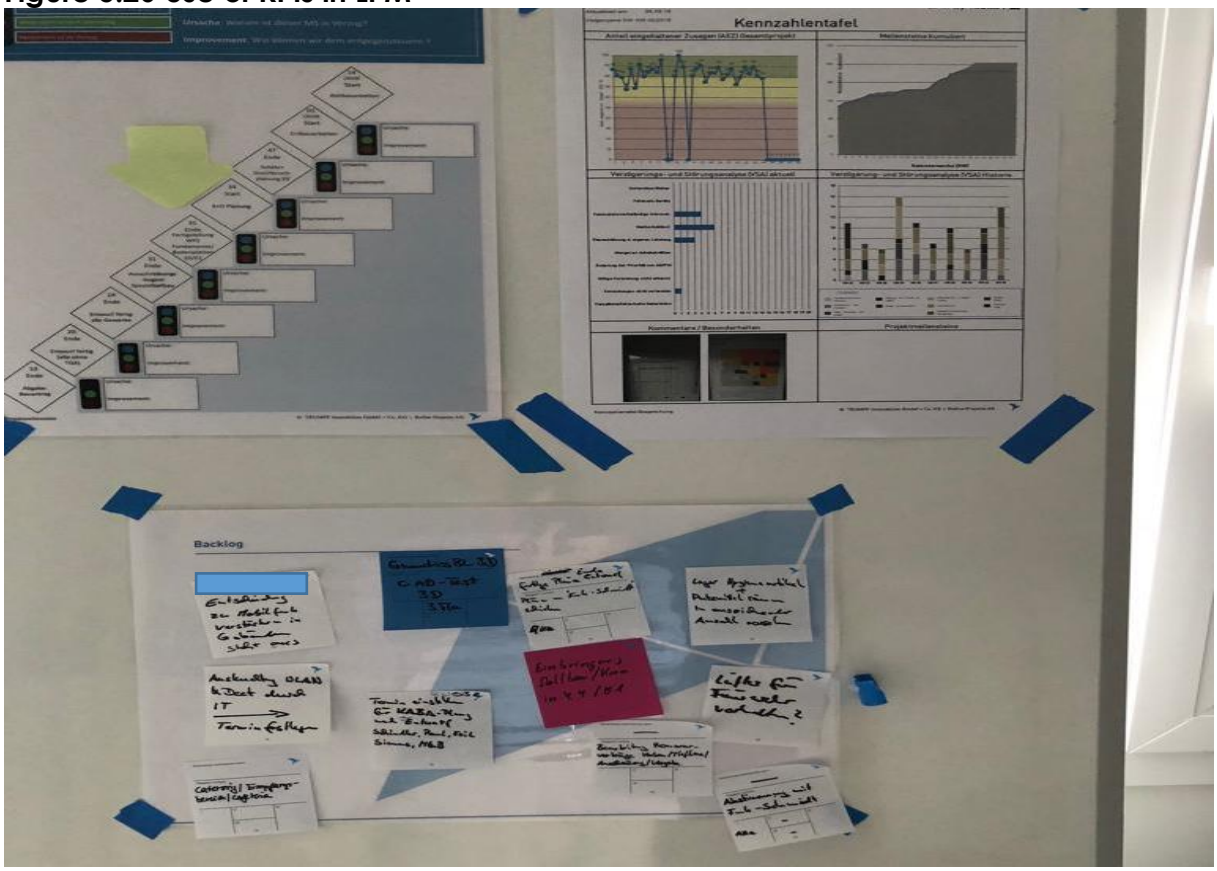
Source: researcher's photographs

This clear demonstration of achievements was noted by the researcher:

> The glass box on the central table is considered motivational, especially when a project is starting up, so that people can see how much is being achieved. It also not perceived as "waste" as it adds value; it is not thrown away when the project is completed. As the project progresses, the glass box gets filled up and serves as an effective visual ongoing motivation for anyone who comes into/interacts in the room. (Researcher's Reflection after 1st Observation)

At the opposite wall, the KPIs are also shown. These are replaced every week, with the updated information based on achievements to date, including but not limited to PPC (percentage promises complete), an essential element of LPS and Lean Construction. Figure 5.26 below shows the status of the project according to the overall GPA (left-hand image) and the weekly evaluation meetings (right-hand image). A more detailed example of KPIs is provided in the Appendices.

Figure 5.26 Use of KPIs in LPM



Source: researcher's photographs

These visual reminders not only provide an update at any one time, they also depict the progress of a project over time, so it is easy to see at a glance the rate of progress, which trade areas have the most delays and faults, and whose activities are in a backlog state. The backlog "log" is available for team members to place any relevant coloured Post-It notes, at any time. These are activities that have not been achieved, and must remain visible, or new tasks that require action. For example, in the above image (bottom, centre) White Post-It notes represent Project Leadership who currently have the most backlog items. They may or may not affect scheduling, but will be reported, considered and/or discussed at the relevant time by the relevant Process Owner. They are kept on the Backlog sheet until such time as they can be removed. Again, these are not discarded, but once achieved, are struck through in pen and placed in the glass Post-It notes box.

Figure 5.27 At the end of the Weekly Project Evaluation & Planning (PEP) Meeting

Source: researcher's photographs

After the second observation, the wall chart for This Week has been taken off the wall, since the achievements have been reported, and is ready to be taken back to the Lean Facilitation company's office to update electronically. Information relating to KPIs will also be fed into the electronic planning documents, and a new print-out will be brought to the weekly meeting to update the project team with respect to the current status of weekly KPIs and overall project KPIs, as per Figure 5.26. The above scene also enables a sense of the Big Room seen through the essential project documentation on the wall – from left to right: Risk Matrix, 5 Main Flows, Holiday Chart, Design Plans, groundwork and engineering, the overall GPA and the current MPP – which is continually visible to anyone walking into the Big Room. Further documentation can be seen in the filing cabinet behind the Lean Facilitator; this contains approved documentation, building planning, architectural design drawings and concept planning, used for reference only. The processes and practices of LPM implementation that were observed during Observation 1 were also found during

Observations 2, 3 and 4. One such practice is a reminder of the ground rules and the process of annotating Post-It notes, which is given briefly at the start of every meeting, and additionally throughout the meetings, prompted by the Lean Facilitator (LF), when deemed necessary. During the first observation, the researcher's field notes commented:

> "09:00: LF introduced the agenda for the day, reminding everyone of the **process**, specifically what and how the Post-It's work and how they should be placed." (see image below)
>
> "09:50: A reminder of the ground rules is also given briefly."
>
> "10.35: LF checked that everyone in the room understood what the milestones were, that everyone had the same understanding, also that they would be constantly mindful of the five main flows. LF reminded participants that, in the event of a lack of understanding, they should ask now, as better to slow down a process now rather than have misunderstanding later down the line. For project learning he reminded everyone that the big blue diamond is representative of the MPP, then drilling down into details through individual colours would follow in a short while."

This consistency in outlining, reminding and checking understanding of processes and principles of lean implementation, illustrates a broader trend that remained unchanged over the data collection and analysis period (May 2018 to May 2019). Although the intention of the case study was not to specifically trace changes over time, the discovery of this consistency serves to add a further level of assurance that the implementation of LPM was being undertaken correctly by the project team.

5.2.4 Learning in LPM

The case study set out to describe and demonstrate the definitions and characteristics of project learning that were perceived, understood and observed during the

implementation of the LDMT project. This refers to any learning undertaken and iterated by individuals, as well as any learning observed across the case study project. Additionally, the case study sought to explore what, if any, and how any pertinent aspects of organisational learning were apparent during the course of the implementation. Multiple sources of evidence from interview, observational, image and documentation data were combined to provide evidence for the theme of learning within the case.

5.2.4.1 Project Learning (PL)

Project learning was articulated by interview participants mostly in terms of the practical interaction with the lean processes, learning through experience, mistakes and problems, and learning by doing:

> "Learning is there that more information comes from other participants who are part of the discussions; also, there is a large discussion instead of many more small discussions where there are not so many participants. The learning effect is already that one learns something of what someone else does, something that [is] not actually one's own area, and this is already, yes, this comes through lean working, through this discussion, through this common commitment, and sticking the Post-It's together, and so on. Yes." (I32)

> "…the waste, we learned much better not to write so much emails, and talk face to face is much better in this project." (I9)

> "I'd say learning is very much about kaizen. If you make a mistake, you document the mistake somewhere but you try to solve it, and you also want to learn from the mistake, or, even better, don't even make the mistake in the first place. This is a big part of learning, trying to learn from your mistakes and cultivating wisdom." (I3)

Interview participants suggested that project learning could be characterised by the focus on solutions, and by collecting information such as KPIs in order to make progress and improvements:

> "A big part that we have in the system is learning about the reasons or the main route for the not fulfilling of a planned task. When we are in our projects and we ask the project owners if they fulfilled all of their tasks that they planned on a daily basis, and, if they didn't fulfil them, we ask them for a reason for that, it's in the Big Room, where everybody can see and listen. Everybody gets the learning." (I3)

Interestingly, lack of attendance at the weekly project meetings is not tolerated well. Interview participants perceive this to have a negative impact on those absentees, who do not appear to understand the essential processes and actions, and thus then experience difficulties with implementation:

> "We have some colleagues [who] do not attend very often. And you see that that kind of thinking completely different. For example, we have made a global planning and chapter planning and so all the dates are fixed and you have… you can look [at] the dates in the schedule. When do I get this information? And so on, and it's well prepared. There's the reason why the date is this one, not any other. The colleagues who are not attending, they say, 'Where is this information, [we] need to have this information now' but the date is completely different. And for them it's as I said, it has a reason: because you do not need to have this information. They try to get as much information in advance. Not using it. That's the difference. So the difference is the colleagues who are present in most of the meetings, they get the information at the time they're able to act. And they're also able to accept that they're not getting information now because everybody knows they do not need information." (I17)

The way in which learning from mistakes, problems and issues occurs was particularly notable from observational data. For example, if a task was not achieved, the Post-It note was removed from the wall, and placed on the "Verzögerungen & Störungen"

Delays and Faults chart (see Figure 5. 20 for a visual image of this in action). There are 10 pre-defined reasons, and the owner of the Post-It must briefly confirm which reason and why. These comprise:

1. Incorrect/incomplete pre-requisite
2. Missing/unavailable pre-requisites
3. Pre-requisite/agreed action not recognised/not identified
4. Changes in priority from company or PM
5. Additional service/output requested
6. Shortfall in workforce/HR
7. Overestimation of own service/output
8. Re-work
9. Missing/incomplete information
10. Missing software/hardware

(Translation of poster on wall of LDMT project's "Big Room", September 2018)

The Post-It note is then placed on the relevant number above and recorded in the electronic project record, which forms part of the overall project data feeding into KPI charts. The researcher was interested to see the reactions and responses by the Post-It note owner at the 1st observation and was surprised that there was no discernible adverse reaction, embarrassment or justification for the reason why something was not achieved. This was echoed throughout the observations and during the 2nd observation, when queries came to light that indicated error or problems:

> "At 09.35 the 2nd structural engineering issue is discussed – in the corridors, the lift doors need to be made bigger and extend into the corridor space more. The lift cables also need more space in the ceiling cavity, each lift requires 23 lights. Issue number 3, [name] has a question about the 2nd floor break room/meeting room, [name] notes that on the current architectural drawings the female changing rooms/toilets have been incorrectly labelled. (Researcher's Field Notes, 2nd Observation)

The researcher noted:

> "No blame/adverse reaction when a mistake or error is pointed out. No obvious facial reaction, or attempt to respond, just simply noted in writing by the Process Owner and the PMs." (Researcher's Reflections after 2nd Observation)

Where responses and discussion did take place, the Project Leader (PL) ensured all members got a chance to comment, note and ask any questions. The researcher noted generally that:

> "The PL is firm but decisive when he wants to move the agenda on, but still checked everyone has commented should they wish to. No question is silly. He uses a lot of eye contact around the room." (Researcher's Reflections after 2nd Observation)

5.2.4.2 Organisational Learning (OL)

Organisational learning was more difficult to capture in action and not explicitly demonstrated, nor was it particularly expected, since the focus of the weekly meetings was to specifically progress tasks and activities rather than developmental processes. Therefore, unless particularly overt, no actions or team behaviours were seen that demonstrated evidence of organisational learning. However, there is a clear sense of

the importance of both project and organisational learning from individual perspectives, as demonstrated by case study interview findings. The term is also not easily or directly translated into German, which was required for three out of the four interview participants. However, the following responses were provided to explain the impact the LDMT project has had on organisations outside of the LDMT project:

> "For example, the guy in the company who is the leader of the [subcontracted trade], he took it back to his office and said he saw it in our project and it works pretty well. He said, 'We need a similar organisation in our office', so they start to take what they learned here. So, in this project they use it, and in their other projects and to reorganise their office to make better organisations of things." (I9)

Although this suggests that the principles of LPM and lean can be taken and adapted by another organisation, the transfer of learning from project to project is not without its challenges, according to interview participants:

> "And that's something you cannot transfer to another project that easily. At least, as long as some other team members in the other project are working in the conventional sense." (I17).

> "But I already think, this goes from one to the other if it is about the experience, the Doing, this is what I experience, it goes on; I believe this is possible, passing [these things] on inside a firm or to other people." (I32)

These statements indicate a sense of acknowledgement of, and intention for, the transfer of learning from and between projects and potentially for organisational learning to take place. Similarly, neither the presence nor absence of organisational learning can be confirmed following analysis of visual images and document data, but, rather, these data sources indicate a strong presence of the *opportunity* to undertake project learning.

Evidence from multiple sources of data suggests that there are opportunities to learn through a combination of knowledge, experience and action, through the implementation of LPM to progress the LDMT project. This is clearly seen from non-participant observations of interaction with lean processes, principles and the project team in pursuit of progress as an initial focus, but equally as part of improvement, learning from mistakes and problems, learning by doing and sharing of best practice. Moreover, the "learning by doing" (lean principles) appears to have multiple benefits: initially, learning to be lean enables the LDMT project to become more effective and efficient, but additionally appears to support individuals to improve their knowledge and understanding of lean.

5.2.4.3 Mechanisms of Learning

Interview questions were asked by the researcher for response by interview participants within the case study. These were the same as the Interview Study, asking participants to share their thoughts and perceptions that additionally specifically related to their experience within the LDMT project. This included the mechanisms of learning, in terms of how learning took place (if answered positively), when and who interview participants felt was responsible for learning within the LDMT project. Observations from weekly meetings and the available project documentation provided the contextual content, which enabled exploration of any aspects of learning for analysis. All interview participants suggested that learning does indeed happen, when directly questioned, and that it was continual and ongoing. This was considered as a generally positive and expected aspect of LPM, but also enjoyable:

> "I think everybody learns and it seems to me they have fun about it and they like it." (I9)

Interview participants implied that the responsibility for learning within the LDMT project also lay with the team members as a collective effort, articulated as "everyone", rather than any specific named role or person.

> "…the people who are organised in the project, well, yes, this would be more or less my understanding. That we implement the systems that ensure everybody in the project has the same possibility to learn from the others, that nobody is getting… learning by itself, but everybody is sharing, more or less." (I3)

> "…yes, everyone, this should be the goal." (I32)

5.2.4.4 Summary of findings for Case Study

Findings from multiple sources of evidence through data collection and analysis of interview data, observational data, images and documents have provided evidence in support of the case for the existence of a relationship between LPM and project learning. This evidence has been demonstrated by the lived actuality, experience and perceptions of practicing professionals in project management in the specific context of a project implementing LPM as a case. Such evidence has been provided in line with Objectives 1, 2 and 3, and is essential in increasing knowledge. Since the relationship between LPM and project learning has attracted little to no published research to date, an inductive theory-development approach to gain insight into the phenomenon (Edmondson & McManus, 2007) was used. A project in the construction industry was chosen because it is an interesting example of a relatively conservative industry that is strongly project-based (Söderlund & Sydow, 2019) but making great strides in lean implementation, thereby providing a valuable context within which to explore project learning.

CHAPTER 5: FINDINGS

Through the case study, findings revealed the existence of a relationship between LPM and project learning. This is established via individual responsibilities for their discipline-specific functions (such as Building Engineering, Architecture, User involvement) and their actions within the project to progress these individual responsibilities. This is characterised by collaborative and communicative verbal interactions with each other, through constant explanation, discussion, reflection and evaluation of the project's lean processes before, during and after implementation of those processes. The nature of this continuous collaboration is underpinned by an understanding of lean principles, which also provides further evidence of the previously mentioned benefits and enablers of LPM implementation. Project learning is thus characterised by the practical interaction with the mechanisms of learning, in particular learning by doing, experience, challenges, mistakes, problems, issues, and dealing with risk, which facilitates effective interaction with the processes. Socio-cultural behaviours that underpin the ability of individuals to work within the project include, but are not limited to, the expectation that everyone participates in project activity and takes responsibility for his/her own learning needs. This relates to providing, receiving and understanding key information pertaining to project tasks, activity, resources, etc., rather than the designated Project Manager or Project Leader being responsible. The ability to interact with the procedures but also the project's LPM platform and methodologies (for example, physical and digital use of Last Planner System®) was noted.

By focusing on solutions to facilitate immediate and short-term progress within a distinct time boundary (six weeks), project improvements are also generated. What is clear is that the main purpose of LPM implementation is that it serves as a useful and effective mechanism to deliver essential project processes and track progress. Where

learning does occur, regardless of individual or project-based, there is a sense that this is an added bonus to project deliverables. Team members acknowledge the opportunities to learn on a continual and collective basis; however, this is not a primary focus. Although there was little negative perception of project learning concepts, and the possibility to transfer learning from the immediate project was valued, and sometimes intended, this was not considered "business as usual". The case study project provided similar evidence that wider organisational learning was important, but not necessarily something individuals felt was their specific responsibility.

5.3 Summary of key findings

5.3.1 Conceptualisation of LPM

Understanding of the meaning of the concept of LPM was articulated by the 40 interview participants. LPM was generally held in high regard by the majority of the interview participants, from 24 different organisations located in Germany, the UK, Switzerland and globally. Eleven different industries were represented within the dataset, comprising a combined length of PM experience of 179 years between participants whose ages ranged from in their 20s to over 60.

The value of LPM

This diverse range of highly experienced PM practitioners articulated and defined LPM in terms of the outcomes that implementation of LPM could bring to bear; improved efficiency, improved understanding, improved knowledge, improved supportive culture, improved satisfaction, improved skills and improved perception. In order for these outcomes to be realised, LPM is characterised by a combination of its values-based philosophical approach, underpinned by lean principles and implemented as social and practical processes, tools and methods, as summarised below.

LPM as a values-based mind-set and philosophy

Statements provided by interview participants made clear reference to the relationship between people and professional practice, characterised by the importance of team working to achieve effectiveness. Shared understanding, visibility and transparency of actions are central features of the typical LPM mind-set, together with the requirement and capability to work individually and as part of a team. This appears to be a clear expectation that interview participants assume is the norm not the exception. The importance of social behaviours, processes and mechanisms such as communication and collaboration of all stakeholders cannot be underestimated to support the application of day-to-day practice.

LPM as the application of lean principles

LPM was understood by its direct application of lean principles; some of these were built on established traditional PM principles, but adapted as a lean approach. Efficiency and effectiveness, avoiding waste and learning from mistakes were typically and frequently mentioned as examples across a wide range of demographic attributes. In particular, the process-driven and results-oriented principles were often considered as extensions to, and ways of dealing with, the delicate iron triangle balance of time, cost and quality.

LPM as the employment of specific tools and methods

Interestingly, findings suggest that the employment of specific tools and methods is more than selecting one or more appropriate lean tool out of the toolbox, but rather

using lean tools within a combination or framework of various tools and methods used in PM delivery. This includes combining together with traditional planning and stage-gate approaches, more often than not at specific project life cycle stages, for example, traditional planning for design, lean approach for implementation, or a specific tool such as Kanban for incremental improvements during the delivery stages, as well as for project handover to organisations.

5.3.2 Implementation of LPM

Factors of Implementation

A number of Barriers, Benefits and Enablers were identified as specific factors for effective implementation of LPM. A common thread running through each factor was the prevalence of socio-cultural and behavioural aspects. In particular, negative perceptions of lean concepts, resistance to and fear of the change required to implement LPM were cited as specific barriers. These and other barriers of poor leadership and support from senior managers, missing and lack of knowledge, and understanding of both general lean knowledge and that specific to LPM were deemed important to overcome so that the benefits of implementing LPM could be realised. Specific benefits were identified as facilitating progress and improvement, stakeholder communication, and achieving targets including cost savings. Enabling factors that were important to effective implementation were again socio-cultural and behavioural: the ability to work within a team mind-set, having a shared vision, involving all stakeholders and generally working within a supportive culture to underpin lean behaviours were important to interview participants.

Features of Implementation

Tasks, activities and action plans are the most frequently measured, recorded and tracked throughout the duration of the project, via various means. On completion of the project, the focus is on outputs and outcomes firstly. In some limited cases, the project's development and overall journey is evaluated. Generally, the milestones that have contributed to the outputs and outcomes are measured in terms of PPC, at points in time, rather than the milestone itself. The main focus in measuring and recording is progress tracking, the means to the end. This takes place via either or both traditional and lean methods, and tracking documents become part of the artefacts of a project. What is rare is that any implementation of LPM does not feature progress relating to lean behaviours; only a small number of organisations across the dataset recorded and measured this implementation feature, although knowledge and understanding of lean was considered an important enabler and benefit of LPM.

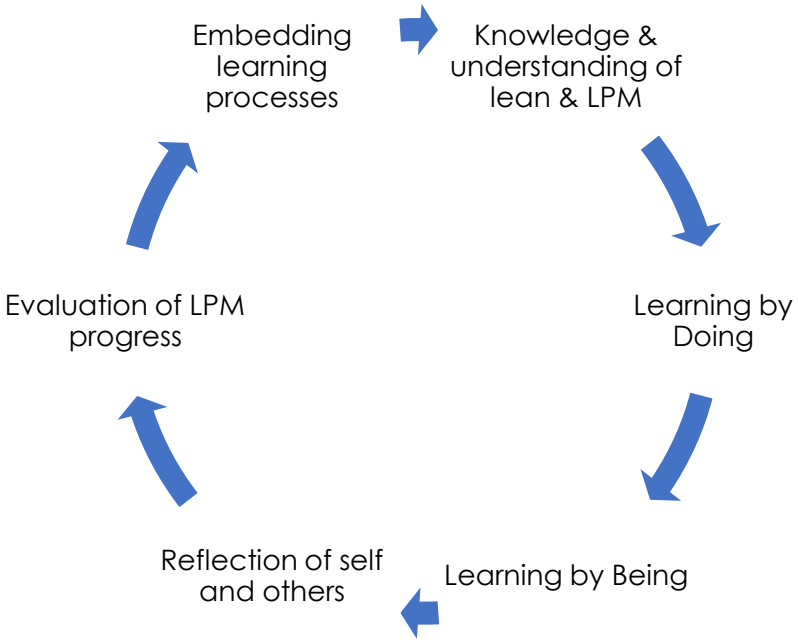
5.3.3 Learning in LPM

Project Learning

Project Learning is determined by means of practical actions and processes, together with socio-cultural and behavioural interactions. This appears to be influenced to a greater or lesser extent by the existence or absence of knowledge of lean. The purposes of project learning are determined by both current need and future need, not just for progress tracking, and achievement of project goals and outputs, but to sustain underpinning lean principles such as avoiding waste, generating cost savings and generating continuous improvement across, between and beyond projects. The way in which project learning occurs tends to be therefore dominated by task-based

actions, and "learning by doing" is still an effective way to learn within projects, according to this dataset. This includes learning about lean as well as learning to be lean within the project setting. Increased knowledge therefore is an important aspirational output which supports both individual and project learning. This can be summarised by the following illustration:

Figure 5.28 The continuous cyclical process of LPM and project learning



The cycle is supported by individual behaviour, attitudes, perceptions and actions which are required within the project's LPM implementation. LPM therefore serves as a vehicle for, as well as an output of, project learning. In line with the literature, the timing of such project learning is not prescribed within LPM; moreover, project learning is a pervasive and abundant opportunity to be accessed and utilised wherever and however it can be. Since there is a generally positive perception surrounding the requirement and act of learning, the responsibility for project learning lies with all PM team members. There is an expectation that this is a usual or routine activity for practitioners, although, in some cases, practitioners feel that project learning should

be facilitated by the PM within lean project working. How this could occur is outside the scope of this research, but this was identified as a way of linking project learning to organisational learning through this individual and project action.

Organisational Learning

Organisational learning often starts out by provision of scheduled training, certification and development events, and can incorporate formal and informal means. This can and does involve workshops, study days and one-off events that focus on increasing individual knowledge acquisition and sharing of best practice, through learning tools, techniques and methods, and/or by focusing on specific issues, challenges and problems that have been experienced by other team members. The purpose of organisational learning, according to interview participants, tends to be characterised by the need to generate improvements across an organisational entity, rather than at project level, regardless of whether individuals may be part of the same projects. Interview participants acknowledged the need for their attendance at both formal and informal learning events, and this included learning within and across functional departments or units of an organisation. Informal and often unscheduled (or at short notice) learning tended to occur at project level, with the same purpose.

A positive regard for organisational learning to take place from projects was noted by interview participants in order that project learning did not become too much of a "one-off" event and output, but that a continuous positive culture for learning cold grow and develop within the organisation. Indeed, some felt that this should be a specific strategy taken by the organisation, to exploit the outcomes of learning more purposively. Together with the support of senior managers and leaders, and sometimes without it, the effort to implement positive outcomes from project learning was seen

as symbiotic. Further investigation into any negative views of learning revealed that the interview participants considered their organisations to be "behind the curve" in terms of their lean journey.

PM practitioners have an additional challenge in that knowledge-sharing activities and behaviours include knowledge or know-how sharing at the regulatory or professional level which exists outside of the immediate environs of individual and organisational domains. This is particularly true in health, construction, nuclear and data-related fields. This supports the extended and multiple communities of practice which are said to exist within the literature.

The combined findings from both the Interview Study and Case Study offer robust evidence for answering the research question, using appropriate and suitable research methods, data collection and analysis, to better understand the phenomenon of LPM and project learning. This chapter has addressed Objectives 1, 2 and 3 in support of the research aims, and provided a basis for Objective 4, which is to develop a framework for understanding the relationship between LPM and project learning. Chapter 6 takes these findings and discusses them further, in helping to determine what and how this relationship manifests itself.

CHAPTER 6: DISCUSSION

6. Discussion

The purpose of this chapter is to bring together, discuss and reflect on the findings presented in Chapter 5. The findings incorporated the information and data following the data collection, analysis and reflexive processes that were undertaken in the Interview Study and Case Study to achieve Objectives 1, 2 and 3 specifically.

6.1 Introduction

The findings in Chapter 5 brought together the Objectives and provided key information and data to contribute towards achieving the final one, Objective 4: the development of a framework to help understanding of the relationship between lean project management (LPM) and project learning (PL). In order to achieve Objective 4, this chapter will discuss and consider findings against the extant literature as outlined in Chapter 2. Additionally, this chapter will consider and discuss appropriate theoretical perspectives pertinent to understanding the nature of the phenomenon of LPM and its relationship with PL. This will also be discussed in terms of a theoretical positioning within project management. Following this discussion, a proposed framework will be presented which illustrates the relationship between LPM and PL, based on the outcomes of the research. Finally, the chapter summarises the discussions to enable better and deeper understanding of the concept of lean project management, its potential utility and impact on project learning. This increased knowledge is intended to provide academic and practical insights prior to Chapter 7, which will present concluding remarks, discussing implications, recommendations and limitations.

6.2. Establishing a framework for the relationship of lean project management and project learning

The opportunity to explore the lived actuality of a lean PM approach and examine project learning processes through the chosen instruments of an interview study and a case study enabled deep reflexive sense-making to take place. The interplay between object and subject places great importance on the social conditions constructed by humans and their real consequences (Easterby-Smith et al, 2018). Exploring this interplay aims to provide a clearer picture, bringing a well-informed and informative understanding of the phenomenon so the reader can make their own sense and judgement surrounding the existence and potential feasibility of this relationship, from a research and practice perspective.

The findings led to a conceptualisation of LPM which revealed some similarities as well as differences across different industries, but nevertheless provided an understanding of lean project management and project learning as perceived and practised within contemporary PM. The Case Study sought to describe and characterise the processes of project learning within a complex and multi-disciplinary Construction industry project providing a realistic essence of lived actuality, through the researcher, who has collected the evidence together, and understood and made sense of the experiences in order to clarify the case for the relationship between LPM and PL for the reader. Thomas (2016) suggests that, "where little is known, the principal purpose is to establish the 'shape' of a relationship" (here LPM and PL) (2016, p132), but this is also partly explanatory. This is particularly relevant where the potential connections between the issues of implementation of the phenomenon (of LPM) and intended

outcome (facilitating project learning) need unravelling. By capturing the real ingredients of a person's practical experience, it builds a picture; readers can share in the experience being illuminated, and make sense of it (Flyvbjerg, 2006). Reflecting on and analysing multiple sources of visual and textual data that have been created by the researcher through image taking and observations, enables new realities of meaning and knowledge, according to Keats (2009). This increases the capacity of the researcher to "understand the complexities of inter-textual connections in the lived experience being explored" (*ibid,* p193). This 'deep dive' into LPM and PL provided triangulation of multiple data collection methods, offering further evidence for the concept of LPM and strengthening the evidence base for the case: the relationship between LPM and PL.

The unit of analysis for the Interview Study focused on the individual, their perspectives, experiences and reflections, whereas the unit of analysis for the Case Study focused on the project level (the case), which also incorporated multiple units of observation; four aspects or items of data were observed and collected in order to learn something about the unit of analysis (De Carlo, 2018). Throughout data analysis, all sources of evidence were investigated for plausible rival interpretations (Yin et al, 2018). Analysing data by comparing or matching the pattern based on the collected data with a pattern defined prior to data collection is a specific technique used. However, the actual pattern-matching procedure did not necessarily involve any statistical comparisons or tests, but nevertheless contained sufficient data to entertain and test plausible rival matches (*ibid*, p352).

The most significant aspects of the research findings arising from analysis and discussion are presented and discussed in the following sections:

- **The value of and appetite for the concept of lean project management**
- **The mechanisms of project learning**
- **The changing place of project learning within project management**

6.3 The value of and appetite for the concept of lean project management

The findings support the recognition of LPM as a concept that is distinct from and extends traditional project management. In Chapter 2, it was suggested that lean project management was beginning to emerge as a viable approach that was required across all life cycle phases, not just at the delivery phase, in order to effect change and improvement in practice (Loo, 2002; Jacobsson & Söderholm, 2011; Chronéer & Backlund, 2015). It was also suggested that combining the philosophy of lean thinking, processes, systems and tools (Womack & Jones, 2006) might better address the challenges brought about by increasing complexity, multi-disciplinarity and an apparent failure to learn (Söderlund & Maylor, 2012; Turner et al, 2015; Holweg & Maylor, 2018). However, part of the challenge was that, although the benefits of using a lean management approach were clear across many different industries, the understanding of the meaning, or definition of LPM was less clear, despite its apparent use as a global concept (Modig & Åhlström, 2017). Attempts had been made in different industries to integrate and adapt lean for specific output purposes, for example, increased efficiency, waste reduction and improved productivity. However, despite some consideration for the social and behavioural processes and impacts (Hines et al, 2004; Saier, 2017), there seemed to be less focus on the outcomes of the relationship between the philosophy of lean, its inherent practices, at the project level as well as the individual level (Longoni et al, 2013). How and what was the relationship

between the concept (of LPM) and the outcomes appeared to be a gap that had hitherto been neglected. The relationship between individuals working functionally and collaboratively as part of the project team would appear to be one of the most important drivers in the utility of (any) new or emerging management approach. To understand the potential utility of LPM, it was important to obtain a level of understanding of its definition, or at least the meaning of the concept, by those practising it, in addition to what the literature suggested or had failed to clearly and fully define.

This was intended to obtain a baseline understanding of practitioners' knowledge and understanding of LPM and to assure the research team that this was articulated and aligned with the core lean principles of identifying and specifying value, flow, pull, continuous improvement and reduction of waste (Womack & Jones, 2003). Additionally, capturing the understanding or meaning of the term LPM enables the development of the LPM discipline itself and its potential to improve existing PM knowledge (MacIntyre, 2007; Jarzabkowski & Seidl, 2008; Söderlund, 2011). Statements from interview participants were many and varied, as outlined in Chapter 5; however, they fully supported the main aspects that differentiate lean project management from traditional project management. LPM was conceptualised by respondents in terms of its general ability **to improve and sustain efficiency**, and specifically by **connecting practitioners** with each other by applying essential lean processes, employing established lean methods and tools, and **adopting values-based philosophical approaches.** The widespread prevalence of statements across several different demographic attributes, suggests that LPM is indeed an appropriate and meaningful concept that is generally understood and accepted, thus establishing a foundation for its suggested utility and value as a concept.

CHAPTER 6: DISCUSSION

Practising LPM has conceptual value, providing continual opportunity to better understand and apply lean and LPM origins, concepts and processes. This can be seen clearly from the Interview study, where practitioners experienced in various disciplines perceived LPM to be an important concept which could and did facilitate successful project outcomes. This was noted by interview participants in the delivery phase of projects, but importantly at planning and design stages, where often the LPM approach was employed as a strategic decision to facilitate success and progress into implementation. The findings demonstrate how the value and appetite for the concept of LPM can be manifested in several ways, and this is discussed below.

Each aspect of the value and appetite of LPM described from the findings is illustrated as a triangle shape, and each triangle leads to the overall conceptual framework.

6.3.1 LPM enables improved management of complexity

Interview participants posited the ability and usefulness of LPM to better manage complexity, especially in project design and effective handling of ambiguity, risk, stakeholder expectations and their complex requirements (Schoper et al, 2016).

LPM supports practitioners in the way in which it supports understanding of and working with a diverse number and nature of connections between organisational entities, workflows and delivery (Baccarini, 1996; Burns, 2005; Antoniadis et al, 2011). The timeliness and relevance of information streams and mechanisms which can often cause further complexity (Adrodegari et al, 2015) was found to be of particular value, especially in Construction and Health & Medicine. Rather than becoming overwhelmed with too much information or dissatisfied with the lack of timely information, practitioners actively sought out information which would enable faster

and more efficient progress in their projects. This can be thought of as a cornerstone in the overall concept of LPM, as shown by the triangle below in Figure 6.1:

Figure 6.1 LPM enables better management of complexity

Findings revealed that traditional project management concepts, such as reporting of progress, were often still used but became leaner in their implementation. A good example of this was found in Transport & Logistics, where 'lessons learned' was brought forward from the usual timing at project closure to a regularly monthly basis to ensure organisation-wide and timely PM learning.

6.3.2 LPM enables better tracking of progress

Findings from the interview study revealed that much of this perception of value for the concept of LPM had arisen from having experience within traditional project management, sometimes, but not always, supported by the tools and methods in use. Many of the traditional elements of project management are embedded into the LPM approach, specifically, milestone planning, scheduling and estimates of time. Using the Last Planner System within Construction is a pertinent example, where many of the practitioners (in both interview study and case study) reported their own and others' prior scepticism of this approach. The increased time and effort in understanding the

LPM approach had been considered a costly requirement, with concerns that the design phase might not keep to time, and thus delay the build phase and overall project closeout. What was subsequently experienced by the interview participants in recounting their lived experiences was, in fact, the increased satisfaction of team members implementing lean processes and practices in the design phase. Regardless of whether this did or did not extend the design phase, the project team enjoyed the lean processes, and wanted to continue with them, within the LDMT project as well as recommending lean to their organisations for future project management.

Information to help projects stay on track was often characterised by the use of digital and visual information of important but complex technical content such as schedule specifications, and also non-technical content, such as the complexity and nature of the many different processes such as those inherent in the Last Planner System®. Displays of information often began as a way of ensuring stakeholders could see a snapshot of project progress at specific times (e.g. in time for a weekly meeting as a physical display), but this was often made available on an almost immediate basis to all stakeholders. This was demonstrated by the number of teams within Construction accessing, recording and updating their information to contribute to the overall progress of a project. Rather than perceiving this as an additional burdensome task or process, communicating, sending and receiving this kind of information in digital ways, was welcomed as a means to understanding complex project content and scope. In Construction, access to information had sometimes been recognised only as important to those within the project management team and dismissed as irrelevant for project team members on site. Findings demonstrate that site workers employing an LPM approach felt included and empowered, having been assigned to colours or trades, and found the easy access to pertinent project information

relevant to their functional needs as well as their satisfaction with the conduct of the overall project. This correlates with research undertaken by Saier (2017), who suggested that underlying principles were essential in increasing both business and social impact. A specific focus on staff engaged in implementing lean practices was a particular recommendation made by Lindsay et al (2019) in order to sustain effective lean practice. Therefore, this has been considered as the second cornerstone in the overall concept of LPM.

Figure 6.2 Lean project management enables better tracking of project progress

Practitioners saw the value and utility of using LPM as a means to record project-specific progress, outputs and outcomes, as indicated above, and, additionally, other progress such as the developmental progress of the project, the stability of PM processes, team development and organisational maturity of lean. Information relating to the numbers of lean-trained project team members and recording and measuring of lean behaviours within the project was not commonly captured, and, within this dataset, only occurred in a small number of organisations, predominantly within Construction. This may have been due to the level of organisational lean maturity and/or the practitioner's experience, and this was not a specific focus of this research.

6.3.3 LPM enables shared understanding

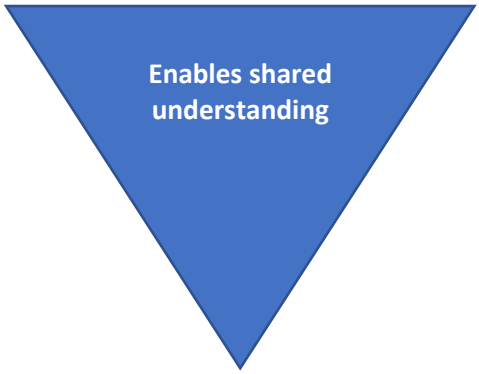
What was important to interview practitioners was that the concept of LPM was understood by all relevant members of project teams, not just the designated PM. This tells us that the concept of LPM plays a vital role in not only increasing efficiency, productivity and effectiveness at the project level (Womack & Jones, 2003; Moujib, 2007; Maylor, 2010), but in considering the values and interests of wider stakeholders, including those responsible for delivering projects (Artto et al, 2015). Practitioners in both interview and case study reported they had experienced initial reluctance from their colleagues and team members and were sometimes reluctant to adopt LPM themselves. Findings suggest that a significant barrier to implementing an LPM approach concerned a whole range of socio-cultural and behavioural barriers, cited as originating from negative perceptions of LPM (Lewchuck et al, 2001; Hines et al, 2004; Longoni et al, 2013), fear of change or a resistance to new approaches. However, after having worked within projects that utilised an LPM approach, increased satisfaction and improved perception was reported. Of particular note was the enjoyment and personal satisfaction of the specifically collaborative way in which stakeholder engagement and involvement was undertaken, especially in terms of the inclusivity of stakeholders in co-creation of schedules, and design of plans and processes.

Team mind-set, shared vision and, importantly, the existence of a supportive culture were perceived as important enablers in the implementation of LPM that were seen to affect, and be affected by, socio-cultural behaviours. Thus, the LPM approach could facilitate the desired change in lean thinking behaviours (Kasasbeh, 2015), which may further generate a desire to learn and practise lean (Milton, 2011; Gosling et al, 2019). This suggests that LPM could feasibly act as a vehicle for both continuous

learning and improved knowledge, which could additionally support sustained best practice at the individual, project and organisational levels (Danese et al 2016). This is further evidenced by the benefits described by interview participants in terms of facilitating progress and improvement across all representative industries in the dataset. Limited data was collected in terms of the qualification and certification level of interview participants, as only half of the dataset provided this information (see Appendices). However, many had received one-off training – for example, a study day or workshop – that was provided internally, ascribed as "on the job", or externally by an independent training provider. Ten had received training via accredited and non-accredited short courses, and self-study also featured under training for seven participants. Experienced practitioners indicate that, although formal learning has its place, its utility is limited, as indicated by the perception from one participant: "You have to live it, experience it, and survive it to really understand" (I1). Together with the finding that a low number of participants had received formal certified training from a PM professional body, this could suggest opportunities to integrate more informal training into project working as a way in which to encourage and facilitate shared understanding. The fact that these types of training generally took one day or less to provide, and appeared to favour a high level of communication and exploration of lean principles and practices, would suggest alignment with situated learning and engaged scholarship approaches (Lave & Wenger,1991; Lesser & Stork, 2001; Wenger et al, 2002; Van de Ven & Johnson, 2006).

Shared understanding is a central part of the concept of LPM and was evident in all industries across all demographic attributes; therefore, it is placed within a central location within the conceptual framework, as shown in Figure 6.3:

Figure 6.3 Lean project management enables shared understanding



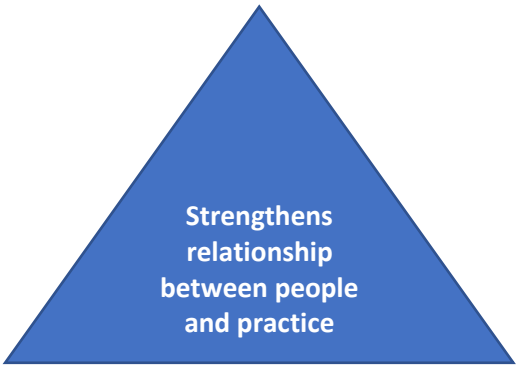
This appears as an inverted triangle, since it is influenced by the cornerstones of the outlined positive functional attributes of the value and appetite – better management of complexity and better tracking of project progress. Its upper boundary provides a solid foundation for the relationship between people and practice, as discussed below.

6.3.4 Lean project management strengthens the relationship between people and practice

Findings from the interview study highlight the importance of an underpinning mind-set and philosophy that connects the relationship between people and their practice. This goes beyond individuals' basic knowledge and understanding of lean principles, but rather, it reflects the ability to see shared understanding from others, which requires a much more responsive, adaptive mind-set (Whittingham, 2017). The visibility of actions that follow from understanding the principles was clearly important to interview participants, who not only expected to practise the lean principles themselves, but also expected others to practise them. The researcher's observations and reflections noted a distinct level of expectation on the part of the individual who has a responsibility for knowledge and learning within the project yet is still supported and facilitated by the project within the LDMT case study. This again correlates with

Longoni et al's (2013) study, which suggested that workers' perception and understanding of the project environment appeared to influence subsequent lean behaviour. The research demonstrated that project team members valued the knowledge and experience from other members and used this to increase their own levels of knowledge. This was achieved by engaging with and gaining a sense of understanding of the needs and tasks of other team members, even where these were not the individuals' responsibility. Better, faster connections were made, which also led to an increased satisfaction with the lean approach by team members, regardless of seniority. The mind-set and philosophy of LPM can therefore be characterised as a relationship between people and processes, which includes, but is not limited to shared understanding, visibility, transparency, collaboration, stakeholder engagement and communication within project team working. This enables better comprehension of the needs of the individual within the team as well as at the project level, as well as addressing the challenges inherent within the project environment, enabling uncertainty and ambiguity to be managed more effectively than in traditional PM approaches (Thomas & Mengel, 2008; DePrisco, 2020). The final part of the conceptualisation of the value and appetite of LPM is found below. This is supported by the shared understanding of practitioners and forms the final piece of the conceptual diagram.

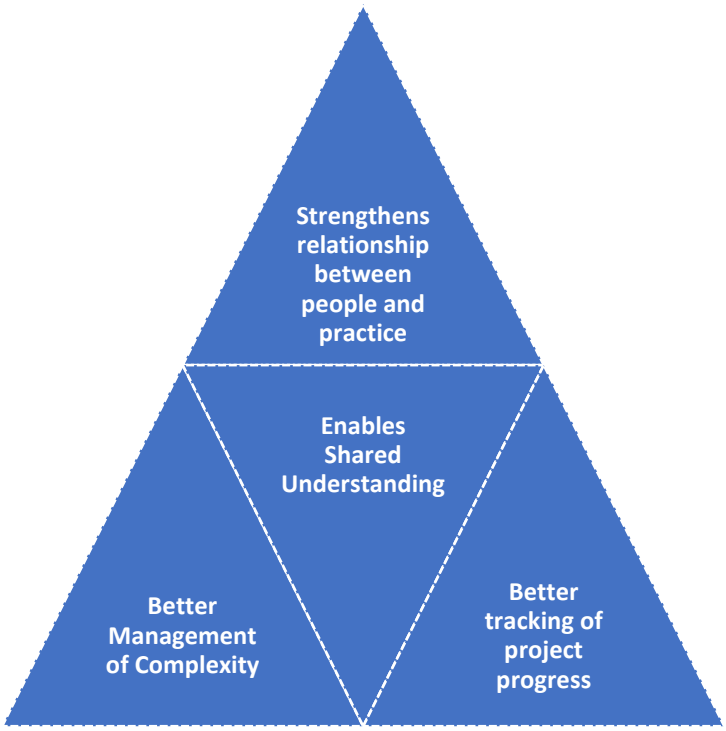
Figure 6.4 Lean project management strengthens the relationship between people and practice



6.3.5 Summary illustration of the value of and appetite for lean project management

The value and appetite of LPM can be illustrated by the following diagram, which integrates the above elements.

Figure 6.5 The value of and appetite for lean project management



The positive perceptions and expectations of the benefits of LPM in terms of its effectiveness in dealing with complexity as well as its functional utility in managing and tracking progress appear as the two important cornerstones, which then enable a shared understanding of the concept. This in turn strengthens the relationship between people and practice of implementing LPM. When boundaries are joined together, they are represented by dotted lines, to symbolise a semi-permeable edge – signifying one can influence and support the other adjoining element. This relates to both inner boundaries in this diagram and outer edges, and this will be revealed in the next section. Combining these elements could transform learning for individuals, projects, organisation and discipline-specific communities of practice, since LPM

offers a unique way of blurring these boundaries (Gherardi & Nicoloni, 2000; Korac-Kakabadse et al, 2002; Bechky, 2003; Tsoukas, 2009; Orlikowski, 2010). The next section addresses the mechanisms of learning, as evidenced by the practice and processes of project learning found within the research.

6.4 The mechanisms of project learning

Learning within projects has long been considered as a functional output (Filstad, 2017); however, this viewpoint fails to consider that project learning is in fact a transformation process which leads to new outputs and outcomes of knowledge (Bechky, 2003; Jugdev, 2012). Defining project learning as an output as well as an outcome (Jugdev, 2012) requires a focus on forms or mechanisms of learning that take account of social and behavioural processes (Williams, 2008; Goffin & Koners, 2011). This is especially important in interdisciplinary projects where diverse knowledge exists and co-creation of shared understanding is required for project progress (Bechky, 2003). Mechanisms of learning which support rather than hinder motivation to share knowledge and learning are therefore particularly important (Ardichvilli et al, 2003; Kislov et al, 2012). Literature suggests that, not only is there a paucity of evidence of success where project learning has occurred (Schindler & Eppler, 2003; Williams, 2008; Williams et al, 2012; Duffield & Whitty, 2016), but up to 90% of tacit knowledge that does exist is lost through unexpressed experiences, social processes and behaviours of project contributors and stakeholders (Smith, 2001; Gao, 2002; Butler; 2012; Kislov et al, 2012). Literature also suggests that this gap would not be bridged by merely being better able to identify and access learning and knowledge opportunities (Anbari et al, 2008; Bakker et al; 2011; Jugdev, 2012), but that practice and processes of learning are as important as the content of the knowledge (Blackman & Henderson, 2001; Disterer, 2002; Jugdev, 2012). It is recommended that

the individual must be involved in and understand what constitutes learning in the context of project and organisational knowledge with and on behalf of those who consider knowledge as an organisational asset (Wenger et al, 2002; Cox, 2005).

Thus, in the research, interview participants were asked to define the term 'project learning' in order to compare and contrast with extant literature, and to provide a level of their understanding within current LPM practice. Project learning was defined as a cyclical process (see Figure 5.17), which was characterised by the inter-relationships between knowledge of lean, practical actions and processes, and the socio-cultural and behavioural interactions of team members. This addresses the suggested literature recommendation and extends it in that it connects the intended output of learning with the processes (both practical and social) that facilitate output and outcomes. The next sections outline and discuss how project learning is manifested within the lived actuality of LPM. This has been termed 'being' and 'doing' lean by the researcher as a way of explaining the mechanisms of project learning.

6.4.1 The practice of project learning

Learning within specific practice often assumes that control and responsibility for learning falls on the individual rather than on the organisation (Rose et al 2014; Swart et al, 2014). However, this research found that individuals within the LPM environment were often "self-driven" individuals who held a core belief that "doing" and "being" lean was an expected norm, for themselves as well as for everyone in their project teams. different socio-cultural and behavioural factors. The common aim is that the project progresses through a combination of the essential elements of understanding,

practising and learning, but that this is a shared responsibility on the part of individuals and organisations, rather than being the responsibility of just one or the other.

During non-participant observations, the researcher experienced learning in action – watching "live" knowledge being created and shared by others. Team members experienced the practice of lean through reflexive and collaborative planning (see photographs in section 5.3.3). Documents such as agendas, GPA and MPPs were co-created, enacted and evaluated on a weekly basis, and this was undertaken by all team members. This can also be evidenced through the continual reminders and checking of understanding at key stages of design, indicating that the LDMT project had enabled a safe space to learn from mistakes, problems or issues. There were observations which depicted negative learning in action as well as those learning actions and practices which supported the development of project learning. For example, obvious dissatisfaction at cross-talking behaviours during meetings, and the lack of tolerance when questions were asked due to the previous absence of a team member. It seems that mistakes and problems are tolerated, but lack of understanding and misunderstanding are less well tolerated. However, the difference that LPM and PL made is the ways in which these "negatives" were dealt with: generally quicker, with less fuss and a willingness to accept and move on. The researcher had considered that perhaps only positive behaviours were shown during her attendance. However, the LDMT project is a commercial project with a high financial and reputational value; its project team members have less inclination to impress the Project Leader, Lean Facilitator or any researchers. Team members were always being observed by trainees, interns, and students of project and construction management as a usual practice of business operations in Germany. Additionally, documents such as the KPIs (section 5.3.3 on KZT) show that, even where expected

progress was not made, resulting in some timelines being extended, this did not impact on the satisfaction levels of the project team or PL. In fact, the lean facilitation company was retained after the Design Phase, to continue facilitation into Construction Phase, thus demonstrating the value of its LPM approach to the client.

6.4.2 The processes of project learning

Being and doing lean manifests as a **set of practical (action-oriented) lean processes** such as frequent meetings, reporting and reflecting on planning and effects on one's own team tasks in relation to others. Collaborative verbal communication means such as discussion and evaluation were supported by written and visual information that was available through flexible and fixed means during the meetings and between times. Learning was characterised by the practice of "doing" and "being", i.e. doing lean embeds learning from both the practical and intellectual levels. The practice of being lean reinforces learning on a continual basis, supported by others' and own experience and reflection from week to week. Challenges, mistakes, problems, issues and risks provide the content for learning whilst the project's delivery platform (Last Planner System) enables content and information to be captured and easily accessed. Understanding the position of project learning as it occurs within LPM from findings in this study is suggestive of Pettigrew's (1997) premise that people learn more by practice rather than theory.

Images are useful in depicting the social process and providing a frame for discussion around content and context (OU, 2018). The **process of capturing visual documentation** (taking and using photographs) was an active process within this research. The research found that photographs of meeting activity were used not only as self-referential sources of information for project team members, but additionally

for the lean facilitator, project manager and project leader. Team members in these team roles took photographs of the flexible walls and Post-It notes, which provided a snapshot of activity, immortalised at that specific point in time, which Barthes (2000) calls a 'certificate of presence'. Images are useful in depicting the social process and providing a frame for discussion around content and context (OU, 2018). Documenting the processes visually also captures layers of complexity inherent in the project; as Mannay (2010) points out, "...the sense that viewers make of images depends upon cultural assumptions, personal knowledge and the context in which the picture is presented" (p.100). This provides the content and opportunity for the viewer of the photograph (whether the viewer is the photographer or the photographed) and drives the quest for knowledge and understanding through interaction with the image.

Together with sense-making of the process surrounding the image, increased knowledge and understanding is strengthened (Bohnsack, 2008). In other words, visually documenting the process, not just the outputs of the meeting, can depict the "what", the "how" and the "why" of the connectedness of the social phenomenon they describe. Photographs depicting team members listening and focusing on each other during a team meeting imply an initial social contract, a re-affirmation of the social grouping represented by the activity photographed (Bourdieu, 1990), but can also generate investigation of the perceived social interaction, compared and contrasted with interview evidence and observational evidence of the same social phenomenon of LPM as depicted by team working. Bohnsack (2008) asserts that extensive understanding of images for practical action and everyday practice has been widely neglected. Behaviour in social group situations as well as forms of expressions through gestures and facial expressions are learned through the medium

of imagery, and stored in memory (Bohnsack, 2003, 2008). In this way, visual and documentary analysis can work hand in hand, to illustrate and question taken for granted assumptions and social constructions of the photographed and the photographer (Back, 2009).

In the weekly team meetings observed by the researcher, wider project team members also found it helpful to take their own photographs as a reminder of activity for their own knowledge and understanding. The advantage of this process was that information could be easily and quickly recalled, discussed for clarification with other team members or used to appraise employing organisations with regard to progress or information, especially when off-site. This is supported by Balm (2014), who suggested that visual images appeal to the human ability to process visual images quicker than text. Indeed, humans are said to be able to remember a visual image for a longer time than if they had read a passage of text on the same subject, and this processing ability forms an essential part of the circuit of knowledge (OU, 2018). Rose (2003, 2004) suggests that visual images also carry a trace of 'absence', showing but also hiding meaning, intended to capture reality, but such snapshots cannot be the whole picture (Back, 2009). In short, image presentation and analysis reflect substantive assumptions about human beings and their social institutions in thinking about how best to describe and explain social phenomena (Hammersley, 2010).

The LDMT project case highlighted the collaborative nature of lean practice through co-creating the schedule and other decisions, to progress the design phase of the LDMT project. Interactions and sense-making of "live" and charted activity that was constantly updated and shared suggest a positive appetite. This remained the case

even when negative results were seen, or disagreements occurred which potentially impacted on timelines. Such instances appeared as opportunities to learn. Although a clear 'no blame culture' was evident, the surfacing of a mistake or problem – perceived or actual – is captured and welcomed in a positive light, with noticeable immediate commitment to act upon the mistake or issue (Womack, 2007; Hines et al, 2008; Feldman & Orlikowski, 2011; Butler, 2012). This reinforces and strengthens the need for context-specific situational and dialogic learning that changes practice and leads to increased knowledgeability (Bourdieu, 1990; Feldman & Orlikowski, 2011; Jarzabkowski et al, 2012; Corlett, 2013).

O'Keeffe (2002) posits that the learning process necessarily **involves "unlearning"** that requires restructuring of past successes and failures to fit the changing or evolving organisational and environmental conditions. Although this often comes across as a negative process, due to triggers of errors and failures, it should be regarded as a source of innovation and creativity (*ibid*). This was particularly noted by the Delays and Faults chart (section 5.3.4). The pre-defined reasons for failure to progress an essential task did not result in long discussions, justifications or reasoning, and were generally accepted by the project team. The emphasis was on quickly solving the issue or problem and working out ways to progress the project, its milestone and stages. As various interview participants noted (I3, I10, I16, I28, I30, I35 in particular), the fact that mistakes are made is not the key message here. The point is, if lessons are learned and processes, tasks, behaviours – whatever is needed – are adjusted so that project progress and improvements are made to the PM, this cultivates and sustains the wisdom (I3).

Therefore, learning from one's own and others' positive and negative experiences is essential and must be actively encouraged through co-operation mechanisms that cut across internal and external boundaries, according to Sundqvist (2019). This is in line with the types of behaviours required to generate continuous improvements, recommended by Winter et al (2006) and more recently by Chronéer and Backlund (2015).

6.4.3 The drivers of project learning

The research explored the lived experiences of practices and processes of project learning within LPM, and the findings reveal three important and underlying drivers which impact upon project learning:

- Leadership and management support
- Knowledge and understanding of lean
- Socio-cultural and behavioural interactions

Leadership and Management support

Research findings show that learning processes can be supported by senior managers and leaders in order to improve the individual's perception, satisfaction and commitment to learn and share best practice (Kislov, Harvey & Walshe, 2012; Frost, 2014), but such support was frequently perceived as a specific barrier to the effective implementation of LPM. Moreover, the support of senior managers and leaders was perceived as an essential enabler to fully exploit the positive outcomes of project learning, for example, by implementing similar effective lean practices in further projects or within organisations.

Senior leaders and managers with decision-making responsibilities were expected to have lean and LPM knowledge and understanding, and this was perceived as engendering a level of trust (or mistrust). This social and participative learning is suggestive of Wenger's (1998, 2002, 2009) iterative approach, as learning cuts across functions, tasks, teams and levels of responsibility. This driver of project learning is represented by the figure below.

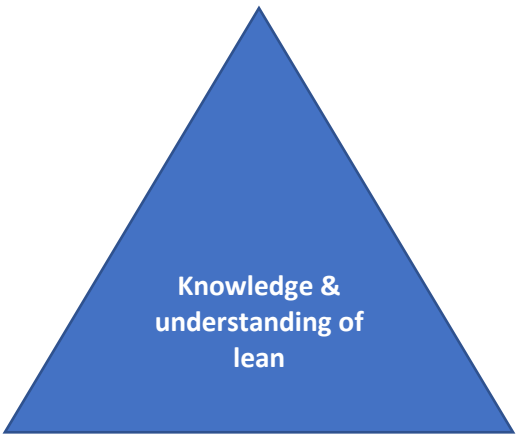
Figure 6.6 Leadership and management support

Knowledge and Understanding of lean

Findings indicate that project learning is facilitated by knowledge and understanding of lean principles and is enacted by individuals with responsibility for their specific functions and tasks which contribute to overall project team progress. Missing or a lack of knowledge of lean was considered a significant barrier across all industries, and this included generic lean knowledge as well as specific lean project management knowledge. Findings demonstrated that this also cuts across levels of seniority within the project team. The fact that interview participants saw clear benefits in the importance of knowledge and understanding of lean and LPM, particularly in the effective delivery of projects but additionally as a route to increasing wider organisational learning, suggests that this is *not* a performative or analytical

feature of learning cascaded from managerial levels (Davenport & Hall, 2002; Contu & Wilmott, 2003; Cox, 2005). Rather, this illustrates that context-based experiences can in fact be created, and are valued and shared, in contrast to Davenport and Prusak's (2000) and Hildreth and Kimble's (2002) arguments to the contrary. The supportive, flexible and adaptable approach envisioned by Wenger (2002, 2004, 2013) is seen clearly through the implementation of LPM within the case study, as different members of the team support and extend their colleagues' knowledge and understanding using the project and its processes as a conduit and context for learning (Brown & Duguid, 1991). This second driver of project learning is again depicted by a triangle, as per the below figure.

Figure 6.7 Knowledge and understanding of lean



Socio-cultural behaviours and interactions

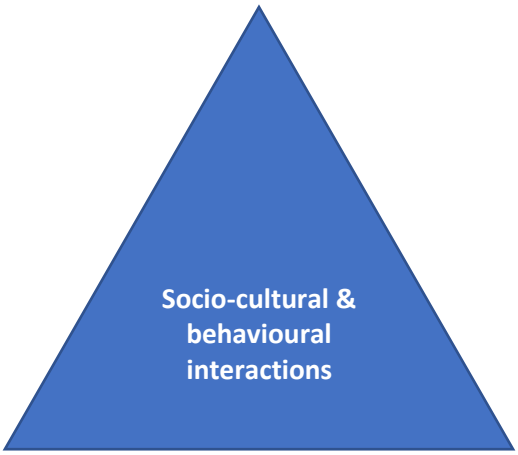
Findings provide further evidence for the need to employ socio-cultural behavioural elements of learning to maximise and optimise learning acquisition and exploitation. This is especially true for project environments where the velocity of change exceeds the velocity of learning, leading to an inability to keep pace with the challenges being faced (Womack & Jones, 2003; Revans 2011). The development and extension of

socially-driven processes of learning underpinned by hypothesis-driven behaviours (Staats et al, 2011) could overcome the difficulties that have previously been associated with and inhibited project success (McClory et al, 2017), including but not limited to continuous improvement (Van Aken et al, 2010; Tortorella et al, 2015). This is in keeping with the recent debate around the need to focus on more informal behaviours across project teams, as well as the commitment by PMs specifically (Braun et al, 2013; Ekrot et al, 2016). This may in turn promote better collective alignment with project and organisational strategy (Loufrani-Fedida & Missionier, 2015), specifically in the area of improvement agency (Sundqvist, 2019). Indeed, this was made quite clear by interview participants who had experienced the weight of responsibility within their project environments. Social exchange theory (Cropanzano & Mitchell, 2005) may help us understand that, where several types of resources are exchanged between parties, there is a greater potential to create high-quality relationships. This includes interpersonal interactions, collaboration, as well as competition, and can be reciprocal or completely altruistic (*ibid*.) Project learning within the research indicated that information and knowledge are exchanged between one or more interacting parties, although the reasons for this were outside the scope for exploration.

However, socio-cultural behaviours influence the willingness and transparency of (other) individuals to practise as well as collective practice within the general project environment. Some interview participants welcomed the ability to co-create schedules and value and expected other team members to feel the same way. Others were more concerned about the risks of learning and improvement failing to either take place or not being embedded. This can cause further challenges such as the strong competition for resources, high staff turnover and rotational nature of some

project managers, especially clinicians (Harris et al, 2002), which can lead to inconsistent participation for practice improvement. This inhibits the growth of innovations, creativity, flexibility, risk taking and entrepreneurship (Chen et al, 2012). Therefore, the importance of social and behavioural processes for PL cannot be underestimated. This aspect comprises the third driver, and is represented by a triangle, as per the below figure:

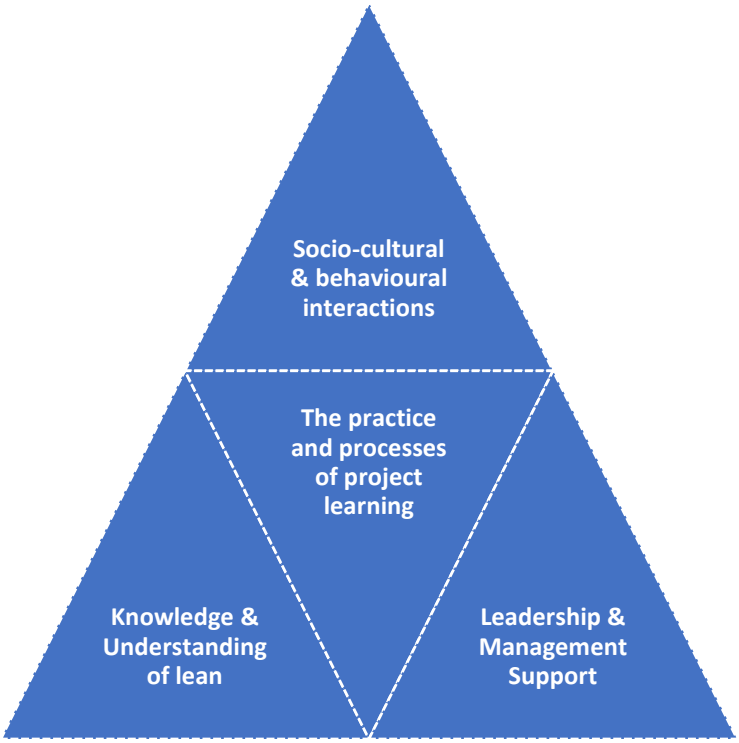
Figure 6.8 Socio-cultural & behavioural interactions



6.4.4 Summary of the mechanisms of project learning

Capturing, developing, sharing and using knowledge is a complex process that cuts across project and organisational boundaries (Pedler et al, 1997; O'Keeffe, 2002). The research suggests that three are core elements or drivers of PL. These are each represented visually by a triangle which underpins and influences the mechanisms of PL. Dotted lines represent the ability of all the elements to influence and support one another. As underpinning elements, the importance of foundational or basic levels of knowledge and understanding of lean cannot be underestimated. Together with leadership and management support, this enables a safe space for the practice and processes of project learning.

Figure 6.9 The mechanisms and drivers of project learning



The level and nature of their formality depends on the project context and to a varying extent will also be influenced by (and impact on) the interactions between project personnel. Accordingly, organising project learning must be developed in conjunction with project goals that align with (often multiple) organisational strategies (Brown & Duguid, 2001). The **mechanisms** of learning within LPM extend the traditional learning curve (Marquardt & Waddill, 2004), making learning ubiquitous and not at prescribed times, stages or phases. The **process** of project learning through the LPM approach extends beyond mere acquisition of learning and knowledge (Nonaka & Takeuchi, 1995), providing a basis for context-based, dialogic reflexive learning (Cunliffe, 2002, 2008; Jørgensen & Lauridsen, 2005; Corlett, 2013). Processes such as modes of information which support the content being learned, and thus practice and practice development, provide mutual benefit, and this is consistently shown

throughout the findings. LPM strengthens the link between project outcomes and behaviour, which can lead to improved project performance and better management of limited available resources. Thus, the implementation of the LPM approach could mitigate the unpredictability of human behaviour as an essential element of project management (Kreiner, 1992).

6.5 The changing place of project learning within project management

"Lessons learned" is a well-established concept within project management that has typically formed part of formal post-completion and project review mechanisms (Kransdorff, 1996; Kamara et al, 2002; Liebowitz & Megbolugbe, 2003; Rowe & Sikes, 2006; Jugdev, 2007; Williams, 2008; Jugdev, 2012). Although the research provides evidence of more informal and less-structured forms of project learning at any time point (PMI, 2010), which reflects both the positive and negative experiences of a project, this also infers that learning within projects has an important role to play in extending knowledge further and wider, to other projects within and outside of current organisations. By taking opportunities to learn from the actual experiences of others (Rowe & Sikes, 2006), this represents a level of practitioner commitment to project management excellence. Findings suggest there is a general acceptance of the need for learning within projects to achieve both project-specific progress and continuous improvement. The LPM approach to project learning could therefore facilitate better awareness and importance of the broader role of knowledge and learning, with particular reference to continuous improvement and its development (Hines et al, 2004; Rowe & Sikes, 2006; Lindner & Wald, 2011; Jugdev & Wishart, 2014; McClory et al, 2017; Sundqvist, 2019). This can be characterised by the effectiveness (or otherwise) of the knowledge conversion process as well as extending the life cycle of knowledge and learning beyond the boundaries of PM. The next section outlines

and discusses the ways in which the LPM approach to PL supports the knowledge conversion process. Since the LPM approach to project learning extends the boundaries of knowledge and learning beyond PM, facilitating and creating opportunities to OL, this is also discussed.

6.5.1 Knowledge conversion processes and practice

Project learning is seen as emerging within 'communities of practice' through improvised responses which individuals make to demands situated within such contexts (Lave & Wenger, 1991). These improvised responses are often unintentional yet will yield consequences from implementing LPM: practitioners gain new knowledge about the experience of implementing LPM, how it makes them feel, gaining a more realistic idea or insight. Statements from interview participants intimated that this was much more effective than 'book learning'. They were able to describe the experience and sense of increased perception, satisfaction with the processes and practices. Watching and learning from others instilled a level of confidence or willingness to engage and participate. Some liked or disliked the experience, and the after-effects. However, the outcome of LPM for PL is not a linear process, but an iterative as well as a cyclical process which strengthens the knowledge basis at each block.

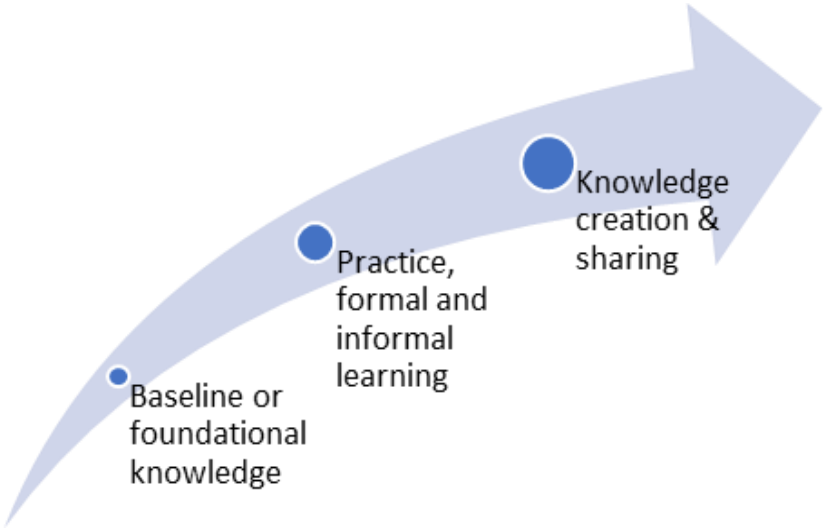
The implementation processes within the LDMT project team enable project team members to be efficient conduits of information and experience regardless of their co-location or otherwise (Ardichvilli et al, 2003). As well as their functional role identity, project team members are engaged within the project as "active participants" (Wenger, 2002), and their "knowledgeability" (Wenger, 2009, 2010) allows them to make sense of multiple landscapes of practice in which the individual and the

organisation exist. This is evidenced by the fact that, even when it is not their specific responsibility or knowledge area, they actively participate in and contribute to discussions about and development of the project. This was also evident from the interview study, where findings suggested a similar pattern. Since CoPs help individuals bridge the gap between knowing WHAT and knowing HOW to convert theory into practice (Duguid, 2005), valuable context-based experiences are created that are not easily captured/codified/stored (Davenport & Prusak, 2000; Hildreth & Kimble, 2002).

Knowledge conversion supports and extends the individual's ability to acquire, retain and retrieve knowledge (Walsh & Ungson, 1991). These stages are essential to the project learning processes and can be facilitated by additional processes of shared understanding, decision-making, co-operation, systems and perceptions (Frost, 2014). Similarly, the absence of these processes hinders project learning, according to the perceptions from the research.

Knowledge management concerns itself with the complex process of capturing, developing, sharing and effectively using organisational knowledge (Pedler et al, 1997) through a multi-disciplinary approach to achieving organisational objectives by making best use of knowledge (O'Keeffe, 2002). According to Rose et al (2014), organisations create knowledge by tackling problems and learning from experience (p212). In this way, competitive advantage (Porter, 1980) is facilitated and the domains of knowledge management and organisational learning become not only intertwined but mutually dependent on each other (Kennedy & Burford, 2013), if competitive advantage is to become sustained (Porter, 1998). This is illustrated as a growing learning curve in Figure 6.10 below:

Figure 6.10 Key elements of the knowledge conversion process for project learning



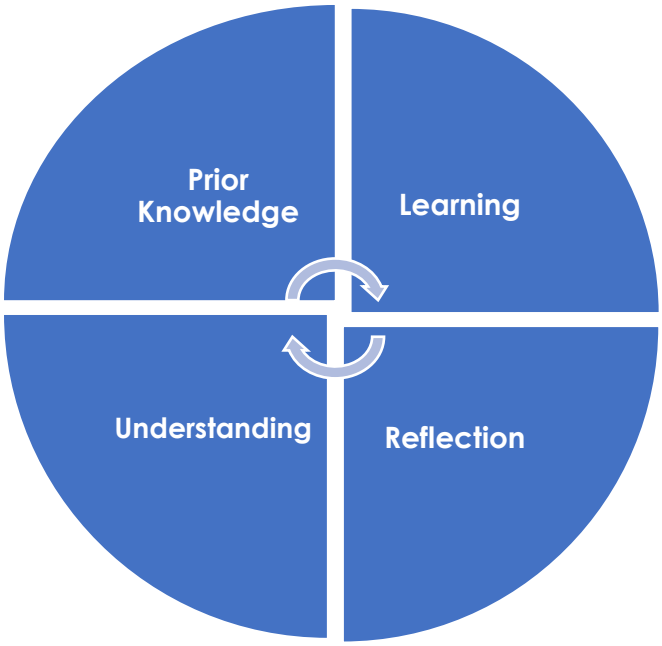
Source: adapted from Lave and Wenger (1991)

This traditional, one-way or single-directional arrow assumers a linear flow of knowledge, which is built on initial knowledge and through practice becomes new knowledge that is created and shared to others. The findings agree that, in order to reach the intended outcome of new knowledge, there must be a (small) amount of prior learning which has resulted in the existence of a basic level of knowledge and understanding. This can be shared with and accessed by additional individuals, acquired by current learning and understanding, which deepens when connecting with others in the same situation. This is where CoPs and practice-based perspectives on learning acquisition and knowledge can help us to understand the role that project learning can play in the knowledge conversion process.

However, the findings also indicate that the knowledge conversion process does not necessarily start at the bottom of the curve and increase to achieve the highest levels, where it is then stopped and shared. Knowledge can be illustrated by a circular process, which is subject to any number of influences, not least the processes of

learning as outlined earlier. Findings show that knowledge can be integrated at multiple points of entry along the knowledge flow and thus would be more representative of a circular diagram, such as shown in Figure 6.11 below:

Figure 6.11 The knowledge cycle in lean project management



Individuals bring their own prior knowledge, learning, reflections and understanding, and this represents their experience from past and recent past (current) experiences. The project therefore receives multiple contributions from individuals that enter into the cycle at any time point, and in one or more quadrants. There is no finite end point or stopping point for new knowledge. New knowledge circulates continually and becomes embedded into practice. It can be accessed continually for current project use and for use outside of the project. The individual can act as a conduit of knowledge transfer through recommending and sharing best practice or process to an employing organisation, and to the wider community of practice outside of the current project and organisational boundaries.

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Contributing to new knowledge levels within specialist communities of practice extends Lewins' (1946) original concept of "Plan, Do, Study, Act" (PDSA), and this is something that the interview participants across the research were keen to foster. Many of the organisations represented in the research are organisations whose core business is to transfer learning into practice, and as such must espouse a range of learning theories for individuals and organisations who seek to improve professional knowledge and competencies, according to Eraut (1994). The "lived experiences" of front-line staff (Schein, 1985) are important to capture as part of knowledge capture and sharing within the (multiple) communities of practice. Many projects are not unique in that their designers and delivery staff are also practising professionals in a variety of fields, and providers, and this allows a deeper self-reflection, enabling sense-making of their own and others' environments. This supports further creative licence in the development of products and services as required by the customer, which is more frequently applied through projects and the application of learning that arises from projects. This remains relevant today and can be seen clearly from the exploration and examination of project learning practice within the LDMT project and the extent to which this is extended to other organisations. The project itself has created a specialist community of practice that is commonly bound by and through implementation of LPM as its core knowledge concept and practice. In addition, it has then provided an impetus for extension of the knowledge and practice of LPM outside of the project. Multi-disciplinary projects such as the LDMT project show the flexibility of the CoP, allowing the space within it to be occupied by different knowledge levels, but with the ability to enable growth and development of individuals within and across the CoP. In the LDMT project, there is a plethora of different disciplines that are characterised by different elements of fragmentation,

standardisation and complexity within their own practice and processes. Yet, collaborating with the rest of the LDMT team through the implementation of LPM, this variation appears to be welcomed rather than perceived as a difficult challenge that cannot be overcome.

It is important to understand why and how organisations operate through the concept of communities of practice in order to determine aspects of knowledge management and organisational learning required to achieve future organisational sustainability. In the creation of such specialist communities of practice, it became apparent that many tensions between these elements had been created, which were affected by and affecting the very individuals, their participation and the communities these elements sought to strengthen. This can be demonstrated by the fact that, although everyone within the LDMT project began the LPM journey together initially, individuals within this CoP appeared to develop and grow at different rates. The finding that there were many different definitions and meanings for the concepts of LPM, PL and OL demonstrates this, to a certain extent. This is supported by Wenger (1998), who found that members of CoPs could not always determine any similarities of understanding when asked about the meaning and identity of their CoP. Osterlund and Carlile (2003) also found that relationships and power forces between and within CoPs sometimes became a source of change and conflict which threatened the CoPs' success (Wenger & Wenger-Traynor, 2018). Different rates of development, knowledge and understanding of LPM existed within the LDMT project, perhaps in part due to different baseline starting points of different individuals. Since measurement of knowledge and its conversion to practice was outside the scope of this research, a causal effect cannot be determined. However, findings suggest that the development of knowledge was one of the most important elements underpinning

effective LPM implementation, and perceptions revealed that such knowledge and understanding was expected to develop in the right (upwards) direction. Where traditionally hierarchical or structured project environments in Construction and Health & Medicine might assume project manager responsibility for knowledge and understanding, this was an expected norm in the lean project environment.

Theorists viewed communities of practice as an essential component of the knowledge-based view of the 'firm' (Kogut & Zander, 1996; Brown & Duguid, 1998; Cook & Brown, 1999; Tsoukas & Vladimirou, 2001; Grover & Davenport, 2001). Some initially viewed communities of practice as privileged sites of knowledge sharing and innovation (Prokesch, 1997; Swan et al, 1999; Lesser & Everest, 2001), especially given their initial use by some as technological solutions for knowledge sharing (Scarbrough, 2003; Thompson and Walsham, 2004; McDermott, 1999). But communities of practice have also long been recognised as an indispensable element of organisational knowledge management programmes. In a field that is often criticised for its increasing fragmentation (Alvesson & Kärreman, 2001; Wilson, 2002; Gray & Meister, 2003), communities of practice have emerged as one of the few common denominators in existing typologies of knowledge management (Hansen et al, 1999; Despres & Chauvel, 2000; Binney, 2001; Earl, 2001; Alvesson & Kärreman, 2001; Kakabadse et al, 2003; Lloria, 2008). Although the notion of 'legitimacy' of the participant within CoPs remains hotly contested within the literature, Kim and Cavas (2013) suggest that there is still no feasible, empirical measurement of socially recognised legitimacy, other than measuring time variables of novice participants. The LDMT project is a good example of this, since all team members were using the LPM approach for the first time as a project team together as well as for their own individual learning. Wenger (2013) argues that the applicability and adaptability of

CoP into a range of different learning landscapes, whether for the purposes of organisations and/or individuals, shows that it can be flexible and suitably adapted if that is what the community in question requires (*ibid*). Thus, the LDMT project acknowledges the different boundaries within and between practices and disciplines that many of Wenger's contemporaries had argued against (Duguid, 2005; Cox, 2005). The importance of the individual learner taking responsibility for self-directed learning and the notion of "competency" are highlighted through the processes and practices of project learning across the dataset, which is important in translating and demonstrating application of knowledge into skill and practical action.

Findings suggest that LPM grows and develops in the same way that CoPs do, shaping and driving practice as the community membership grows and learns together, though not necessarily at the same pace, through the specific vehicle of the project. As a result of the continuing debates surrounding the benefits and criticisms of the application of CoP in practice, this concept has been subject to continual iteration and development over time. It has been used as a tool to respond to different organisational and individual needs, such as the need to make sense of surroundings, the drive to increase productivity and performance in changing business and economic circumstances, and the desire to become knowledgeable and competent as individuals. Wenger (2013) described CoPs as a journey from the observational to the analytic to the instrumental, and this can be evidenced in the research from the exploration of the processes and practices of project learning suggesting a similarly journey. Indeed, Wenger's (2013) suggestions that "human learning [is] fundamentally about making sense of the world" (2013, p268), and that the essence of CoP is that "learning is a socially constructed characteristic that involves the person and the

social structure in complex ways" (2013, p 272) sum up PL as the epitome of a CoP which is facilitated by LPM, as both provider and content for its practice.

Practice defined as action informed by meaning drawn from a particular group context (Cook & Brown, 1999) is thus seen as embedded in particular organisational and institutional contexts. As Cook and Brown (1999) note, the craft elements of practice are acquired individually (what our PMs called Learning by Doing), but the knowledge of what constitutes 'acceptable' and 'unacceptable' practice is developed and negotiated collectively, among a particular group or community (Scarborough et al, 2004). A second contribution arising from the practice-based perspective is the emphasis that it places on the importance of 'divisions of practice' in establishing boundaries to the acquisition and sharing of knowledge within organisations (Scarborough et al, 2004). Knowledge sticks in the gap between boundaries of practice and only become fluid when it is shared across practice boundaries (Brown & Duguid, 2001). Thus, the importance of a situated (context specific) practice-theory approach helps PMs to facilitate optimum and effective learning transfer (Danese et al, 2016). The requirement to respond and adapt to complexities within and across project boundaries and business contexts (Cova & Hoskins, 1997; Staber, 2004) may also reduce inefficient resource management (Hopp & Spearman, 2004), improving actual ability to deal effectively with variability (Joosten et al, 2009). The recognition of implementation of LPM as an emerging practice could provide a positive impact on the ability of the organisation to better integrate and improve the knowledge-sharing processes and outcomes (Bechky, 2006; Ivory et al, 2007; Kim & Wilemon, 2007; Feldman & Orlikowski, 2011).

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The research provides evidence that input to the knowledge conversion process is determined by pre-existing or prior knowledge brought to the project by an individual, as well as knowledge that is created by individuals within the project to improve their own and others' knowledge and understanding. This is followed by action-based "learning by doing", which was a common thread, and this too was articulated in terms of perceiving the purpose of learning for continuous improvement. Lessons learned from the experience of "doing" were also considered as a bridge between and across projects, as well as from projects to the organisation. The result of learning by doing, or output, is the combined prior and acquired knowledge which is then seen as a tangible product and implemented by individuals not only across the current project, and additional projects, but essentially focused on the individual and his/her interaction with the others and the project as an entity. The main outputs were productivity and efficiency – signified by less re-work, fewer errors and risks that are identified much earlier in the LDMT project in particular, with potentially less time wasted in waiting for decisions that are more quickly resolved through collaborative work observed in the LDMT project. Following this, outcomes were achieved where knowledge is spread to and accessed by individuals across the organisation, or organisations, which suggests an extension beyond the traditional boundaries of project learning and leads to organisational learning.

Thus, the individual and collective experience of learning within the research study importantly moves beyond the traditional knowledge management paradigm to become part of an ongoing process of continual improvement and reflection, beyond one-off or isolated purposes (Lawler & Sillitoe, 2013). The type of learning occurring within the research is indicative of the double-loop learning (Argyris, 1999) and recursive interactive feedback loops (McCarthy et al, 2006) that utilise reflection

on the learning process itself, evidenced by participants consistently describing their satisfaction with the process and its feasibility in seeking to determine insight and the shift from explicit knowledge to tacit and implicit knowledge (Easterby-Smith & Lyles, 2005; Sveiby, 2007). According to Hargrove (2003), this is the point at which learning becomes "transformational" (Mezirow, 2000), as underlying patterns of thinking change shape and lead to an informed change in behaviour. Importantly, findings demonstrate that data collection processes and methods of this research provided the learner with a safe place and conducive conditions to face anxieties of real-world problem solving, enabling reflection and facilitating subsequent personal and professional development (Schein, 1979; Marquardt, 2000, Haith & Whittingham, 2012).

LPM utilises situation-specific, socio-cultural and discursive conversion processes and this raises the profile of learning and knowledge (McClory et al, 2017) as well as the role of practice (MacIntyre 2007; Jarzabkowski & Seidl, 2008) as a means to increasing knowledge, experience and learning. LPM therefore bridges the gap between the domains of "know -what" and "know-how", as well as strengthening "know-why", as espoused by Corallo et al (2009) and Hussain et al (2015). This suggests that LPM can be utilised as a vehicle to strengthen project learning whilst also using the practice and processes of project learning to increase lean knowledge.

6.5.2 The extension of project learning to organisational learning

Undertaking the process of knowledge conversion can also foster a positive relationship between the job satisfaction of the employees involved and newfound organisational commitment that is influenced by a satisfaction with the actual knowledge management process itself (Chatzoudes et al, 2015). Findings from the research suggest that engaging in the practice of LPM improved practitioners' perceptions of lean concepts, as well as satisfaction with the associated processes. Thus, learning to be lean, by "doing and being lean", not only appears to improve project-related knowledge but additionally facilitates the acquisition of subject (lean) knowledge within the wider community of practice. The communities of practice (CoP) perspective can help organisations (here the project as a temporary organisation) to capture tacit knowledge and lead to higher productivity (Wenger, 2004).

The process and nature of project learning within the research suggests the existence of a set of building blocks to reach the desired state of organisational learning. Previous research by Scarborough et al (2004) suggested that high levels of learning at the project level learning inhibited learning at the organisation level, since the role of the PM tends to focus more on project delivery stages rather than wider and broader learning. This is supported by recent authors who suggest that PMs are conflicted in managing expectations relating to project and organisational learning (Müller et al, 2013; Chronéer & Backlund, 2015). However, this was not found to be the case in the research. Knowledge and learning remain an unapologetic common thread running throughout the research and the ways in which LPM, its implementation and its learning mechanisms have been undertaken. Knowledge and learning are clearly evident through face-to-face (offline) and online communities

due to the technological advances possible and an ability to engage "safely" for increasing numbers and types of participants. This supports the premise that CoP has application within a wide variety of business organisations wherever learning needs to take place (Murillo, 2011). The LDMT project is an example of a multi-professional and interdisciplinary community of practice where the process of learning itself is as important, if not more so, as the finite end-product of the created knowledge and its subsequent use.

The traditional place of project learning is shifting from output-driven PM processes to process-driven outcomes. The pursuit of continuous improvement within project learning within LPM transferred to organisational learning supports the notion that learning and development requires investment, intellect and interactions (the 3 Is), within a carefully constructed, supportive culture, to maximise opportunities for individual as well as organisational learning (Pedler et al, 1989; Korac-Kakabadse et al, 2002).

Project learning as part of a relationship with and through the vehicle of LPM is a specific aspect of a CoP which poses significant challenges. One of these challenges is that the inherent processes, systems and dynamics necessarily require interaction and engagement from a variety of schools of thought – predominantly the technocratic, economic, behavioural and integrative schools (Earl, 2001; Blackman & Kennedy, 2009; Kennedy & Burford, 2013). Any number of organisational players focus on different and often conflicting priorities and this takes place within a multitude of intellectual and professional communities at any one time. However, this level of complexity was considered as a strength rather than a threat to the successful collaborative working of the project and the organisations represented by the LDMT

project team members. This can be seen within the LDMT project where the tensions that surfaced based on discussion of potential risks were not perceived negatively. Early stakeholder involvement was welcomed despite some of the problems and issues that were raised; this essentially meant that these were able to be raised and managed satisfactorily prior to expensive equipment being installed, then uninstalled and reinstalled. Further examples highlight the importance of wider stakeholders who were not present at meetings but whose voices were nevertheless represented at the project meetings through the Project Leader and their concerns discussed seriously, with the necessary time taken to address issues, despite potential delays that may have been caused by their absence.

Research findings characterise the way in which the concept of project learning may be identified, explored and combined with the knowledge, understanding and experience of lean and LPM. This establishes firm foundations for the relationship of project learning within the practice of LPM and findings highlight a flavour of how this is manifested for a group of practitioners. Accordingly, this presents an opportunity to explore this further as an evolving construct within the project management, knowledge management and organisational learning body of literature. The next section presents and discusses a suggested illustrative framework which comprises this relationship and its underpinning elements.

6.6 Summary of discussion

The roots of knowledge management and organisational learning span centuries, back to the first knowledge economy, with the realisation that economic growth and prosperity was founded upon the solving of a problem through technological innovation (Jacob, 2014). Thus, when knowledge, creativity and industry combined,

continuous economic development prevailed on a larger scale, across industries and geographic areas (*ibid*). The early proponents of the Industrial Revolution believed the key to success was in combining knowledge and skill, which would not only lead to profits for innovators and investors but would also lead to an outcome that benefitted everyone in society (Farmer, 2010). Thus, knowledge can provide the foundations for limitless progress (Jacob, 2014).

Engaging in the production of knowledge in order to produce new and improved specialists of different kinds to enter into industry, academic and research work (Jørgensen & Lauridsen, 2005) can help organisational knowledge, and facilitates its (and others) learning to a significant extent. Cooper (2014) deems that participative learning requires practitioners to engage with the process of evaluation as "researchers of their own practice" and not just "data collection" in order to enhance the learning potential for all. Since individuals are assumed to be the actors who engage in the knowledge conversion processes (Argote et al, 2000), research has tended to focus on knowledge sharing between individuals (Mueller, 2014), and it has been suggested that teams, departments and networks provide an enabling function for individual knowledge sharing (Wasko & Faraj, 2005). Others have suggested that organisational culture and values influence day-to-day knowledge management behaviours and therefore knowledge management outcomes (McDermott & O'Dell, 2001; Alavi et al, 2005). As suggested earlier, project-based organisations try to implement strategies to ensure that learning occurs from the project teams' experiences, despite the difficulties of knowledge integration (Scarbrough et al., 2004). This can be implemented formally through project report databases as well as informally through supportive communities of practice (Wenger & Snyder, 2000; Prencipe & Tell, 2001; Cacciatori et al, 2012).

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No matter how project learning manifests itself, it nevertheless suggests a flow of knowledge that is characterised by knowledge feedback loops for the purposes of either and/or individual or organisational learning. Feedback loops are the recursive cycles of interactions over time (McCarthy et al, 2006; McClory et al, 2017; Matthies & Coners, 2018), improving and refining innovations (Van de Ven et al., 2008), to articulate new knowledge (Fischer, 2001). In the research, findings show that multiple feedback loops exist, in practice as well as in theory, demonstrated by the level of anticipation and expectation that learning and knowledge will flow. Recent research suggests that, whilst these feedback loops are generally positive in terms of intended desirable knowledge outcomes, less is known about the processes, or about how loops facilitate movement from one type of knowledge to another, how they function and evolve (Akbar et al, 2018). However, findings from the research show that the process and practice of providing and sharing knowledge to others through collaborative activity is not only achieved through project-level loops (Sokhanvar et al, 2014) but also facilitates organisational-level (double-loop) feedback (Mathies & Coners, 2018; Love et al, 2016). Importantly, findings demonstrate common supportive elements which influence the process and practice of multiple feedback loops. The knowledge conversion process transfers to become re-used knowledge in the form of intellectual assets which may then inform and improve current and future projects (Yap et al, 2017).

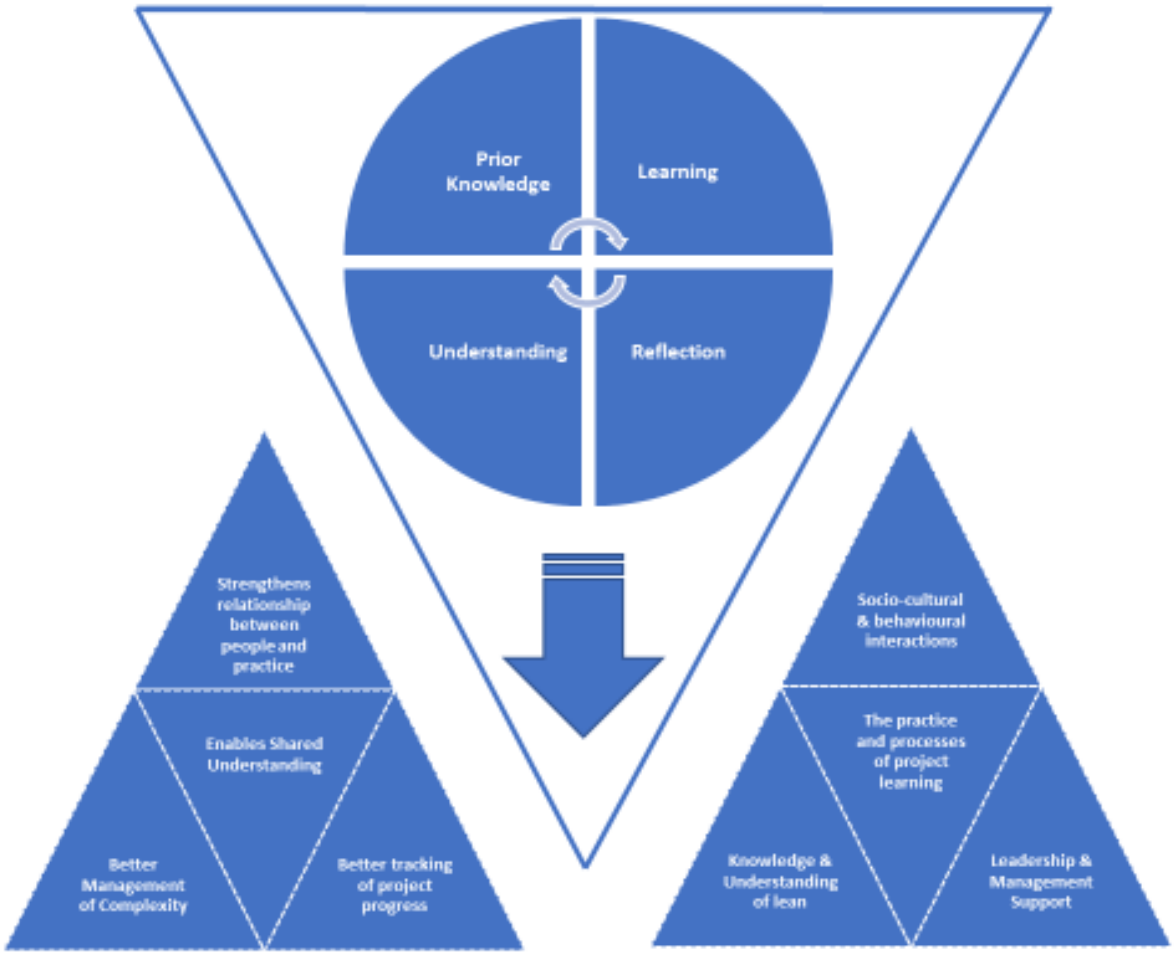
6.7 Presentation of an illustrative framework

In keeping with the sense-making approach aligned to the situation, experience and interpretations of the members of the social context (Nonaka & Takeuchi, 1995), the following illustrative framework has been constructed, based on the presentation and discussion of findings. This has two purposes – to present the framework as a 'product' of the knowledge created from the research and to provide a visual or graphical representation of the relationship between LPM and PL, to enable the deeper understanding sought from the aims of the research.

The framework illustrates the contribution of the positive conceptualisation of LPM, together with the mechanisms of project learning which serve as essential underpinning elements which capture knowledge and understanding for the benefit of the individual, project, organisation and wider community of practice. Knowledge may originate from all three domains of the individual, project and organisation (those represented by project team members).

The processes and actions of transferring, sharing, converting and exploiting this knowledge are supported by the lean principles of continuous learning, collaboration, engagement and openness, which combine to form the relationship between LPM and PL. Knowledge grows in the direction of all domains, and, as the process and outcomes of knowledge are shared, perceived and interpreted, it is integrated into existing and new knowledge sets (Watzlawick, 1976).

Figure 6.12 The relationship between lean project management and project learning



LPM and its underlying lean principles provide the content for the processes to take place as well as a vehicle to allow knowledge to reach its intended destination – for the project to progress. Thus, it enables the context-specific concept of PL by allowing and welcoming diversity, uncertainty and continuous change to thrive within projects and organisational environments, providing new knowledge sets (Jugdev & Wishart, 2014). The findings observed from this research could lead to an increased, or at least more equitable, sharing of power and responsibility for progress through project

learning that utilises the LPM approach that transcends project and organisational boundaries (Feldman & Orlikowski, 2011).

Research findings give credibility to the notion that, where the project learning is regarded as highly important, when combined with LPM, it can be regarded as both an instrument of progress and a means to uncover complexity (Burgoyne, 2010). Successful transformative learning can only occur within organisations and across systems by bringing together the needs and expectations of these diverse stakeholders (Haas & Hansen, 2007; Cooper, 2014). The relationship between LPM and PL additionally provides a further set of opportunities to improve understanding of the underlying lean principles, which perpetuates and embeds learning and knowledge further for the individual, their practice and the context within which they operate.

In presenting this framework, it is acknowledged that barriers still exist to the implementation of LPM as well as to project learning. The next steps – which are outside the scope of this research – could be to investigate the usefulness of the framework. This may aid practitioners to engage in socially constructive thinking for potential solutions, which is of particular importance when working in organisations that are in a state of flux and change (Cavanagh & Lane, 2012). The next chapter presents conclusions and recommendations of the research and considers its contribution as a body of work within the knowledge and practice of project management.

CHAPTER 7: CONCLUSIONS & RECOMMENDATIONS

7. Conclusions and Recommendations

This chapter will provide an overview of the research that was undertaken in line with its aims and objectives, as well as a summary of the key findings that have arisen following examination of the data and analysis. Concluding remarks are presented in consideration of the detailed discussion from Chapter Six and the extant literature from Chapter Two. Contributions to the knowledge and practice of project management are presented together with acknowledged limitations of the research and suggested recommendations for further research.

7.1 Summary of key findings

Crucially, the relationship and interaction between people and processes is a recurring theme. Although Lean Project Management is generally seen as an enabler to progress, the most frequently cited barriers are those connected to Knowledge, Skills and Behaviour; the understanding and ability of individuals to communicate, commit to and undertake change. This suggests that there is a value and an appetite for LPM as a PM approach that can effectively manage the complexities found in multi-disciplinary contemporary project environments. This places LPM in a unique position as it can make sense of, interact with, respond to and shape the very systems and processes of learning that can be responsible for success or failure.

Findings suggest that the practice of lean project management (LPM) could extend formal learning mechanisms through streamlined communication and hypothesis-driven behaviour (Staats et al, 2011). Moreover, the socially driven processes and practice of learning within lean project management are important in developing the knowledge and understanding of individual, team and project needs, connected through the common purpose of progress and improvement. Project learning (PL) requires a supportive culture which can be provided regardless of seniority. However,

specific leadership and senior management support is expected and anticipated, including a basic level of lean knowledge, especially for the purposes of decision-making, which practitioners deem necessary for the required levels of trust and respect.

Evidence from findings and analysis suggests project learning within LPM extends knowledge beyond traditional formal and instructive means and can be evidenced as a specific outcome of LPM. Therefore, LPM serves as a vehicle and a platform for learning at all levels to take place, and this brings multiple and mutual benefits at all project life cycle stages. Key conclusions are presented below.

7.2. Key Conclusions

7.2.1 Lean Project Management has value and utility as a concept

Findings support the premise that LPM is a distinctive concept from and extends traditional project management. Exploring the lived experiences of practising professionals confirmed that the concept has value and utility. LPM was conceptualised in terms of its general ability to improve and sustain efficiency, and, specifically, by connecting practitioners through lean practices and processes, focusing on project outcomes as well as outputs.

The factors of implementation of LPM were articulated by respondents in the Interview Study and comprised a number of barriers, benefits and enablers. Based on the lived experience of respondents, the research suggests a general state of the art in terms of current practice across industries and countries, with some comparisons that suggested patterns and trends. The features of implementation of LPM were identified in terms of the way in which LPM enabled recording and tracking of progress, and the employment of specific tools and methods to enable project progress. This was then further evidenced through the Case Study, which built up a rich picture of the

phenomenon of LPM by observing the way in which it was practised in a contemporary project environment. Importantly, socio-cultural, and behavioural interactions, knowledge and understanding were considered to be responsible for the effectiveness (or otherwise) of the implementation of LPM.

This further supports recognition that LPM is a concept that is distinct from and extends traditional project management. This was confirmed through respondents' articulation, knowledge and understanding of the meaning of LPM, defined as the ability of LPM to improve and sustain efficiency, connecting practitioners to one another through lean processes, methods and tools. Moreover, adopting values-based philosophical approaches throughout all project life cycle stages is regarded as an essential enabler to effecting progress, change and improvement (Loo, 2002; Jacobsson & Söderholm, 2011). Despite its apparent use as a global concept (Sauser & Voss, 2001; Modig & Åhlström, 2017; Saier, 2017), the definition or understanding of its meaning as a concept had been inconsistent and less clear, thus attracting much criticism (Hopp & Spearman, 2004; Matthias & Buckle, 2016; Poksinska et al, 2016).

However, in this research, the widespread ability of respondents to articulate and provide evidence across several different demographic attributes shows that LPM is generally understood and accepted. Capturing the understanding and meaning of LPM as a concept establishes a firm foundation for its suggested utility and value as a project management concept. Additionally, LPM provides opportunities to improve existing project management knowledge as well as further development of the concept and practice (Jarzabkowski & Seidl, 2008; Söderlund, 2011).

7.2.2 Lean project management enables better management of complexity

Assertions were expressed regarding the ability of LPM to better manage complexity through the supportive mechanisms of processes and practices. LPM supported practitioners to more effective handle ambiguity, risk, and stakeholder expectations and their changing requirements, as suggested by Schoper et al (2016). This was particularly prevalent in the design phases of projects but was not limited to this phase. The timeliness and relevance of information streams and the need to work with multiple layers of connectivity between and across functions, usually associated with causing further complexity (Adrodegari et al, 2015), was found to be of particular value within this dataset. Respondents explained how they actively sought out information ahead of time where possible, to enable more accurate, timely and efficient progress. Leaner reporting mechanisms led to a better quality of information, particularly in Construction and Health & Medicine, thus reducing the likelihood of information repeatability and being overwhelmed with data and information.

7.2.3 Lean project management enables better tracking of progress

Many elements of traditional project management are still in widespread use within the implementation of LPM; for example, use of tools, methods and techniques in planning, scheduling and estimating time aspects. This was often used as a basis for encouraging other, less experienced, practitioners to try lean processes in order to facilitate better and faster progress. LPM is considered to better track progress across project life cycles, but the process of achieving that progress is also a generally positive experience, increasing understanding of the project as well as of LPM as a practice. Thus, the research concludes that LPM has utility as an outcome as well as an output.

7.2.4 Lean project management enables shared understanding

Regardless of whether lean project management is a deliberate, strategic or operational approach taken by respondents, knowledge and understanding of lean principles, processes and practices was an essential element for its implementation. Identifying and exploring barriers to implementation of LPM revealed that, next to socio-cultural and behavioural barriers, knowledge and understanding was significantly indicated across all demographic attributes. Missing (incomplete) as well as lack of knowledge and understanding of lean included general lean principles as well as those specific to LPM (processes, targets, delivery, measurements, requirements, methods relating to implementation of lean within projects). Interestingly, this cut across all levels of seniority. Those with decision-making authority were expected to have the requisite knowledge and understanding, regardless of their role in LPM implementation. Similarly, knowledge and understanding of lean was considered one of the most important enablers in this dataset. Shared understanding extends beyond acknowledgement of the value and benefits of LPM and can manifest itself by a subsequent shared vision and team mind-set. There are two specific challenges associated with facilitating shared understanding, which are influenced by the ways in which understanding (and knowledge) is obtained, and the influence of socio-cultural behaviours in facilitating the desired changes to enable understanding (Kasasbeh, 2015). The research found that both were important, and that LPM provided an opportunity for mechanisms of learning, knowledge and understanding to take place, through largely informal means within projects, as well as supporting the desire to learn and practise lean for individual development purposes (Milton, 2011; Gosling et al, 2019). More experienced respondents suggested that, whilst formal learning had its place, in order to really understand lean "*it needs*

to be lived, experienced and survived in order to really understand it" (Respondent I1).

7.2.5 Lean project management strengthens the relationship between people and practice

The relationship between people and practice was characterised by project team members engaging with task requirements. At first glance this looks no different to established traditional project management, as an essential function of project roles. However, in LPM, respondents reported that practitioners again went beyond this expectation, and made efforts to understand and appreciate other team members' roles and functions. This was evidenced by visible practice which facilitated transparency, openness and collaboration. Better, faster connections were made which additionally led to a reported increase in satisfaction of this approach. This additionally enabled better comprehension of the needs and functions at the individual as well as at the project level. The research concludes that the practice of LPM could lead to an increased, or at least more equitable, sharing of power and responsibility for project progress (Feldman & Orlikowski, 2011).

Respondents reported that they had experienced initial resistance from other individuals and teams to adapting to lean practice, not least due to fear of change, negative perceptions of lean, and old-fashioned mind-sets. However, the general consensus was that any initial fears or concerns in adapting to the lean project management approach did not last long. These included further scepticism regarding the time and effort needed for learning about lean principles, processes and practices in project working. However, respondents reported an increase in the satisfaction around the processes of increasing knowledge and understanding of LPM

and a desire to continue, not only within their current projects, but often beyond, including across their employing organisation's operations and new projects.

The research concludes that the perception of value, together with the recognition of the ability of LPM to better manage complexity, enabling project progress through shared understanding, strengthens the relationship between people and practice. This is suggestive of the responsive, adaptive mind-set that Whittingham (2017) asserts is required to increase the capability of social awareness and reflexivity of project management practitioners (Winter et al, 2006). Similarly, the recognition of the implementation of LPM as an emerging practice could have a positive impact on the ability of the organisation to better integrate and improve the knowledge-sharing processes and outcomes (Bechky, 2006; Ivory et al, 2007; Kim & Wilemon, 2007; Feldman & Orlikowski, 2011). LPM was held in high regard in terms of its value and usefulness as a concept, and clear benefits were articulated in terms of its ability to facilitate progress, improvements and communication with stakeholders, to generate savings and achieve targets set. By making a strategic choice to implement LPM as an approach on an ongoing basis, respondents reported a noticeable enhancement in their organisation's reputation. This was prevalent across a number of different industries, but particularly in Construction.

7.2.6 Relevance of lean project management to project learning

Findings could additionally provide an opportunity to embed knowledge of LPM origins, concept and practices to transform individual, project and organisational learning, since its practice offers a unique way of "blurring the boundaries" (Gherardi & Nicolini, 2000; Bechky, 2003; Tsoukas, 2009; Orlikowski, 2010). The influence and importance of LPM has been highlighted through the observations and experiences obtained by the research, which may address the pressures, challenges and

dynamics of projects as organisational forms (Geraldi & Söderlund, 2018; Sydow & Braun, 2018) operating within the VUCA world (Kadefors, 2006; Adrodegari et al, 2015; Omoregie, 2016). This is particularly important in contemporary project environments that are characterised by complexity, inter-disciplinarity and multi-disciplinarity (Thiry, 2014), such as the delivery of major projects, which have a tendency for high failure rates, excess waste, and a failure to learn and improve (Maylor et al, 2015; Holweg & Maylor, 2018).

The definition, meaning and drivers of learning were explored through the Interview Study, and led to the understanding that project learning is concerned with the practical interactions with lean processes, learning through experience, mistakes and problems, but also learning by practice, focusing specifically on solutions to facilitate current and future improvements. Capturing learning in practice was more difficult but was obtained by non-participant observation of LPM in practice, through the Case Study. This was concerned with exploring implementation as a process that facilitated project learning as a potential outcome. The research was able to characterise the mechanisms of project learning and identify if there was a relationship between LPM and PL. This was established and an illustrative framework was created to demonstrate contributing elements. Key aspects of project learning are presented below.

7.2.6.1 Project learning cultivates and sustains knowledge and understanding

It is widely acknowledged that project environments often experience difficulties extracting, distributing and applying learning across both cultural and structural boundaries (Prencipe & Tell, 2001; Bosch-Sijtsema & Postma, 2009), which makes it more difficult to exploit knowledge in such settings. This has led to an increasing expectation of standardised and codified project management knowledge

(Hodgson & Cicmil, 2007; Packendorff & Lindgren, 2014). Learning within projects has long been considered as a functional output (Filstad, 2017), which has failed to consider that project learning is in fact a transformation process, which leads to new outputs and outcomes of knowledge (Bechky, 2003; Jugdev, 2012). However, the process and practice of implementing LPM extends beyond mere acquisition of learning and knowledge (Nonaka & Takeuchi, 1995), providing a basis for context-based, dialogic reflexive learning (Cunliffe, 2002, 2008; Jørgensen & Lauridsen, 2005; Corlett, 2013).

7.2.6.2 Mechanisms of project learning

The research provided evidence to suggest that the mechanisms of learning are expressed as a cyclical process that takes account of social and behavioural processes and practical actions. This facilitates the co-creation of knowledge by engaged stakeholders. The LDMT project illustrated that project team members are aware of the theory but, until they apply it in practice, they have limited knowledge. Learning by doing (implementation) is the quickest route to increased knowledge of lean in PM, according to the experiences reported and observed in the research. This is suggestive of the premise that people learn more by practice than by theory (Pettigrew, 1997). Since knowledge and learning are the most important assets an organisation can have, this must go beyond just the connection and collaboration of different parts; it is the process of learning which is as important, if not more so, as the finite end product of the created knowledge (Blackman & Henderson, 2001; Jugdev, 2012).

7.2.6.3 Processes and practices of project learning

In the research, respondents associated project learning with the practical and social processes that facilitated knowledge as both an outcome and an output, but,

importantly, perceived this as a shared responsibility. This is shared between individuals across organisations, defined and bound by the project context. The connections forged by individuals and their respective multiple organisations strengthen the link between project outcomes and behaviour. These connections promote informal knowledge sharing through lean principles of continuous improvement, learning from mistakes, communication, and engagement with all stakeholders (Womack & Jones, 2003; Hines et al, 2004). This supports Longoni et al's (2013) study, which suggested that team members' perceptions, interactions and understanding of the project and its environment can influence subsequent lean behaviour. The extent to which LPM was responsible for enabling and implementing subsequent lean behaviours within projects (Longoni et al, 2013) was not measured as it was outside the scope of this research, but aspects of knowledge and learning in action were observed in the LDMT project. Team members experienced the practice and processes of lean through reflexive, collaborative planning, capturing knowledge "assets" from visual information sources and reporting of progress, as well as socio-cultural and behavioural interactions. Continual visual and verbal reminders of project goals, meeting agendas, schedules, accepted behavioural practices (e.g. team ground rules), checking understanding, active listening, reflection, response to discussions of progress, and risk factors featured heavily. This included the practice and reflection of visual documentation, including photographic capture of processes. The level of transparency and openness was notable, even where so-called perceptions of "negative" aspects, such as disagreements or dissatisfaction with behaviour, were evident. The surfacing of mistakes, problems and issues was met with an immediate commitment to act, therefore demonstrating the fast processing ability of team members that has been associated with visual means of information (Balm, 2014). Such practices and processes facilitate identification of, and access to, knowledge

in a timely manner (Anbari et al, 2008; Jugdev, 2012), reducing the likelihood of knowledge loss (Kislov et al, 2012).

7.2.6.4 The direction of knowledge

The research concludes that learning from one's own (positive and negative) experiences within LPM is essential for the flow of knowledge across individual, project and organisational boundaries (Sundqvist, 2019). As the flow of knowledge proceeds in different directions, the process and outcomes of knowledge are shared, perceived, interpreted and integrated into existing and new knowledge sets (Watzlawick, 1976; Jugdev & Wishart, 2014). This has the potential to maximise opportunities for both individual, project and organisational learning (Pedler et al, 1989; Korac-Kakabadse et al, 2002). The research concludes that learning and knowledge in LPM is multi-directional – the implementation of LPM can facilitate and promote project and individual learning and, in turn, learning and knowledge support effective LPM practice. Further, evidence illustrates that the traditional place of project learning is shifting from output-driven PM processes to process-driven outcomes, which may overcome the difficulties and challenges of learning that have hitherto inhibited project success (McClory et al, 2017). Findings suggest that knowledge management may enable diversity, uncertainty and continuous change to thrive within projects and organisational environments.

7.2.6.5 Socio-cultural and behavioural interactions drive implementation of lean project management and project learning

In exploring the lived experiences of LPM and PL, the research concludes that the importance and influence of socio-cultural and behavioural aspects cannot be underestimated. These were perceived (and experienced) as barriers to effective implementation of LPM and also as enablers. Resistance to and fear of change were

amongst the barriers that needed to be reduced, whilst team mind-set, shared visions, stakeholder engagement and a supportive culture were suggested as aspects that facilitated effective implementation of LPM. Such supportive culture is above and beyond an expectation of support from senior management and leadership, cutting across position, role and designation. Socio-cultural and behavioural interactions are required in order to facilitate practical actions for project progress, and for generating future improvements. Interactions between stakeholders are connected through the provision of learning opportunities that arise from current and past experience of practice. This illustrates the importance of social and participative learning as an iterative and informal implementation approach (Wenger, 2009) that cuts across boundaries at the functional, task, team and project levels. When these are underpinned by shared responsibility and commitment, this creates and sustains high-quality relationships, facilitating and optimising learning acquisition and exploitation.

7.2.6.6 The mutual benefits of lean project management and project learning

Learning and improvement can take place at any time and place and within any project context, providing mutual benefits, as shown by the findings. New knowledge circulating alongside reflection and understanding enables learning to become embedded into practice. This continually evolves and does not stop at the project level but extends beyond, to organisational learning and wider communities of practice. This is in contrast to Eather et al's (2013) cautionary note that engagement in PDSA cycles for learning is limited to individual transformational and situation-specific learning only, rather than for the overall benefits of the organisation, especially where high staff turnover inhibits a continuous development of the learning culture. Learning from exploration and innovation is most likely to take place within a culture that values knowledge and innovation (Hamel & Pralahad, 1991). This

necessarily involves the discomfort of experiencing uncertainties, risks and ambiguities associated with iterative processes (O'Keeffe, 2002), and this included positive and negative aspects of learning, as shown by the findings.

The research acknowledges that there is more work to be done in order to understand how learners experience the learning process, and to build foundations for sustainable professional behavioural change, including situational and contextual factors (Blume et al, 2010). However, learning opportunities provided by the case study project and echoed by the reported experiences of the respondents suggest that there is a general acceptance and commitment to developing and extending learning and knowledge. Thus, LPM could mitigate the unpredictability of human behaviour as an essential element of project management (Kreiner, 1992) which develops consistency of participation, as well as practice at individual and collective levels (Chen et al, 2012). Strengthening the link between project behaviours and project outcomes also extends the traditional learning curve (Marquardt & Waddill, 2004), which can be supported by improved social and participative levels of practice. This perspective can help us to better understand the role that project learning has on (LPM) practice as well as the impact that LPM has on project learning.

7.3 The Research Question, Aim and Objectives

The research question shown below focused on gaining deeper insight into and improved understanding of the relationship between lean project management (LPM) and project learning (PL). By focusing on the under-researched area of the psycho-social and behavioural aspects within LPM, a contribution to the current knowledge base and literature was intended and achieved.

7.3.1 The Research Question

What are the characteristics of lean project management and how does it facilitate project learning in contemporary project environments?

Research was undertaken through inductive, exploratory, descriptive means to understand the phenomenon, and robust data collection and analysis methods were employed to obtain increased knowledge and understanding. The research generated contributory evidence to illustrate that LPM is a valuable and useful concept, and that it can be used as a facilitator of project learning and beyond.

7.3.2 Aim

The overall aim of the research was to obtain a deeper insight into and understanding of the phenomenon of lean project management, investigating its utility and impact on project learning. Uncovering and exploring the phenomenon as it is perceived and practised in reality affirms the following:

- The research found that LPM enables shared understanding of individual and project needs, underpinned by team mind-set, shared vision, knowledge and understanding of lean, and a supportive culture across all levels of seniority. These elements serve as both a barrier and an enabler to the effective implementation of LPM as well as the providing the ability to address complexities and uncertainties in projects.

- LPM strengthens the relationship between people and practice, which then facilitates lean thinking behaviours, and the desire to learn and practise lean. Behaviours can be established across social, cultural, project and organisational

boundaries and facilitate individual and project learning, incrementally, iteratively and on a continuous basis.

- The reflexive, valuable, context-based experiences and processes of LPM extend the traditional learning curve, not only bridging the gap between know-what and know-how, but also strengthening know-why. Further opportunities are then created for wider learning, such as organisational learning, and the development of multiple communities of practice.

- Three important and underlying drivers which impact on project learning were found to be leadership and senior management support, knowledge and understanding of lean, and socio-cultural and behavioural interactions. The ways in which these drivers interact depend on contextual factors within the project's contextual environment, which similarly could facilitate, or hinder learning practice and processes.

Through exploration of a lean approach, the research aimed to demonstrate utility and feasibility to strengthen the link between project management and project learning as well as best practice:

- This was achieved by conducting a qualitative, holistic, single case study within a specific project where the phenomenon of interest was underway.

- The case study project demonstrated the characteristics of project learning of individuals, functional teams and the project as a whole. Multiple sources of evidence from interview, observational data, image and documentation analysis illustrated clear practical interaction with lean processes, learning through experience, and focusing on solutions for multiple mutual benefit through collaboration and dialogue.

- LPM provided a platform as well as the content for learning within the case study project, through supportive and meaningful data-capture mechanisms, meeting activities and a collective responsibility for learning. Opportunities to learn and increase the knowledge base were acknowledged by team members and it was a common expectation that learning would take place. Individuals expected to play a role as both a provider and a recipient of knowledge and learning.

- Findings following data collection were presented and discussed thematically, leading to conclusions which further support the value and utility of LPM.

- LPM was characterised and articulated as an approach which extended and improved upon traditional project management generally by its ability to better manage complexity and track progress.

- Through its values-based philosophical approach, LPM specifically demonstrates value by the way in which it connects practitioners, strengthening the relationship between people and practice, creating a safe space for learning to take place.

- LPM enabled essential project knowledge to be easily captured, accessed and exploited, enabling learning as well as practice to flourish. This included 'negative' as well as pleasant experiences, which led to behaviour adjustment, as well as faster recognition and actions in line with changing or evolving circumstances.

- Recommendations for further development and application of LPM research have been presented based on the consideration of the findings. Concluding

remarks suggest how this meets the needs of contemporary project management, as espoused by extant literature.

7.3.3 Objectives

The following objectives are re-presented and demonstrate achievement in a number of ways. The first objective was to identify and assess lean project managers' baseline knowledge and understanding of the principles of lean project management and project learning:

- Findings have been presented and have developed the "state of the art" of these principles.
- The most significant aspects arising from analysis of the findings revealed the value and appetite for the concept of LPM, characteristics of and drivers for the mechanisms of project learning, and the changing place of project learning within project management.
- The research established important evidence to support socio-cultural and behavioural elements of learning to maximise and optimise knowledge acquisition and exploitation.
- Socio-cultural behaviours influence the willingness and transparency of individuals to practise and generate improvements within the project and its environment.

The second objective was to explore the lived experience of lean project management and project learning in practice by project stakeholders:

- Project stakeholders have articulated their lived experiences and described project learning within their practice, generating a rich picture through statements.

- Appropriate, suitable, and robust processes and methods were employed in the research endeavour, providing a safe space for participants to respond, reflect and contribute to data collection and analysis. This has enabled increased knowledge and understanding of the phenomenon and has established an important foundation for the illustrative framework.

The third objective was to assess the role and contribution of factors such as business setting, environment and discipline in the implementation of lean project management and project learning:

- This was explored and analysed through demographic data collection and presented with relevant patterns and trends.

- Demographic data provided a sense of the characteristics and nature of the dataset, building a picture of the sample population and characteristics of demographic attributes.

- The wide distribution and spread of demographic attributes (age, gender, organisational size, industry, country) and high numbers of unique organisations represented within the dataset, should enable a high degree of confidence in and reliability of the data collection and analysis methods employed in the research endeavour.

- Almost 2400 "segments of text", referred to as statements within the findings chapter (Five), generated 181 coding references, leading to three overarching

themes. To make sense of this amount of data, the researcher undertook several iterations of analysis. The most significant statements have been used as evidence within the research, but word limitations prevent inclusion of more.

- Patterns and trends were established where possible; for example, the near-even distribution of participants located in the UK (16) and Germany (20) enabled some comparison for the Construction industry. Unless otherwise indicated, many themes cut across demographic attributes, and findings from this dataset suggest no discernible or significant patterns or trends for age, industry or role.

The final objective, and the intended output of the research, was to develop an illustrative framework for understanding the relationship between lean project management and project learning:

- The research endeavour considered key information and data from chapters One to Five, and, following further sense-making, reflection and discussion, produced an illustrative framework at the end of Chapter Six (Figure 6.12).

- The framework is presented as a specific output of the research and articulated as a relationship, following exploration of the interplay between lean project management and project learning.

7.4 Contribution to knowledge

The research contributes to both the theoretical field and the practice of project management, demonstrating the influence and importance of Lean Project Management to survive the challenges of uncertainty and complexity and to thrive on them. Prior literature has acknowledged the difficulties in extracting, distributing and applying project knowledge across cultural and structural boundaries (Prencipe

& Tell, 2001; Bosch-Sijtsema & Postma, 2009), and that discursive processes and practice are needed to improve project outcomes beyond successful execution alone (Packendorff & Lindgren, 2014). This has been partly addressed by the recognition that situation-specific issues such as complexity need to be integrated with project management (Hällgren & Söderholm, 2018). Jugdev and Wishart (2014) recommended a processual approach to improving tacit knowledge sharing, but the literature investigating the experience and effect of practice-based initiatives is limited. Where it does exist, some positive trajectories have been observed in facilitating the desired change (Kasasbeh et al, 2016). Scholars and practitioners continue to recognise and value the practice and process of learning (APM, 2012; Maylor et al, 2018; PMI, 2018) and the importance and principles of lean as a driver for project management; additionally, a strategic capability has been highlighted more recently (Gosling, 2019). In particular, lean as a method with its associated models and tools has been well developed, often focused on specific disciplines (Construction and Engineering, for example), but aiming to help general PM practitioners (Seymour, 2014; Sydow & Braun, 2018), which has been deemed to raise the profile of learning and knowledge (McClory et al, 2017).

7.4.1 Theoretical Contribution

What none of the literature has been able to provide is a significant link between **lean** and **learning** within project management**.** Thus, by exploring the concept and utility of lean project management, and its impact on project learning, credible evidence has been provided which helps to establish the link. The research undertaken connects knowledge, understanding and practice of lean with LPM and PL. Additionally, the development of the practice of LPM through the concept of project learning has been evidenced as a desirable outcome as well as an intended output.

The research has demonstrated how using practice theory as a theoretical lens to examine the socially constructed reality of project learning within practice illuminates and supports the principle that social actions are consequential, interdependent and grounded in human agency (Feldman & Orlikowski, 2011). Hence, the practice of project learning underpinned by a lean approach could lead to an increased, or at least more equitable sharing of responsibility for project progress (*ibid*.).

The combination of theory and practice, and the exploration of this interaction within a context-specific environment, addresses the requirements and challenges espoused by earlier scholars. Exploring the interplay between LPM and PL has led to a comprehensive understanding of the characteristics of both LPM and PL individually and collectively. The way in which LPM and PL influence and impact on each other has also been better understood, and the result of this is the establishment of an illustrative relationship demonstrating this interplay. LPM remains an emerging concept, but its suitability and utility as an approach that facilitates project learning is clear from this research. Findings suggest that there are patterns and trends in the implementation of LPM and its approach to project learning that are relevant across a number of disciplines, as well as across multiple demographic attributes. This is encouraging, as it provides a foundation or baseline from which to explore further and enhance the development of the project management discipline (Winter et al, 2006; Svejvig & Andersen, 2015; Geraldi & Söderlund, 2018; Maylor et al, 2018).

7.4.2 Practical contribution

In terms of practice relevance, the research evidence provided could enable practitioners of project management to consolidate their understanding of LPM as a concept as well as recognise its ability to sustain collaborative, mutually beneficial

working relationships in a VUCA world. This could also be facilitated by an increased recognition of the importance of informal training, skills and knowledge acquisition in the following ways:

- A knowledge audit could be undertaken at the project team development stage, to support an effective relationship with learning that is underpinned by the principles of continuous improvement at the individual and project levels.
- Project leaders and senior management could additionally improve their knowledge by undertaking one-off workshops or training with respect to enhancing their understanding of lean concepts. This could increase trust and engender respect within the team if decision-making from senior levels is aligned with up-to-date and relevant knowledge.

7.5 Limitations

Like all research projects, this research has certain limitations which need to be acknowledged and addressed. The study was focused on purposive sampling, which was used to recruit and select the interview participants. This was initially based on the established professional and personal contacts of the researcher and, to some extent, snowballing based on the perceptions of other participants regarding the suitability of potential recruits known to their networks. Forty participants were interviewed, although saturation was reached around 27 participants. Many participants were sourced from Construction, and this was the only industry where the sample size afforded comparison between countries (UK and Germany). No other comparison was possible due to the low numbers of participants representing other industries.

In the case study project, there were 15 members of the team, and, despite repeated attempts to solicit responses, only four were interviewed. This was disappointing,

although this limited number nevertheless provided rich data and was compensated by additional sources, such as observational meeting notes, photographs and project documentation. All sources of evidence contributed to and supported the conclusions of the study.

Both the interview study and single case study design revealed the intended exploration of the lived experiences sought. Since the focus of the case study design was to explore and investigate relationships, processes and dynamics of the phenomenon, the research does not claim theoretical generalisability (Tsang, 2014). However, it can offer inference based on transferability and comparability (Chreim et al, 2007). The context of the research is unique to the case study project and highlighted the depth and detail necessary for capturing the "how's and why's" of the phenomenon (Tsang, 2014, p374). This potentially offers opportunities and resonance for other practitioners in similar contexts to generate improvements in practice by identifying, comparing and contrasting findings within this research (Graebner, 2009).

The illustrative framework generated by exploring the social processes, knowledge, understanding and implementation of lean project management together with project learning is provided as an initial framework. No validation or sharing of this framework has been undertaken and it remains an output of the research which is, at the time of writing, not validated. However, this provides an opportunity for future research to investigate further, building on the understanding of this relationship.

7.6 Recommendations for further research

In order to enhance learning within and across projects, more detailed **enablers** which are favourable for learning actions need to be further identified and investigated. Welch et al's (2013) concerns with actions and practice demonstrate the need to balance the notion of "closing" learning loops and cycles while retaining openness and continuity. The research established the foundation for this by demonstrating the existence of multiple (and mutually beneficial) loops. However, these loops need to be permeable to allow new ideas, innovations and creativity in, so that new knowledge can be enhanced and exploited as quickly as possible.

The LPM approach explored in this research has suggested that there is a strengthened link between beneficial project **outcomes and behaviour**. Additional research on this type of approach may help to further close the gap between theory and practice (Bensimon et al, 2004) and between designing, measuring and linking behavioural outcomes, offering an innovative alternative to traditional forms of learning for sustainable change (Turner & Heneberry, 2013).

The research has highlighted the need to recognise and align social processes and behaviours required to encourage and motivate knowledge sharing and learning. Respondents within the research generally accepted that learning was required and expected, even with the negative or less pleasant aspects of learning that were often experienced. It would be useful to explore learning **behaviours** within projects, but at the same time it is acknowledged that these are difficult to capture and articulate. Further investigation and exploration of reflexivity for self and others, talking, reading and writing, through a process of reflexive conversations could enable practitioners to articulate tacit knowledge and reframe it. Reframing can lead to theoretical knowledge which is publishable (Lawless et al, 2014).

The research suggested that learning within projects was also characterised by **informal training**, one-off study days and workshops, and this appeared favourable compared to formal training or certification. However, further investigation could reveal the type of informal training provided (or required) specifically in lean project management, rather than project management with lean aspects.

One observation from collecting data on (any) **project management qualifications** revealed a low number of respondents either willing to discuss or holding professional-level certification. The apparent lack of such certification did not appear to impact on their role or seniority therefore, this could suggest that qualifications are less important than experience. However, further research could explore the reasons behind this, or at least determine any patterns or trends in specific industries.

Finally, the researcher continues to carry out further research in her ongoing role as Co-ordinating Project Manager and WP3 co-lead in the EU H2020 MSCA Research and Innovation Staff Exchange (RISE) grant, which is a collaborative research project in Lean Project Management (2017-2021). Several joint papers have already been published in journals and via conference activity and further work is planned; for example, the role of consultants in the application of LPM in the Construction industry across the UK, Germany, Switzerland and Malaysia.

7.7 Summary Conclusions and Recommendations

This concluding chapter provided an overview of the relevance of the results of the research conducted through the interview study and case study. A number of themes were identified and an illustrative framework to demonstrate the relationship between lean project management and project learning contributed to the relevance to knowledge and practice. The approaches taken enabled the research question, aims and objectives to be addressed robustly and appropriately, leading to conclusions

which can be considered as having delivered the intended insight into lean project management and impacts on project learning. The findings and resulting illustrative framework constitute a unique contribution to the existing body of knowledge in project management knowledge and practice. By acknowledging the limitations of this work and areas of future potential research, the researcher anticipates that the research will afford an opportunity for debate and further development within the project management community.

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Appendix A

PARTICIPANT INFORMATION SHEET - INTERVIEWS

Title of Research Project: L**ean Project Management & Organisational Learning: an exploratory study within complex project environments (LJMU ETHICS REF: 18/LBS/008)**

Name of Researcher and School/Faculty: **Jane Dowson, Liverpool Business School**

You are being invited to take part in a research study which seeks to better understand the relationship between Lean Project Management and Organisational Learning. Before you decide it is important that you understand why the research is being done and what it involves. Please take time to read the following information. Ask us if there is anything that is not clear or if you would like more information. Take time to decide if you want to take part or not. This study has been registered with, and approved by Liverpool John Moores University Ethics Committee, whose contact details are given at section 7. Thank you for reading this.

1. What is the purpose of the study?

The advancement of project management (PM) knowledge and development of PM capability of people is crucial to the successful delivery of projects. Complex projects can be viewed as temporary learning organisations, and a process through which people collaborate to produce the intended product or service. Understanding performance and success within Project Management is not new, but projects continue to be described as failing, despite many traditional, established PM tools and techniques. Lean Project Management (LPM) is an approach which focuses on delivery, improving communication between stakeholders and eliminating waste and has been identified as useful in helping to learn lessons, rather than lose them, especially in complex environments. We want to understand better the relationship between Lean project management and organisational Learning, which may help projects and organisations to keep pace with the challenges being faced.

2. Why have I been chosen to take part?

You are being asked to take part in this research because you have been identified as a person with experience of working in Lean Project Management. This could be as part of a project team, supplier or client of a specific project/s and the role you have played or are currently playing as part of the process that delivers the project's objectives. Your insights are important and may help us to answer important questions about how processes of learning within Lean Project Management occur.

3. What are the possible risks or benefits of taking part?

There are no anticipated risks involved. In taking part, your opinions and current practices in relation to project management can provide useful insights which help us to better understand the practice of Lean Project Management. We hope that the opportunity to reflect and record your thoughts via participation may help to support your individual personal goals and that the experience of participation may benefit your overall professional practice and career. All participants will benefit by receiving a summary of the research findings should they so wish.

4. How will the study be conducted?

You may be interviewed by the researcher on a one-to-one basis, either face to face or via video/teleconference. This will most likely be undertaken at your work premises or, if not, at another location of your choice. Interviews will take place between May 2018 and September 2019. The interview is expected to last around 1 hour. The researcher may use audio recording to aid with memory recall and will also take field notes. Permissions via written consent form will be sought prior to participants undertaking any interviews. This will also include a confirmation that you are in a position to authorise the research to take place on work premises and during working hours, if applicable. We will also ask you to complete a demographic form (which will not contain your name, or your organisation) so that we can establish relevant patterns and trends following data analysis, for the whole study. You are under no obligation to complete this, but should you wish to do so, please return together with the Consent Form.

5. Do I have to take part in this research?

No. It is up to you to decide whether or not to take part. It is entirely voluntary. If you do, you will be given this information sheet and asked to sign a consent form. You are still free to withdraw at any time and without giving a reason or explanation. Your responses up to the period of the withdrawal may be used, if you are happy for this to be done. Otherwise all your data will be removed from the project and no further use will be made of them. You may also request a copy of any data held that you have provided.

6. What will happen if I take part?

The researcher will contact you to take part in a one-to-one interview. With your permission, activities may be audio -recorded, and notes taken. Capturing the contents of data collection is important so that content can be reviewed, and themes, patterns or trends can be explored. This may help to answer the research questions of the study.

7. What if I am unhappy?

If you have any concerns regarding your involvement in this research, please discuss these with the researcher in the first instance. If you wish to make a complaint, please contact researchethics@ljmu.ac.uk and your communication will be re-directed to an independent person as appropriate.

8. Will my taking part in the study be kept confidential?

Yes. All data will be treated in confidence and anonymised so that no individual or their organisation will be identifiable in subsequent publications of the research findings. The research is conducted according to current ethical and legal practice guidelines. Data you provide will be stored on a password-protected recording device and transferred to the researcher's secure LJMU server, then removed from the recording device as soon as possible. Written field notes, completed Consent and Demographic forms will be stored in a locked cabinet on LJMU premises, as soon as the researcher returns from the site of data collection (if not at LJMU). However, we may need to breach confidentiality for any issues that may arise where we have a statutory duty to disclose. For example, if during the course of a interview, issues of malpractice, fraud are identified, the researcher will report the 'incident' in line with risk and governance arrangements operating within your organisation and refer to LJMU legal guidance where appropriate. If the researcher discovers, or is alerted to, any potential risk of indirect identification of your data to you, you will be contacted so that arangements can be agreed with you to mitigate the risk. e.g. changing wording on responses, withdrawing any quotes.

9. Expenses and/or payments

There will be no formal reimbursements available in this study. If you are asked to attend an activity that takes place outside of your working day, or at a venue that is not your usual place(s) of work, we may be able to provide some travel expenses, subject to LJMU financial policy. If this is required, this will be confirmed in advance of the activity and will include the exact amount and how any reimbursement will be made.

10. What will happen to the results of the study

All of the information that is collected will be brought together and analysed, to help understand participants' perceptions, and their experiences of Lean Project Management and Organisational Learning. Results will be published in academic and practitioner papers and at appropriate and relevant national and international project management and organisational learning conferences and workshops. The main results of the study will form part of a thesis for the consideration of the award of PhD in the Autumn of 2020. Results may also be communicated on LJMU social media, website and other publications.

This study has received ethical approval from LJMU's Research Ethics Committee: 18/LBS/008– date of approval: 17th May 2018

Contact details of researcher

Jane Dowson, PhD candidate, Liverpool Business School
Redmonds Building, Brownlow Hill, Liverpool, L3 5UG
T: 01512313800 e: j.dowson@2014.ljmu.ac.uk

Appendix B

PARTICIPANT CONSENT FORM - INTERVIEWS

Title of Research Project: **Lean Project Management & Organisational Learning: an exploratory study within complex project environments (LJMU ETHICS REF: 18/LBS/008)**
Name of Researcher and School/Faculty: **Jane Dowson, Liverpool Business School**

I agree to participate in a research project led by Liverpool John Moores University. The purpose of this document is to specify the terms of my participation in the project through being interviewed.

1. I confirm that I have read and understand the information sheet INT version 1, dated 18.4.2018. provided for the above study, I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect my legal rights. I confirm I am authorised to undertake this research on work premises and during working hours. In addition, should I not wish to answer any particular questions, I am free to decline. ☐

3. I understand that any personal information collected during the study will be anonymised and remain confidential. I give permission for members of the research team to have access to my anonymised responses. ☐

4. I understand that my participation in the above study may be audio recorded and I am aware of, and consent, to your use of these recordings for the following purposes: transcription and analysis of data; use of anonymised, verbatim direct quotations in any research publications or presentations. In the event or risk that I may be indirectly identified as part of the study, I agree to the research team contacting me to agree mitigation measures. I am happy to proceed. ☐

5. In the event that I withdraw from this study, I confirm that I am happy for any data that I have already submitted to be used. ☐

6. I understand that control and processing of the research data will be compliant with the provisions of the GDPR (2018), and that I can at any time, ask for access to the information I provide. ☐

7. I agree to take part in the above study. ☐

_____	_____	_____
Name of **Participant**	Date	Signature
_____	_____	_____
Name of **Researcher**	Date	Signature

For further information: Research Supervisor: Dr Christine Unterhitzenberger, Senior Lecturer in Project Management, Liverpool Business School t: 01512313672 e: c.unterhitzenberger@ljmu.ac.uk

Appendix C

INTERVIEW QUESTIONS

Lean Project Management & Organisational Learning: an exploratory study within complex project environments

Researcher: Jane Dowson, Liverpool Business School, Liverpool John Moores University, Redmonds Building, Brownlow Hill, Liverpool, L3 5UG

Email: j.dowson@2014.ljmu.ac.uk

Supervisors: Dr C Unterhitzenberger, Prof D Bryde

1. What is your understanding of Lean Project Management?
2. How do you measure progress in projects managed by lean principles?
3. How is progress recorded?
4. How could LPM enable more progress within your environment?
5. What in your opinion are the barriers to implementing LPM in projects?
6. How would you define learning from projects managed by lean principles?
7. When and how does this take place? By whom?
8. What is your understanding of Organisational Learning?

Appendix D

PARTICIPANT INFORMATION SHEET – NON-PARTICIPANT OBSERVATION

Title of Research Project: L**ean Project Management & Organisational Learning: an exploratory study within complex project environments (LJMU ETHICS REF: 18/LBS/008)**

Name of Researcher and School/Faculty: **Jane Dowson, Liverpool Business School**

You are being invited to take part in a research study which seeks to better understand the relationship between Lean Project Management and Organisational Learning. Before you decide it is important that you understand why the research is being done and what it involves. Please take time to read the following information. Ask us if there is anything that is not clear or if you would like more information. Take time to decide if you want to take part or not. This study has been registered with, and approved by Liverpool John Moores University Ethics Committee, whose contact details are given at section 7. Thank you for reading this.

1. What is the purpose of the study?

The advancement of project management (PM) knowledge and development of PM capability of people is crucial to the successful delivery of projects. Complex projects can be viewed as temporary learning organisations, and a process through which people collaborate to produce the intended product or service. Understanding performance and success within Project Management is not new, but projects continue to be described as failing, despite many traditional, established PM tools and techniques. Lean Project Management (LPM) is an approach which focuses on delivery, improving communication between stakeholders and eliminating waste and has been identified as useful in helping to learn lessons, rather than lose them, especially in complex environments. We want to understand better the relationship between lean project management and organisational learning, which may help projects and organisations to keep pace with the challenges being faced.

2. Why have I been chosen to take part?

You are being asked to take part in this research because you have been identified as a person with experience of working in Lean Project Management. This could be as part of a project team, supplier or client of a specific project/s and the role you have played or are currently playing as part of the process that delivers the project's objectives. Your insights are important and may help us to answer important questions about how processes of learning within Lean Project Management occur. The person acting as Project Manager for the specific project we are looking at will have already identified the project, but it is still entirely up to you, as an individual, if you would like to be included.

3. What are the possible risks or benefits of taking part?

There are no anticipated risks involved. In taking part, your opinions and current practices in relation to working within project management can provide useful insights which help us to better understand the practices, processes and approaches. We hope that the opportunity to join the research may help to support your individual personal goals and that the experience of inclusion may benefit your overall professional practice and career. All participants will benefit by receiving a summary of the research findings, should they so wish.

4. How will the study be conducted?

You may be observed as part of a wider project meeting where the researcher will attend and observe interactions between meeting participants. This is known as "non-participant observation." In these instances, this does not involve analysing your personal or individual opinions. The researcher is interested in the type of interaction within the meeting, the topic(s) discussed, any follow-up actions that are agreed and the way in which discussions took place. The purpose of this is to observe patterns, trends and themes associated with the content being discussed, and the role of the participants, but not the person or individual interacting. This will most likely be undertaken at your work premises or, if not, at another location, depending upon the project being explored. This is likely to take place between May 2018 and September 2019. The duration of non-participant observation is difficult to estimate, depending on the duration of the meeting being observed, but likely to last up to 4 hours.

The researcher may use audio recording to aid with memory recall, and will also take field notes. The researcher may be present in one or more meetings associated with a specific project. Permissions via written consent form will be sought prior to participants undertaking any such activity.

We will also ask you to complete a demographic form (which will not contain your name and organisational name) so that we can establish any relevant patterns or trends following data analysis for the whole study. You are under no obligation to complete this, but should you wish to please return together with the Consent Form.

5. Do I have to take part in this research?

No. It is up to you to decide whether or not to take part. It is entirely voluntary. If you do, you will be given this information sheet and asked to sign a consent form. You are still free to withdraw at any time prior to non-participant observation activities taking place. You do not need to give a reason or explanation. If you decide you do not wish to participate in the activity, but still require to be present and active in the meetings, your responses will be included within the recording but will not be used. Due to the complexity of recording only specific individuals within a group discussion, all responses will be recorded, but only responses from those who have consented will be used in data analysis. To separate those individuals who have consented/not consented, the researcher will allocate "codes" for each type of individual response (e.g. Consent/non-Consent) and when transcribing, will only use data from those fully consented to responses being included. All recordings will be removed once transferred to LJMU secure server, as outlined below in section 8. Your decision to take part or not, will only be known to the researcher, and not to the Project Manager or any other participants, unless you choose to divulge this yourself.

6. What will happen if I take part?

The researcher will contact you to take part in non-participant observation. With your permission, activities may be audio recorded, and notes taken. Capturing the contents of data collection is important so that content can be reviewed, and themes, patterns or trends can be explored. This may help to answer the research questions of the study.

7. What if I am unhappy?

If you have any concerns regarding your involvement in this research, please discuss these with the researcher in the first instance. If you wish to make a complaint, please contact researchethics@ljmu.ac.uk and your communication will be re-directed to an independent person as appropriate.

8. Will my taking part in the study be kept confidential?

Yes. All data will be treated in confidence and anonymised so that no individual or their organisation will be identifiable in subsequent publications of the research findings. The research is conducted according to current ethical and legal practice guidelines. Data you provide (whether included or excluded from analysis) will be stored on a password-protected recording device and transferred to the researcher's secure LJMU server, then removed from the recording device as soon as possible. Written field notes, completed Consent and Demographic forms will be stored in a locked cabinet on LJMU premises, as soon as the researcher returns from the site of data collection (if not at LJMU). However, we may need to breach confidentiality for any issues that may arise where we have a statutory duty to disclose. For example, if during the course of an observation, issues of malpractice, fraud are identified, the researcher will report the 'incident' in line with risk and governance arrangements operating within your organisation and refer to LJMU legal guidance where appropriate. If the researcher discovers, or is alerted to, any potential risk of indirect identification of your data to you, you will be contacted so that arrangements can be agreed with you to mitigate the risk, e.g. changing wording on responses, withdrawing any quotes.

9. Expenses and/or payments

There will be no formal reimbursements available in this study. If you are asked to attend an activity that takes place outside of your working day, or at a venue that is not your usual place(s) of work, we may be able to provide some travel expenses, subject to LJMU financial policy. If this is required, this will be confirmed in advance of the activity and will include the exact amount and how reimbursement will be made.

10. What will happen to the results of the study

All of the information that is collected will be brought together and analysed to help understand participants' perceptions and their experiences of Lean Project Management and Organisational Learning. Results will be published in academic and practitioner papers and at appropriate and relevant national and international project management and organisational learning conferences and workshops. The main results of the study will form part of a thesis for the consideration of the award of PhD in the Autumn of 2020. Results may also be communicated on LJMU social media, website and other publications.

This study has received ethical approval from LJMU's Research Ethics Committee: 18/LBS/008 – date of approval: 17th May 2018

Contact details of researcher

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Appendix E

PARTICIPANT CONSENT FORM – NON-PARTICIPANT OBSERVATION

Title of Research Project: **Lean Project Management & Organisational Learning: an exploratory study within complex project environments (LJMU ETHICS REF:18/LBS/008)**
Name of Researcher and School/Faculty: **Jane Dowson, Liverpool Business School**

I agree to participate in a research project led by Liverpool John Moores University. The purpose of this document is to specify the terms of my participation in the project through being a member of non-participant observation activities.

1. I confirm that I have read and understand the information sheet N-P OBS, version 1, dated 18.4.2018. provided for the above study, I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect my legal rights. In addition, should I not wish to answer any particular questions, I am free to decline. ☐

3. I understand that any personal information collected during the study will be anonymised and remain confidential. I give permission for members of the research team to have access to my anonymised responses. ☐

4. I understand that my participation in the above study may be audio recorded and I am aware of, and consent, to your use of these recordings for the following purposes: transcription and analysis of data; use of anonymised, verbatim direct quotations in any research publications or presentations. In the event or risk that I may be indirectly identified as part of the study, I agree to the research team contacting me to agree mitigation measures. I am happy to proceed. ☐

5. In the event that I withdraw from this study, I confirm that I am happy for any data that I have already submitted to be used. ☐

6. I understand that control and processing of the research data will be compliant with the provisions of the GDPR (2018), and that I can, at any time, ask for access to the information I provide. ☐

7. I agree to take part in the above study. ☐

_____	_____	_____
Name of **Participant**	Date	Signature
_____	_____	_____
Name of **Researcher**	Date	Signature

For further information: Research Supervisor: Dr Christine Unterhitzenberger, Senior Lecturer in Project Management, Liverpool Business School t: 01512313672 e: c.unterhitzenberger@ljmu.ac.uk

Appendix F

PARTICIPANT INFORMATION SHEET – DOCUMENT ANALYSIS

Title of Research Project: L**ean Project Management & Organisational Learning: an exploratory study within complex project environments (LJMU ETHICS REF: 18/LBS/008)**

Name of Researcher and School/Faculty: **Jane Dowson, Liverpool Business School**

You are being invited to take part in a research study which seeks to better understand the relationship between Lean Project Management and Organisational Learning. Before you decide it is important that you understand why the research is being done and what it involves. Please take time to read the following information. Ask us if there is anything that is not clear or if you would like more information. Take time to decide if you want to take part or not. This study has been registered with, and approved by Liverpool John Moores University Ethics Committee, whose contact details are given at section 7. Thank you for reading this.

1. What is the purpose of the study?

The advancement of project management (PM) knowledge and development of PM capability of people is crucial to the successful delivery of projects. Complex projects can be viewed as temporary learning organisations, and a process through which people collaborate to produce the intended product or service. Understanding performance and success within Project Management is not new, but projects continue to be described as failing, despite many traditional, established PM tools and techniques. Lean Project Management (LPM) is an approach which focuses on delivery, improving communication between stakeholders and eliminating waste and has been identified as useful in helping to learn lessons, rather than lose them, especially in complex environments. We want to understand better the relationship between Lean project management and organisational Learning, which may help projects and organisations to keep pace with the challenges being faced.

2. Why have I been chosen to take part?

You are being asked to take part in this research because you have been identified as a person whose organisation has experience of working in Lean Project Management. This could be as part of a project team, supplier or client of a specific project/s and the organisation you represent is currently part of the process that delivers the project's objectives. Your organisations background and insights are important and may help us to answer important questions about how processes of learning within Lean Project Management occur.

3. What are the possible risks or benefits of taking part?

There are no anticipated risks involved. In taking part, the background of your organisation, and any documents included within the selected project may provide useful insights which help us to better understand the practice of Lean Project Management. We hope that the opportunity to be included in this research gives the organisation an interest in research about learning processes within projects and its' potential usefulness as an organisational approach for wider learning. All participants will benefit by receiving a summary of the research findings, should they so wish.

4. How will the study be conducted?

You may be asked to provide organisational documentation that is outside of the public domain. This may include organisational strategy documentation, project-related documentation e.g. Agendas, Action notes, or Minutes, project charts and key performance indicator information. This will be discussed with the Researcher and you will decide what you feel is appropriate to share on behalf of your organisation. This will most likely be undertaken at your work premises or, if not, at another location of your choice. Discussions with the researcher will take place between May 2018 and September 2019. The discussion will be informal and is expected to last around 1 hour. The researcher may use audio recording to aid with memory recall and will also take field notes. Permissions via written consent form will be sought prior to your agreement to providing any such documentation. We will also ask you to complete a demographic form (which will not contain your name, or your organisation) so that we can establish any relevant patterns and trends following data analysis for the whole study. You are under no obligation to complete this, but should you wish to, please return together with the Consent Form.

5. Do I have to take part in this research?

No. It is up to you to decide whether or not to take part. It is entirely voluntary. If you do, you will be given this information sheet and asked to sign a consent form. You are still free to withdraw at any time and without giving a reason or explanation. Your responses up to the period of the withdrawal may be used, if you are happy for this to be done. Otherwise your organisation's data will be removed from the projectand no further use will be made of them. You may also request a copy of any data held that you have provided on behalf of your organisation.

6. What will happen if I take part?

The researcher will contact you to take part in a one-to-one, informal discussion. With your permission, discussions may be audio recorded, and notes taken. Capturing the contents of data collection is important so that content can be reviewed, and themes, patterns or trends can be explored. This may help to answer the research questions of the study.

7. What if I am unhappy?

If you have any concerns regarding your organisation's involvement in this research, please discuss these with the researcher in the first instance. If you wish to make a complaint, please contact researchethics@ljmu.ac.uk and your communication will be re-directed to an independent person as appropriate.

8. Will my taking part in the study be kept confidential?

Yes. All data will be treated in confidence and anonymised so that no individual or their organisation will be identifiable in subsequent publications of the research findings. The research is conducted according to current ethical and legal practice guidelines. Data you provide will be stored on a password-protected recording device and transferred to the researcher's secure LJMU server, then removed from the recording device as soon as possible. Written notes, documents, Consent and Demographic forms will be stored in a locked cabinet on LJMU premises, as soon as the researcher returns from the site of data collection (if not at LJMU). However, we may need to breach confidentiality for any issues that may arise where we have a statutory duty to disclose. For example, if during the course of a discussion, or during document analysis, issues of malpractice and/or fraud are identified, the researcher will report the 'incident' in line with risk and governance arrangements operating within your organisation and refer to

LJMU legal guidance where appropriate. If the researcher discovers, or is alerted to, any potential risk of indirect identification of your data to you, or your organisation, you will be contacted so that arrangements can be agreed with you to mitigate the risk e.g. changing words, removing data, quotes.

9. Expenses and/or payments

There will be no formal reimbursements available in this study. If you are asked to attend an activity that takes place outside of your working day, or at a venue that is not your usual place(s) of work, we may be able to provide some travel expenses, subject to LJMU financial policy. If this is required, this will be confirmed in advance of the discussion or document analysis activity taking place and will include the exact amount and how any reimbursement will be made.

10. What will happen to the results of the study

All of the information that is collected will be brought together and analysed to help understand perceptions and experiences of Lean Project Management and Organisational Learning. Results will be published in academic and practitioner papers and at appropriate and relevant national and international project management and organisational learning conferences and workshops. The main results of the study will form part of a thesis for the consideration of the award of PhD in the Autumn of 2020. Results may also be communicated on LJMU social media, website and other publications.

This study has received ethical approval from LJMU's Research Ethics Committee: 18/LBS/008 – date of approval: 17th May 2018

Contact details of researcher

Jane Dowson, PhD candidate, Liverpool Business School
Redmonds Building, Brownlow Hill, Liverpool, L3 5UG
T: 01512313800 e: j.dowson@2014.ljmu.ac.uk

Appendix G

GATEKEEPER CONSENT FORM – DOCUMENT ANALYSIS

Title of Research Project: **Lean Project Management & Organisational Learning: an exploratory study within complex project environments (LJMU ETHICS REF: 18/LBS/008)**
Name of Researcher and School/Faculty: **Jane Dowson, Liverpool Business School**

I agree to participate in a research project led by Liverpool John Moores University. The purpose of this document is to specify the terms of organisational participation in the project through enabling access to organisational documentation.

1. I confirm that I have read and understand the information sheet DOC version 1, dated 7.5.2018. provided for the above study, I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that organisational participation is voluntary and that I am free to withdraw the organisation at any time, without giving a reason and that this will not affect my legal rights. In addition, should I not wish to provide any particular documentation, I am free to decline. ☐

3. I understand that any personal information collected during the study will be anonymised and remain confidential. I give permission for members of the research team to have access to anonymised information obtained through documentation. ☐

4. I am aware of, and consent, to your use of any such organisational information for the following purposes: transcription and analysis of data; use of anonymised, verbatim direct quotations in any research publications or presentations. In the event or risk that my organisation, or I may be indirectly identified as part of the study, I agree to the research team contacting me to agree mitigation measures. I am happy to proceed on behalf of my organisation. ☐

5. In the event that I withdraw my organisation from this study, I confirm that I am happy for any data that that has been submitted to be used. ☐

6. I understand that control and processing of the research data will be compliant with the provisions of the GDPR (2018), and that I can at any time, ask for access to the information provided by my organisation. ☐

7. I agree that my organisation can take part in the above study. ☐

_____	_____	_____
Name of **Gatekeeper**	Date	Signature
_____	_____	_____
Name of **Researcher**	Date	Signature

For further information: Research Supervisor: Dr Christine Unterhitzenberger, Senior Lecturer in Project Management, Liverpool Business School t: 01512313672 e: c.unterhitzenberger@ljmu.ac.uk

Appendix H

I have read the information sheet provided and I am happy to participate. I understand that by completing and returning this form I am consenting to be part of this research study and for my data to be used as described in the information sheet provided – please tick box to confirm you have read the statement. ☐

Demographic Form

We would be grateful if you would answer the following questions. All information provided is strictly confidential. Please mark the appropriate answer clearly or write your comments in the space provided.

1a. **Age** 1b. **Gender** Male ☐ Female ☐

Profession and career:

2a. What is your current **job title?**

2b. What is your current **project role?** for example: Project Manager/Lean Project Manager/Project team member/Supplier/Customer/Project Sponsor/PM Expert Advisor/LPM trainer)/Other: please specify.

3a**. How long have you been working in your present position?**

Years ☐ Months ☐

3b. **How long have you been working within your profession?**

Years ☐ Months ☐

4**. Industry sector**: Public/Private/Voluntary/Other (please specify)

5. **Area**: Pharma/Manufacturing/Construction/Health/Education/Other (please specify)

Project details and features:

6a. **Number of projects you have been involved in where specific LPM approach was employed**:

0	1-5
Unsure	6-10
NA	11-20

I have read the information sheet provided and I am happy to participate. I understand that by completing and returning this form I am consenting to be part of this research study and for my data to be used as described in the information sheet provided – please tick box to confirm you have read the statement.

☐

6b. **Value of LPM projects you have been involved in:** (please specify currency e.g. £/EURO/other)

Smallest project: Largest project:

LPM learning:

7. **Please specify any PM qualifications you hold**:

8. **Type of LPM education/training and provider** (please tick all that apply):

	Professional Body i.e. APM, PMI	**Employer/ on-the-job internal training**	**External consultant /trainer**	**NA**	**Other (please specify):**
One off Lecture/Symposium/ Workshop/Event					
Study Day					
Short Course (non-accredited)					
Accredited Module					
Formal qualification i.e. SixSigma, Agile					
Private or self-Study					
None					
NA, I have provided the training					
Other (please specify):					

Thank you very much for taking the time to complete this form.

Appendix I

LIVERPOOL JOHN MOORES UNIVERSITY

Health and Safety Unit

Assessment Number

Risk Assessment			
Building	Redmonds	Date of Risk Assessment	18.4.2018
School/Service Department	LBS	Assessment carried out by	J Dowson
Location	External to LJMU sites (public/workplace organisations tbd)	Signed	
Activity	Research data collection e.g. Interviewing, undertaking non-participation observation	Persons consulted during the Risk Assessment	C Unterhitzenberger, D Bryde (supervision team)
STEP 1 What are the Hazards? *Spot hazards by* • *Walking around the workplace* • *Speaking to employees* • *Checking manufacturers instructions*	None		
STEP 2 Who might be harmed and how? *Identify groups of people.* *Staff and students are obvious, but please remember* • *Some staff/students have particular needs* • *People who may not be present all the time* • *Members of the public* • *How your work affects others*	NA		

if you share a workplace	
STEP 3 (a) What are you already doing? *What is already in place to reduce the likelihood of harm, or to make any harm less serious*	Adherence to LJMU ethical guidelines
STEP 3 (b) What further action is needed? *Compare what you are already doing with good practice. If there is a gap, please list what needs to be done.*	None
STEP 4 How will you put the assessment into action? *Please remember to prioritise. Deal with the hazards that are high risk and have serious consequences first*	Retain a Research project risk register to be held at LJMU for any incidents

Review as necessitated by changes.

Appendix J

Case Study Protocol 17.4.2018

Section A: Overview of Case Study	
Mission and goals	To explore "lived actuality" of LPM and PL in practice
Case study questions, propositions	To see how LPM and PL experienced, implemented, and if a relationship is present.
Theoretical framework	Pluralism of PM, practice theory
Role of Protocol	To guide recruitment and selection of case study projects, aide memoire
Section B: Data Collection Procedures	
Contact persons	JD and "Gatekeeper" – could be organisation CEO, or Project Lead
Data collection plan	Initial visit, followed by agreed observations, interviews with team members, documents and photographs of live and archived activity
Preparation prior to fieldwork	Company or organisation background – public facing website, reports, including annual, any blogs to indicate interest or implementation of specifically Lean project management
Section C: Protocol Questions	
The practice in operation:	Implementation of LPM and observation of PL, connections between them
Description:	A project with multi-disciplinary members – at least 4 different professions, about to or has started LPM. Must be a strategic decision that has been made as opposed to BAU (or trad PM) approach). Can be at any PLC stage – design, execution – both preferable, but either acceptable
Who?	Ideally whole project team, minimum, a Project Leader and/or PM (may be two roles by 1 person). Team members (ideally minimum of 4, max of 20)
How?	Project meetings that can be recorded, or observed
Where?	Face to face rather than virtual – preferably on-site (work premises, office, clinic, construction site, PMO)
When and how often?	Should be regular i.e. monthly minimum, weekly ideal. Ability to visit on a regular/frequent basis i.e. at least 3 times during data collection.
Evaluation of the practice:	Outputs/outcomes/analysis/pattern matching/rival explanations?
How evaluated	Collection of multiple sources of evidence then thematic analysis
What is the output of the data	That LPM was implemented correctly, that PL did take place, and if /no relationship was evident. Any differences found in practice?
What is the outcome?	Evidence to show how the relationship (if any) manifests itself – contributory elements? Direction of travel? Anything surprising found?
Section D: Case Study Findings	Tentative plan as at April 2018
Audience	Case Study Organisation, and Thesis, potential papers for conferences/journals
Physical Artifacts (evidence)* all to be conducted and stored within ethical guidelines	Project documentation – project plans, logs, charters, structure, accompanying documentations relating to the project Case Study Documentation – meeting recordings, researchers' notes, contact names/lists/locations/logo's/photographs taken during visits, interview recordings

Appendix K

interview file	total words	no of codes coded per file	no of refs
1	1367	35	44
2	1885	37	47
3	1270	43	50
4	1146	24	33
5	1496	41	55
6	2366	27	36
7	1946	41	50
8	8047	73	193
9	2406	52	97
10	1292	34	46
11	846	26	36
12	2082	32	45
13	3614	50	114
14	1232	8	9
15	2321	52	87
16	1150	33	39
17	1300	23	30
18	2150	37	43
19	5487	46	69
20	4370	56	82
21	2107	34	53
22	2494	57	90
23	3195	64	108
24	397	15	19
25	1625	40	54
26	1697	46	64
27	1841	54	64
28	2785	58	89
29	3585	61	90
30	2586	58	87
31	2922	50	74
32	2015	33	39
33	2029	47	66
34	3196	41	52
35	2211	25	36
36	3798	23	27
37	1572	43	54
38	3047	27	29
39	1669	26	28
40	2954	33	39
total	**95498**	**1605**	**2367**
ave	2396	41	62
min	397	8	9
max	8047	73	193

Appendix L

Appendix L

Categorisation:	Named Theme/Sub-Themes		
Overarching L1	**CONCEPTUALISATION OF LPM**	**Files:**	**References:**
High L2	**DEFINITION OF LPM**		
Middle L3	**Application of lean principles**		
Low L4	Process-driven	21	35
Low L4	Efficiency and Effectiveness	19	34
Low L4	Results oriented	18	26
Low L4	Avoiding or reducing waste	16	23
Low L4	Cost-driven	9	14
Low L4	Continuous improvement	8	10
Low L4	Learning from mistakes	7	8
Middle L3	**Employment of specific tools, methods**		
Low L4	Set of tools and methods	14	18
Low L4	Framework or combination of tools, methods, techniques	6	7
Low L4	Manages risk	4	4
Middle L3	**Perception of values, mindset, philosophy**		
Low L4	Relationship between people and professional practice	21	27
Low L4	Shared understanding, visibility, transparency	16	24
Low L4	Collaboration	17	23
Low L4	Cust value driven	14	21
Low L4	A philosophy, approach	12	14
Low L4	Communication	9	13
Low L4	Team working	10	12
Low L4	Stakeholder Engagement	2	3
Low L4	Self-managed team	1	1
Middle L3	**No clear definition**	2	3
High L2	**VALUE of LPM**		
Middle L3	Improved Efficiency	25	43
Middle L3	Improved Understanding	22	31
Middle L3	Improved Knowledge	19	26
Middle L3	Improved Supportive Culture	15	23
Middle L3	Improved satisfaction	16	20
Middle L3	Improved Skills	9	11
Middle L3	Improved perception	4	5
Middle L3	Negative Answer	4	4
	total	**340**	**483**

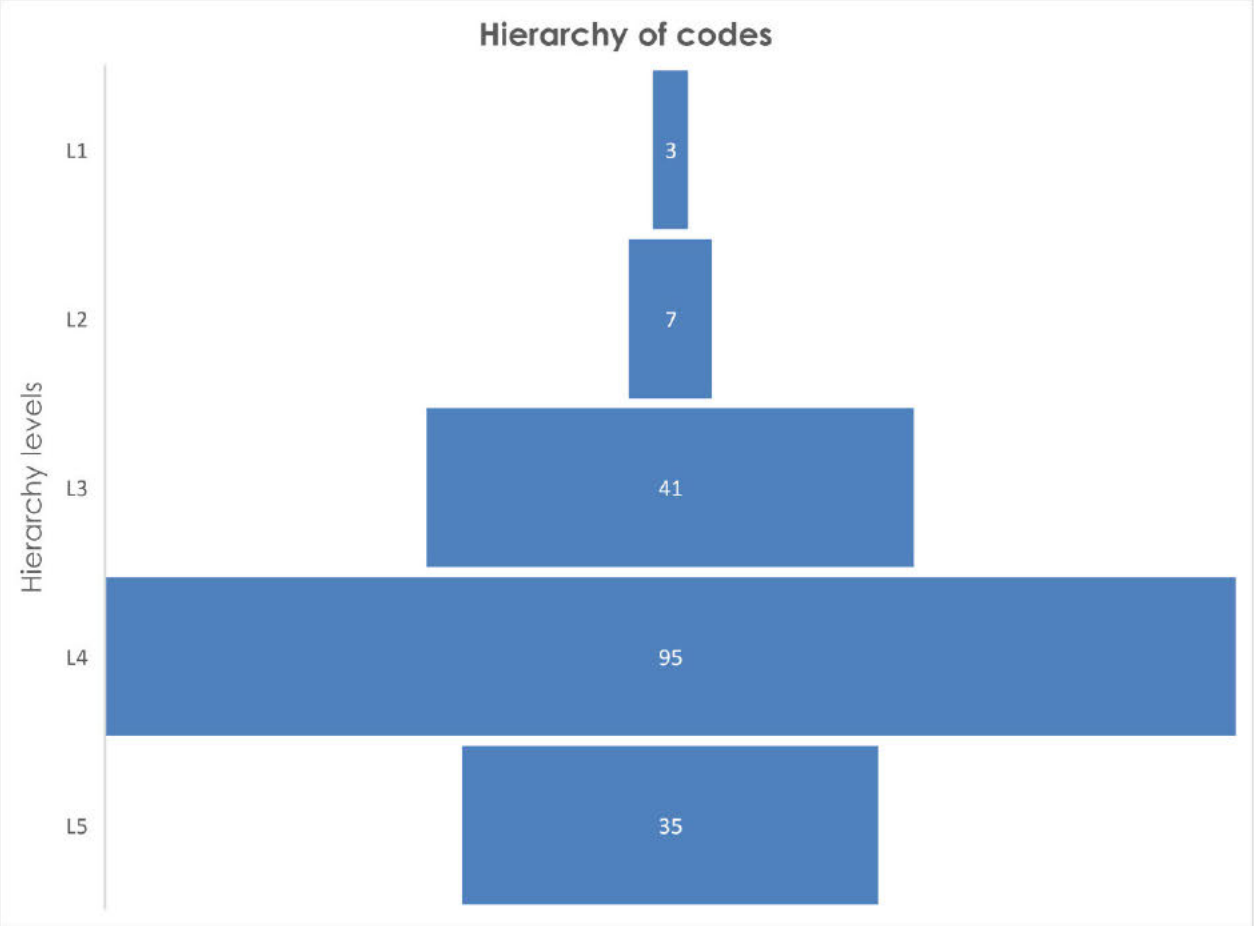
Categorisation:	Named Theme/Sub-Theme		
Overarching L1	**IMPLEMENTATION OF LEAN PROJECT MGT**	**Files:**	**References:**
High L2	**FACTORS INFLUENCING LPM IMPLEMENTATION**		
Middle L3	**Barriers**		
Low L4	(Mis) understanding or lack of understanding (generally)	16	25
Low L4	(Mis) understanding or lack of understanding of processes, targets, delivery, measurements, requirements (specifically)	16	25
Low L4	Acceptance of measurements, tools and techniques	13	15
Low L4	Lack of available resources	11	15
Low L4	Lack of collaboration, sharing and communication	13	26
Low L4	Lack of commitment or trust from or between stakeholders	13	19
Low L4	Lack of control over decisions	2	2
Low L4	Lack of experience	1	2
Low L4	Lack of PM skills	3	4
Low L4	Legal, governance, regulatory	4	5
Low L4	Missing or lack of knowledge	15	28
Low L4	Organisational structures, processes	4	10
Low L4	Poor Leadership and support from snr mgrs	16	30
Low L4	Pressure to implement	11	13
Low L4	Project complexity (volume, geographic location, number of stakeholders etc..)	3	8
Low L4	Socio-cultural, behavioural (generally)	26	48
Low L4	Technology	4	7
Low L4	Tools limitations	5	9
Low L4	**Socio-cultural, behavioural (specifically):**		
Lower L5	don't feel valued	4	5
Lower L5	fear of change	8	17
Lower L5	Negative Perception of lean concepts	23	29
Lower L5	Old-fashioned mindset	19	28
Lower L5	Preconceived industry roles	18	28
Lower L5	resistance to change	18	32
Lower L5	steep learning curve	8	15
Middle L3	**Benefits**		
Low L4	achieves targets set	12	21
Low L4	Cost- savings made	2	3
Low L4	enhances reputation of organisation	3	3
Low L4	facilitates communication with stakeholders	17	22
Low L4	facilitates progress and improvement	24	55
Middle L3	**Enablers**		
Low L4	Appropriate resources	6	18
Low L4	Collaborative planning	5	6
Low L4	Continuous monitoring, reviewing, forecasting, improvement	16	19
Low L4	Contractual obligation	3	3
Low L4	Documentation	1	1
Low L4	Early integration	10	15
Low L4	Flexibility, adaptability, & open to change	20	31
Low L4	Influence of institutions and industry	12	17
Low L4	Involvement of all stakeholders	21	42
Low L4	Knowledge and understanding of LEAN	17	34
Low L4	Market demand	8	15

Low L4	Motivation of individuals or team	7	12
Low L4	Organisational structures, processes	8	14
Low L4	Personal integrity	1	1
Low L4	Satisfaction of employee, team	11	16
Low L4	Supportive culture	22	34
Low L4	Supportive leadership	9	17
Low L4	Supportive tools and approaches	16	32
Low L4	Team mindset, shared vision	28	44
Low L4	Technology	3	10
Low L4	Use of data to drive improvements	6	11
High L2	**FEATURES OF IMPLEMENTATION**		
Middle L3	**How progress is measured**		
Low L4	Knowledge & Understanding of lean	1	1
Low L4	Lean behaviours	3	4
Low L4	Not measured	5	8
Low L4	Nr of lean-trained people in org	1	1
Low L4	Organisational maturity in lean	6	11
Low L4	Outputs, outcomes of a project	25	35
Low L4	Progress tracking throughout project	29	47
Low L4	Project development & evaluation	17	22
Low L4	Stability of processes	8	11
Low L4	Team or individual development	8	11
Middle L3	**How progress is recorded**		
Low L4	**General tools & approaches**		
Lower L5	Action plans	6	6
Lower L5	Bar charts	6	6
Lower L5	Digitally	6	7
Lower L5	Paper-based	9	9
Lower L5	Specialist software	8	8
Lower L5	Spreadsheets	4	4
Lower L5	Task breakdown	8	11
Lower L5	Traditionally	9	13
Lower L5	Visually	14	18
Low L4	**Specific tools & approaches**		
Lower L5	Last Planner System (LPS)	14	20
Lower L5	Agile	3	10
Lower L5	Lean Construction	9	10
Lower L5	PPC	7	8
Lower L5	PRINCE2	3	5
Lower L5	CPM	3	3
Lower L5	MS Project	3	3
Lower L5	Takt	2	2
Lower L5	Kanban (Leankit)	1	1
Lower L5	Logic trees	1	1
Lower L5	Schwarz template	1	1
Lower L5	Shopfloor management	1	1
Lower L5	Visio	1	1
	total	**784**	**1240**

Categorisation:	Name of Theme/Sub-Theme:		
Overarching L1	**LEARNING**	**Files:**	**References:**
High L2	**DEFINITION OF OL**		
Middle L3	Continuous Improvement	22	26
Middle L3	Difficulty or unable to articulate OL	7	8
Middle L3	Evolving journey, cultural shift	15	26
Middle L3	Formal learning & training	13	16
Middle L3	From and between projects and organisation	4	7
Middle L3	Informal learning & training	3	5
Middle L3	Knowledge creation & sharing	18	24
Middle L3	Learning by doing process	3	5
Middle L3	Making tools, models available to all	4	4
Middle L3	Part of efficient ops mgt	10	14
Middle L3	Part of org dev & strategy	25	42
High L2	**MECHANISMS OF LEARNING**		
Middle L3	**How?**		
Low L4	communication with others	14	19
Low L4	improvement focused	20	32
Low L4	openness of individuals	7	9
Low L4	questioning self & others	10	13
Low L4	self-reflection	5	7
Low L4	solution-focused	10	11
Low L4	through creating opportunities for others	16	25
Low L4	through formal learning & training	5	7
Low L4	transparent actions of individuals	6	6
Low L4	using info from KPI's	9	11
Low L4	via Continuous Improvement of self	8	11
Low L4	via shared learning	19	31
Middle L3	**When?**		
Low L4	End of project	16	18
Low L4	Ongoing	22	26
Low L4	Start of next project	3	3
Middle L3	**Who?**		
Low L4	Collective effort	16	22
Low L4	Everyone	19	20
Low L4	Self	5	8
Low L4	Specific Individual:		
Lower L5	Client	3	3
Lower L5	Planner	2	2
Lower L5	PM	9	10
Lower L5	Process Owners	2	2
Lower L5	Senior Management	1	2
Lower L5	Sponsor organisation	1	1
High L2	**DEFINITION OF PL**		
Middle L3	practical interaction with lean processes	18	24
Middle L3	Collecting information	13	16
Middle L3	continuous, ongoing	18	22
Middle L3	Difficulty or unable to articulate PL	8	8
Middle L3	interacting with project teams	17	20

Middle L3	Knowledge of lean	5	5
Middle L3	Learning doesn't happen, or not implemented correctly	5	10
Middle L3	learning from experience	15	22
Middle L3	learning from mistakes & problems	15	22
Middle L3	sharing best practice	15	19
	total	**466**	**644**

Total Number of Codes and Levels:



Appendix M

App M.xlsx

Demographics

Industry	n	%
cons	25	63%
eng	3	8%
IT	2	5%
health	2	5%
manuf	2	5%
other:	6	15%
Utils/Nuc/Transp/Petrochem/Sc	**40**	**100%**

Org Size	n	%
SME	13	33%
LargePriv	22	55%
LargePub	5	13%
	40	**100%**

No. of distinct Orgs:	n	%
SME	7	18%
LargePriv	13	33%
LargePub	4	10%
	24	**60%**

OTJ training received:	n	%
one-offs	16	40%
short course- nonaccred	2	5%
self-study	2	5%
unassigned	20	5%
	40	**100%**
OTJ training provided:		
one-offs	**4**	

Gender	n	%
male	30	75%
female	10	25%
	40	**100%**

Country	n	%
UK	16	40%
Ger	20	50%
Switz	1	3%
Global	3	8%
	40	**100%**

Ages	n	%
20's	7	18%
30's	10	25%
40's	15	38%
50's	4	10%
60's	4	10%
	40	**100%**

PM quals	n	%
APM	7	18%
PMI/IPMA	2	5%
Lean6S	1	3%
acad (PG+)	1	3%
unassigned	29	73%
	40	**100%**

ExtCons training received:	n	%
one-offs	13	33%
short course- nonaccred	6	15%
short course- accred	1	3%
self-study	1	3%
Formal cert	1	3%
unassigned	18	45%
	40	**100%**
ExtCons training provided:		
one-offs	**4**	

ProfBody training received:	n	%
one-offs	3	8%
short course- accred	1	3%
self-study	4	10%
formal cert	4	10%
unassigned	28	10%
	40	**100%**
ProfBody training provided:		
one-offs	**2**	

Current Role	n	%
PM	18	45%
LPM	6	15%
LPM Trainer	1	3%
Team member	5	13%
Customer	1	3%
Supplier	4	10%
Sponsor	1	3%
Expert Advisor	4	10%
	40	**100%**

Value of LPM projects £smallest	n	%
£10-50k	2	5%
£50-100k	1	3%
£251-500k	1	3%
£500k-1m	1	3%
£1-5m	6	15%
£6-10m	2	5%
£11-50m	2	5%
£51-100m	1	3%
Unassigned	24	60%
	40	**100%**

Value of LPM projects £largest	n	%
£51-100k	1	3%
£1-5m	4	10%
£6-10m	1	3%
£11-100m	4	10%
£101-250m	2	5%
£500m-£1bn	4	10%
£1bn plus	1	3%
Unassigned	23	58%
	40	**100%**

CurrJobTitle	n	%
CEO/MD	5	13%
Snr PM	25	63%
PM	10	25%
	40	**100%**

Experience (nr of years in Profession)	n	%
0-4	10	25%
5-10	4	10%
11-20	10	25%
21-30	5	13%
30 plus	8	20%
Unassigned	3	8%
	40	**100%**

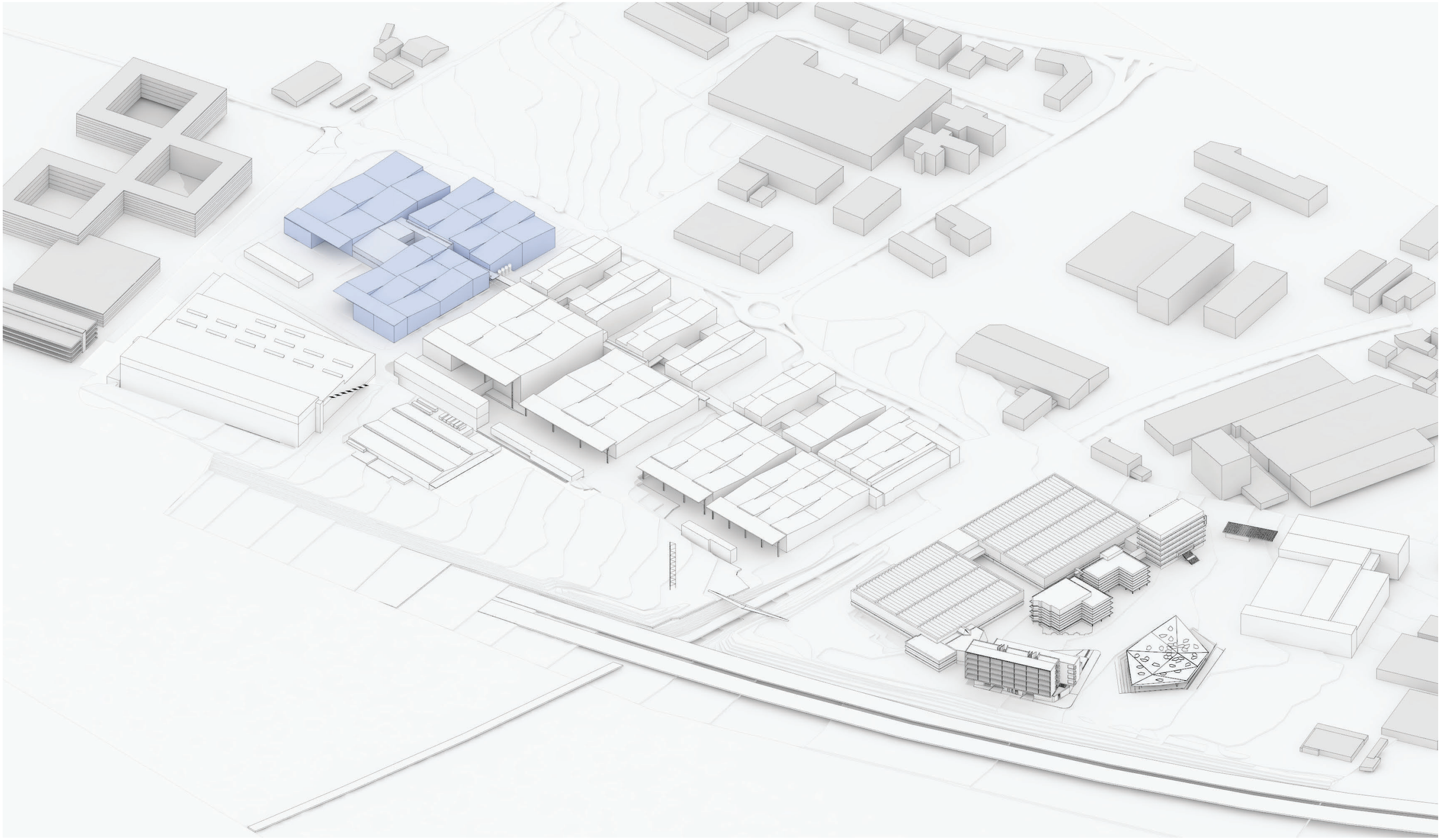
Experience (nr of years in current role)	n	%
0-4	21	53%
5-10	8	20%
11-20	5	13%
21-30	2	5%
30 plus	1	3%
Unassigned	3	8%
	40	**100%**

Experience (nrs of LPM projects)	n	%
0	6	15%
1-5	17	43%
6-10	5	13%
11-20	6	15%
20 plus	3	8%
Unassigned	3	8%
	40	**100%**

Appendix N

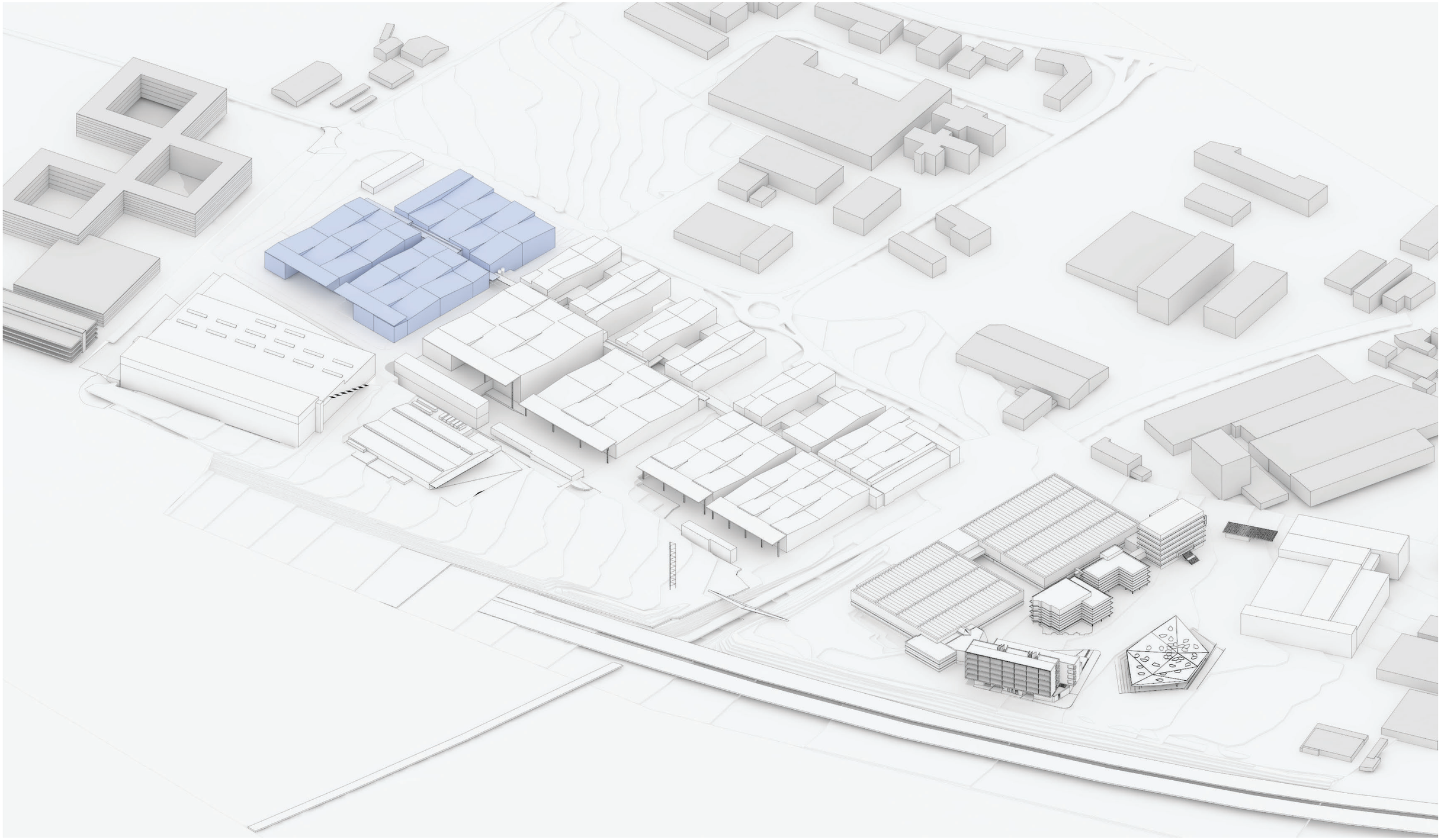
4.2 FE HALLE
18.01.2016

Aktuelle Planung | Perspektive

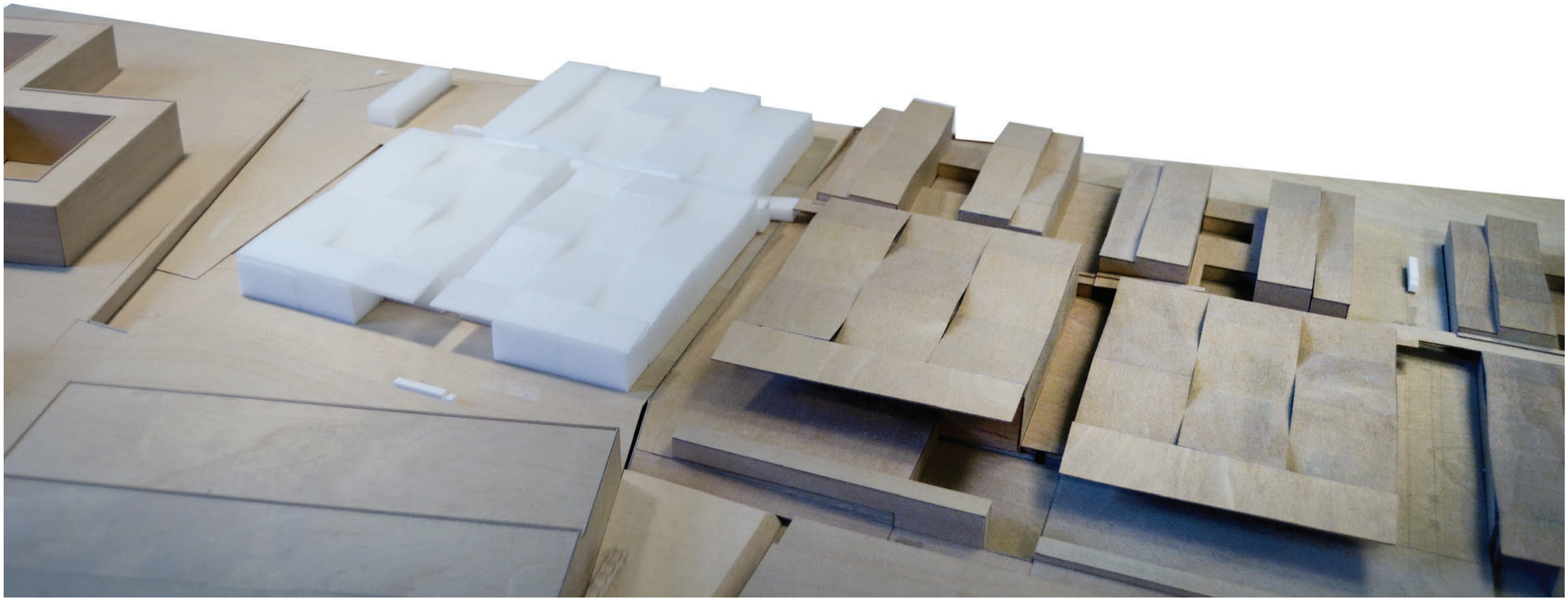


Aktuelle Planung | Modellfoto

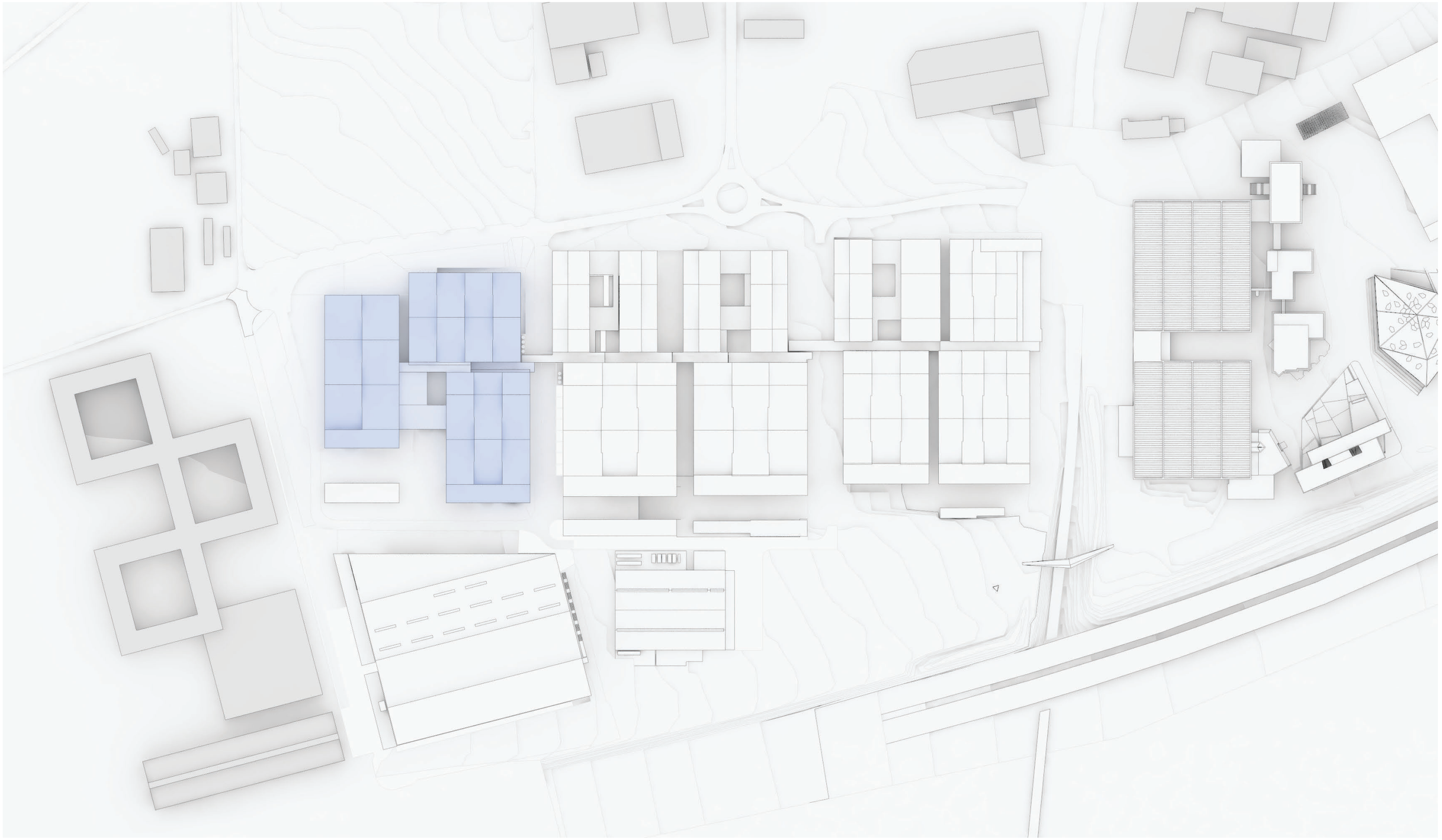
Alternative | “Perspektive”



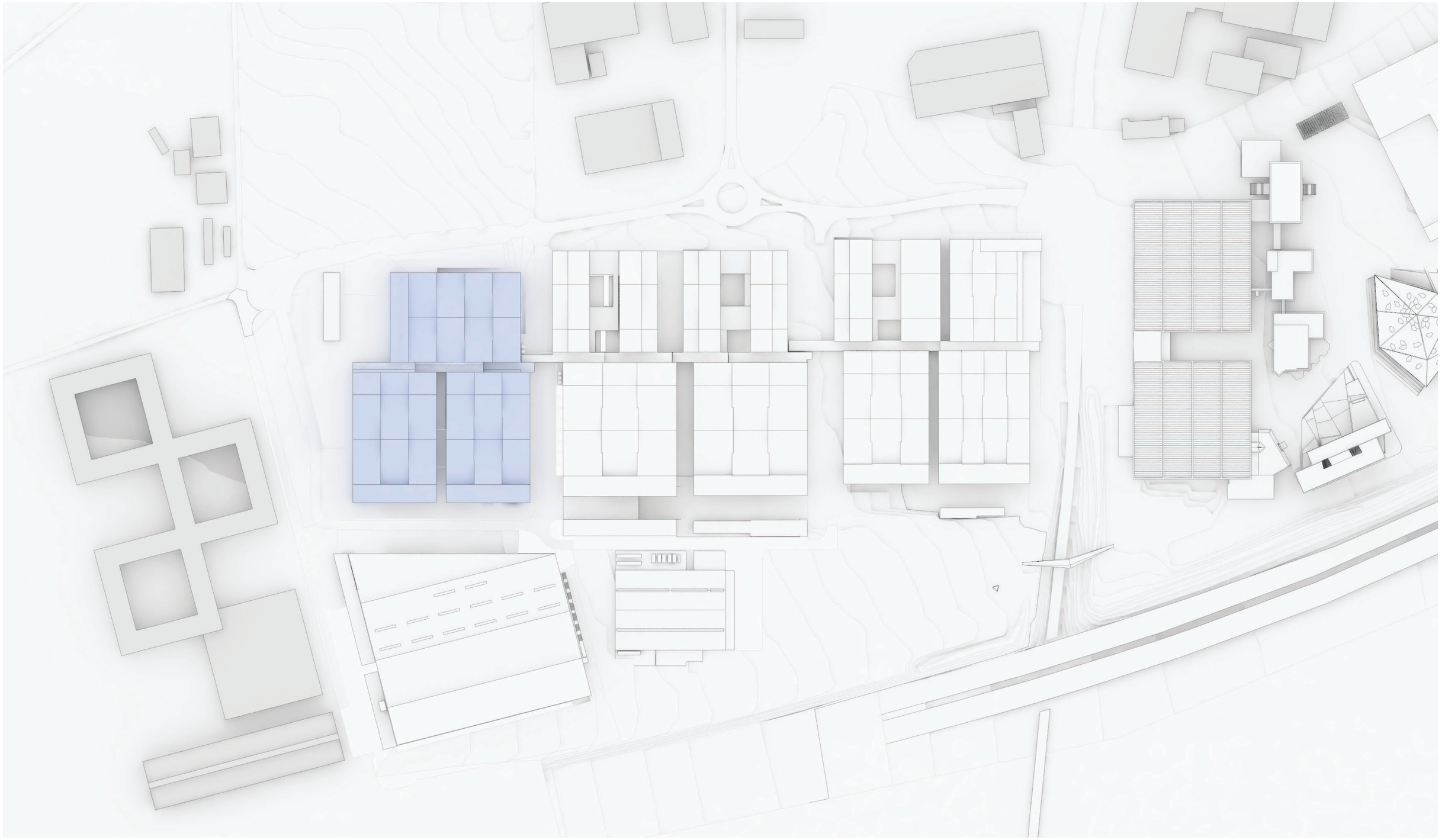
Alternative | Modellfoto



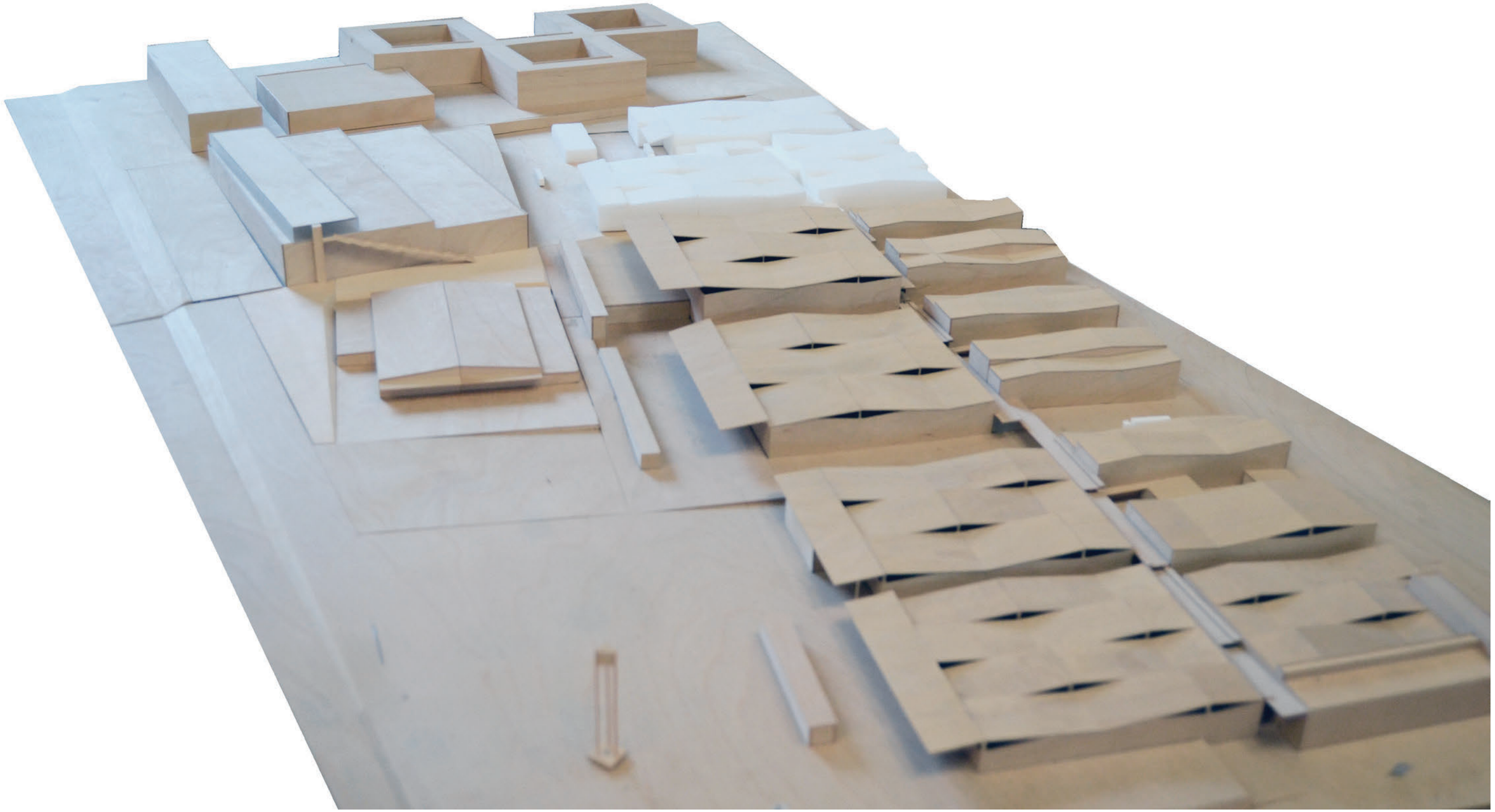
Aktuelle Planung | Top View M 1:2500



Alternative “CUT” | Top View M 1:2500

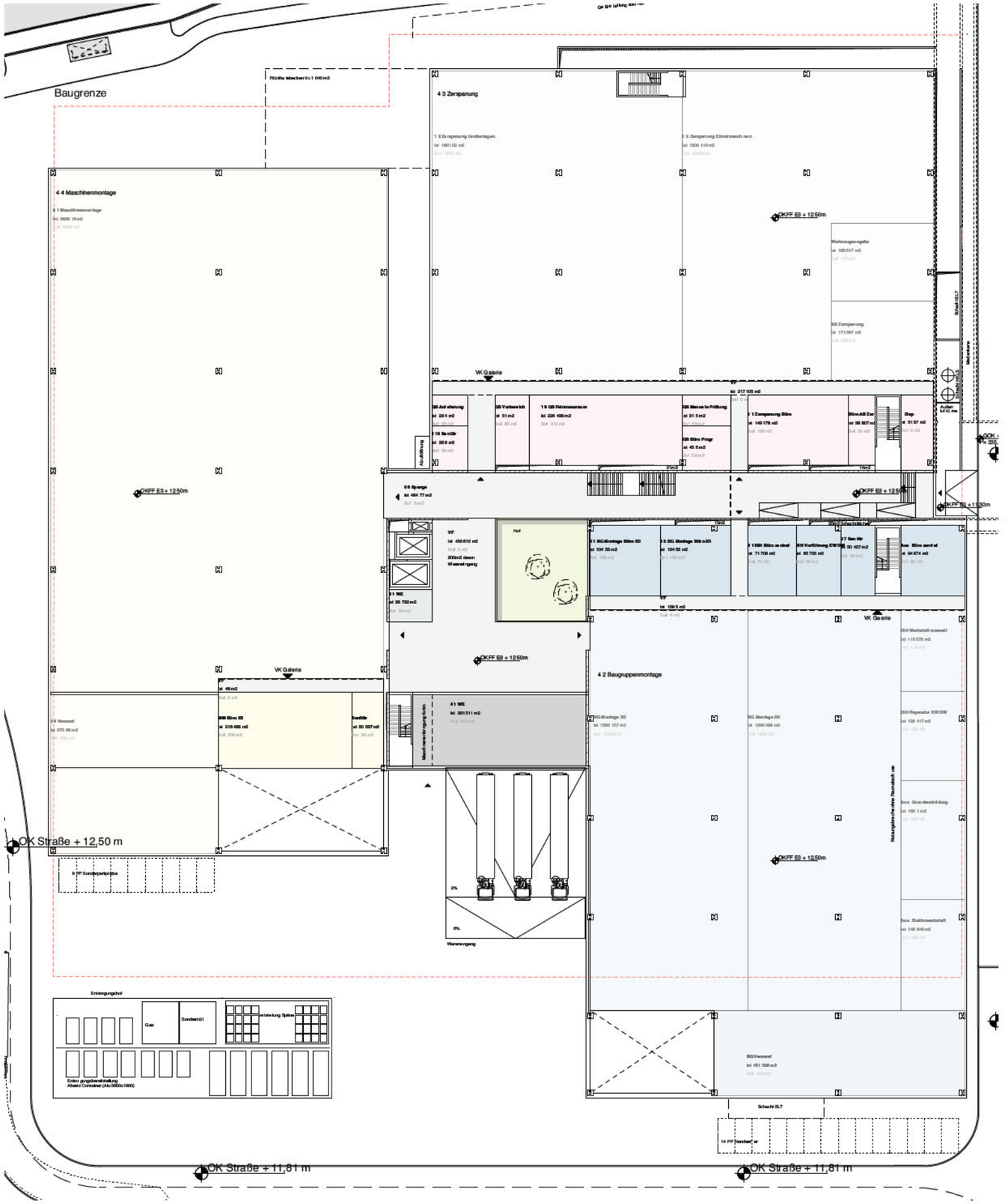


Aktuelle Planung | Modellfoto

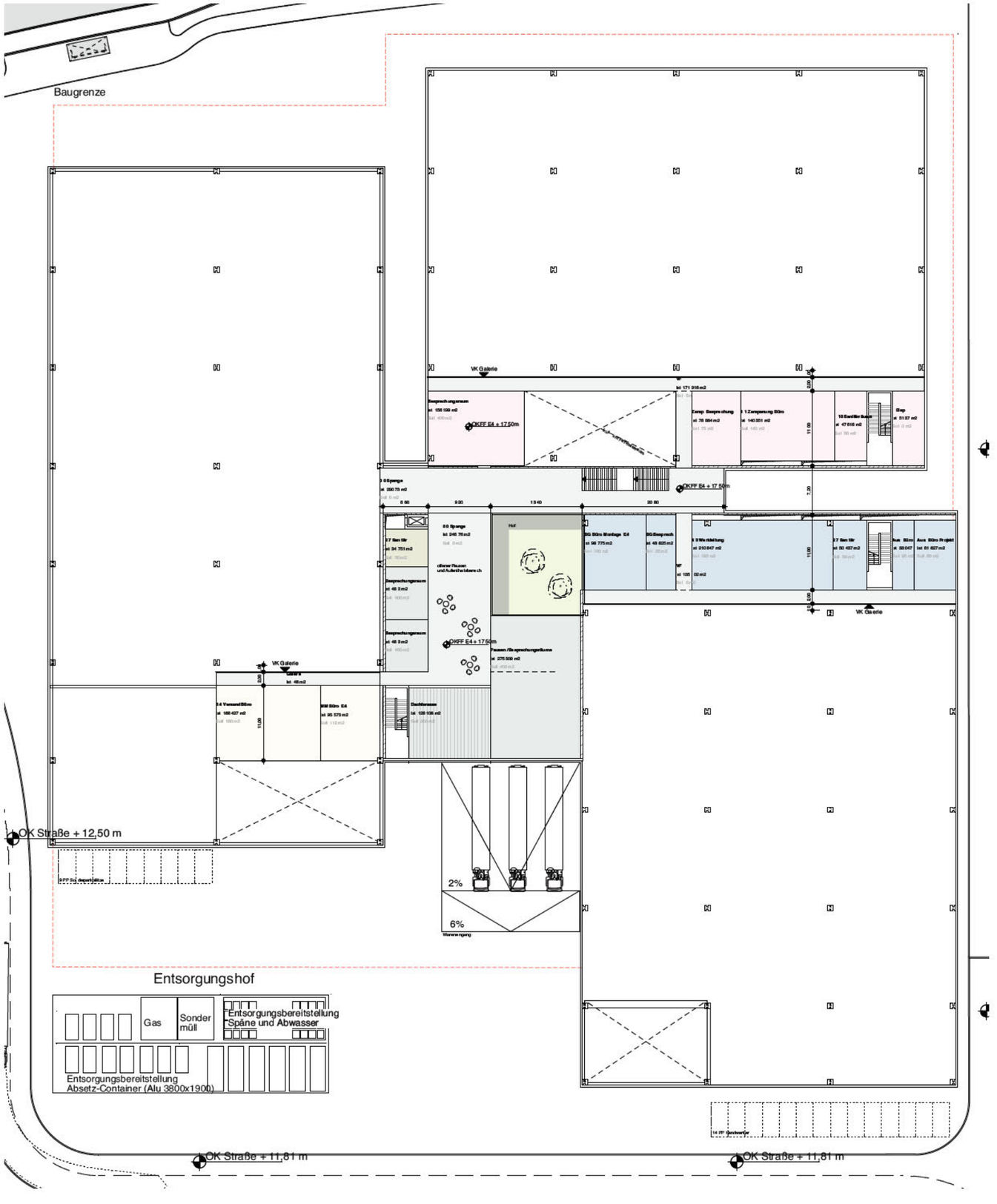


Aktuelle Planung | Lageplan M 1:2500

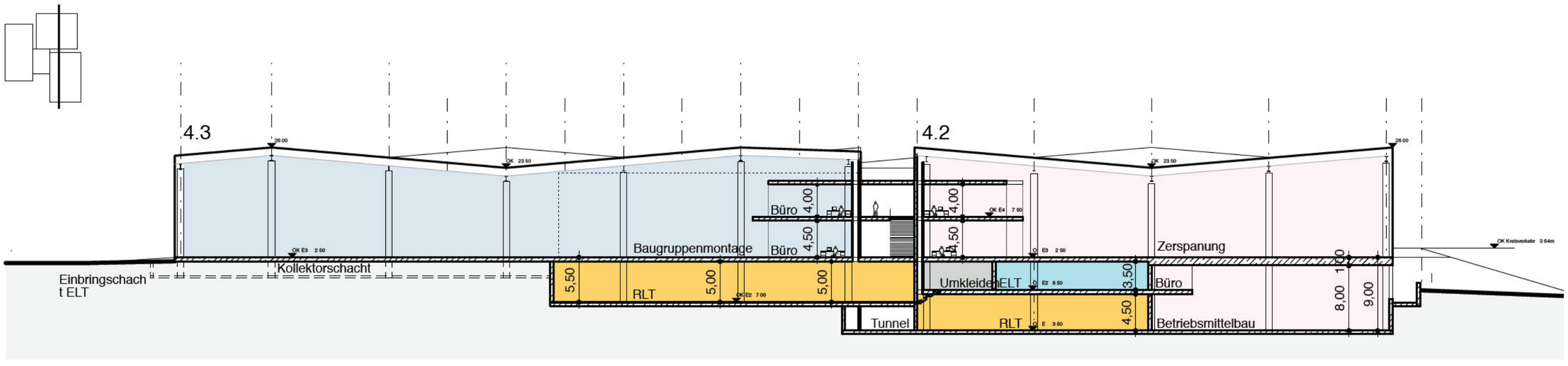
Aktuelle Planung | Grundriss EG M1:750

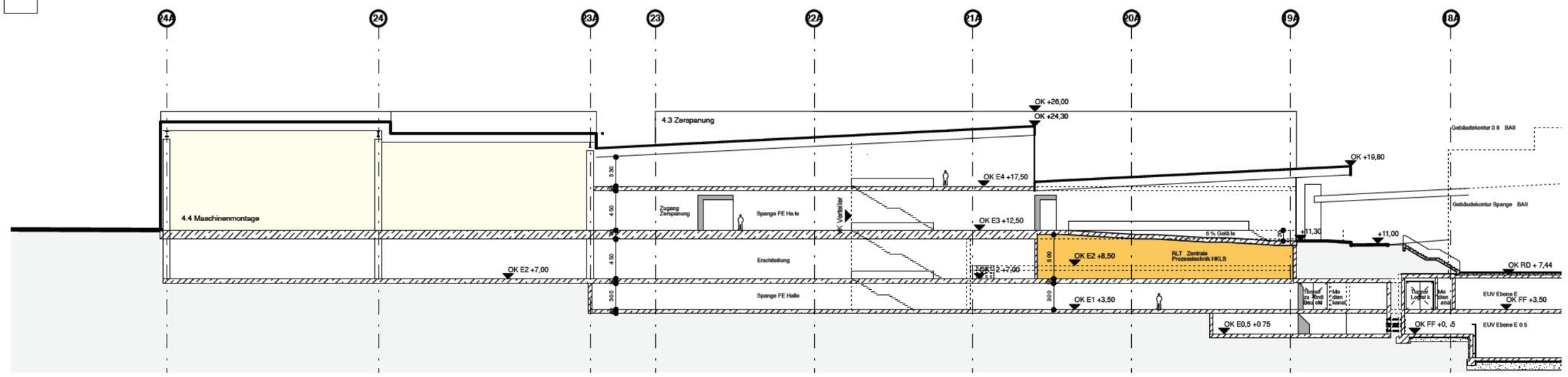

Baugrenze
4 3 Zerspanung
4 4 Maschinenmontage
4 2 Baugruppenmontage
VK Galerie
OKFF E3 + 12,50m
OKFF E2 + 12,50m
OKFF E1 + 11,30m
OK Straße + 12,50 m
OK Straße + 11,81 m
OK Straße + 11,81 m
Schacht ELT
Hof
Entsorgungshof
Gas
Sonderabf.
Aufstellung Spänebehälter
Entsorgungsfahrzeugaufstellung
Abwetz Container (Alu 3600x1900)
Warenausgang
Wareneingang
Hauptgebäude Stahlbeton
Hauptgebäude Stahlbeton/Stahl
Hauptgebäude Stahlbeton/Holz
Hauptgebäude Stahlbeton/Stahl
Hauptgebäude Stahlbeton/Stahl
Hauptgebäude Stahlbeton/Stahl

Aktuelle Planung | Grundriss 1.OG M1:750

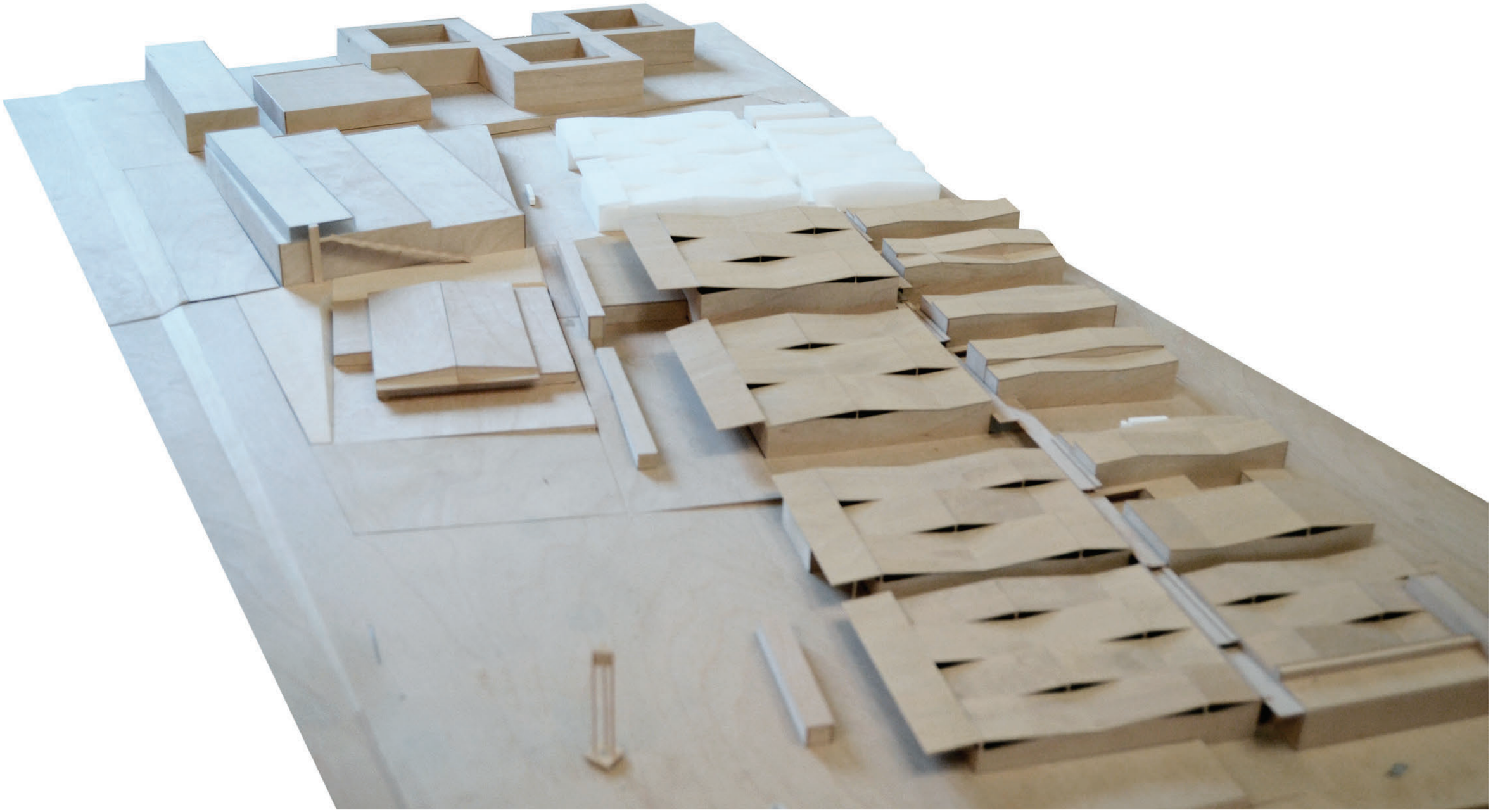


Aktuelle Planung | Schnitte M 1:500

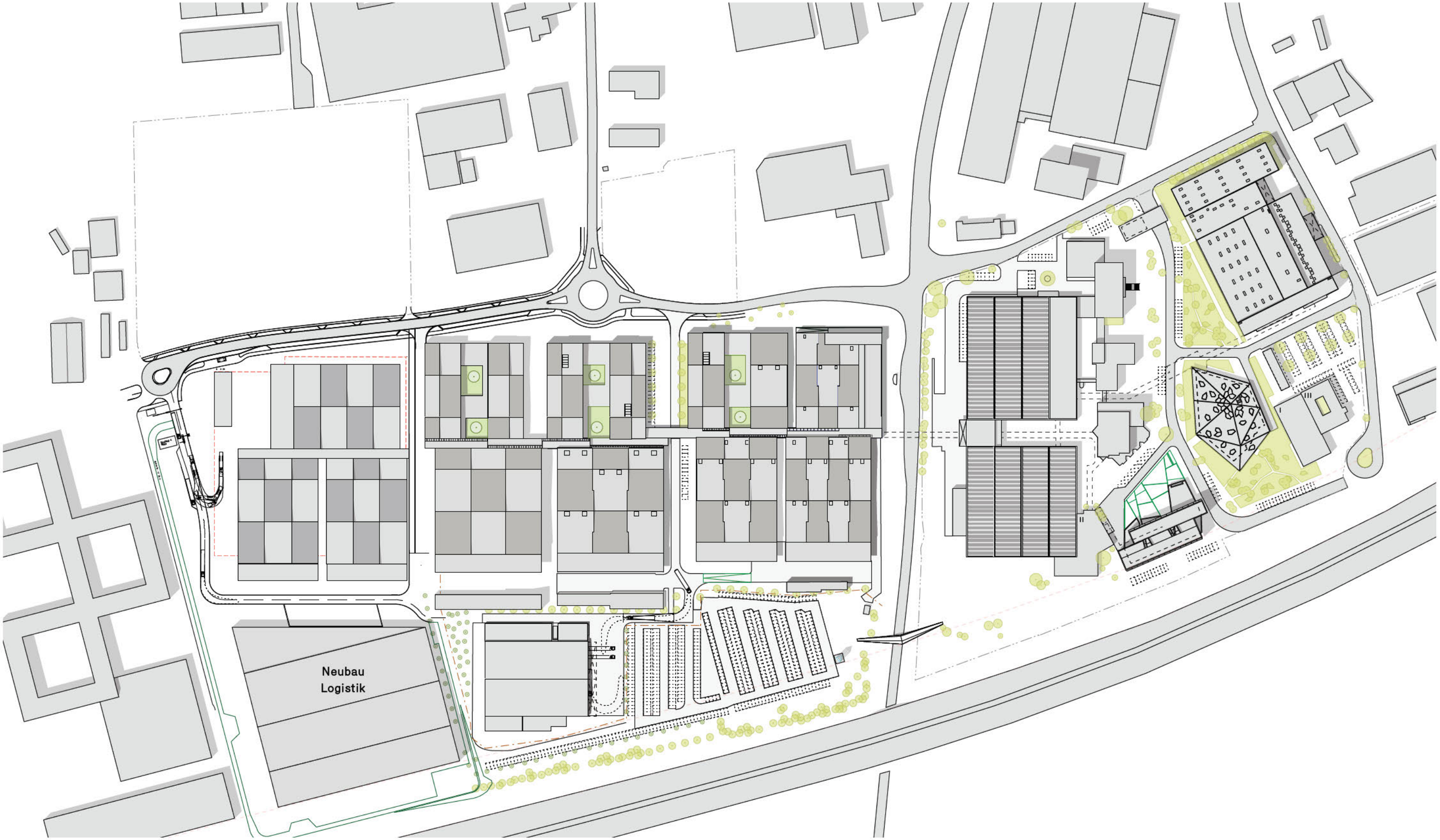




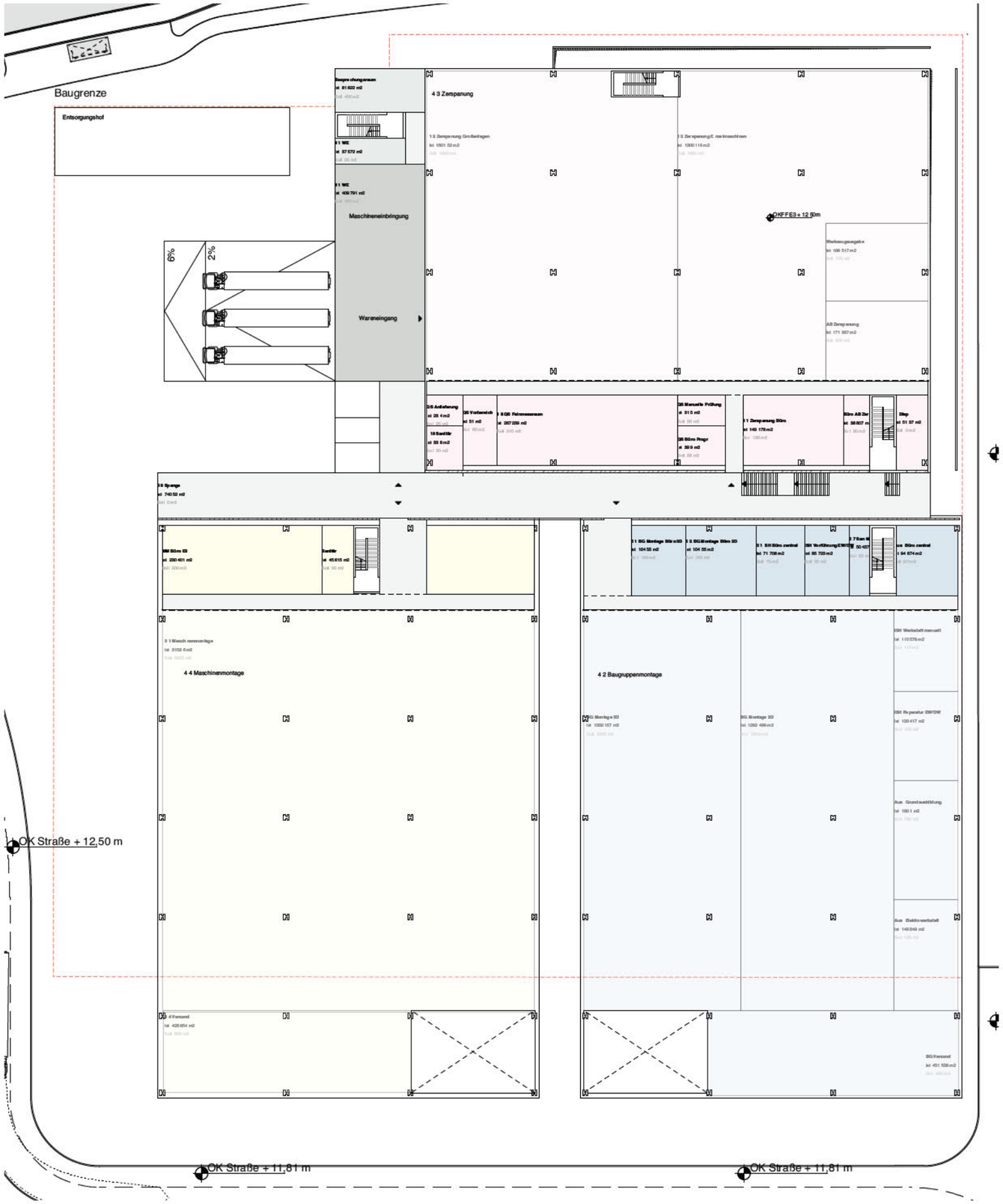
Alternative | Modellfoto



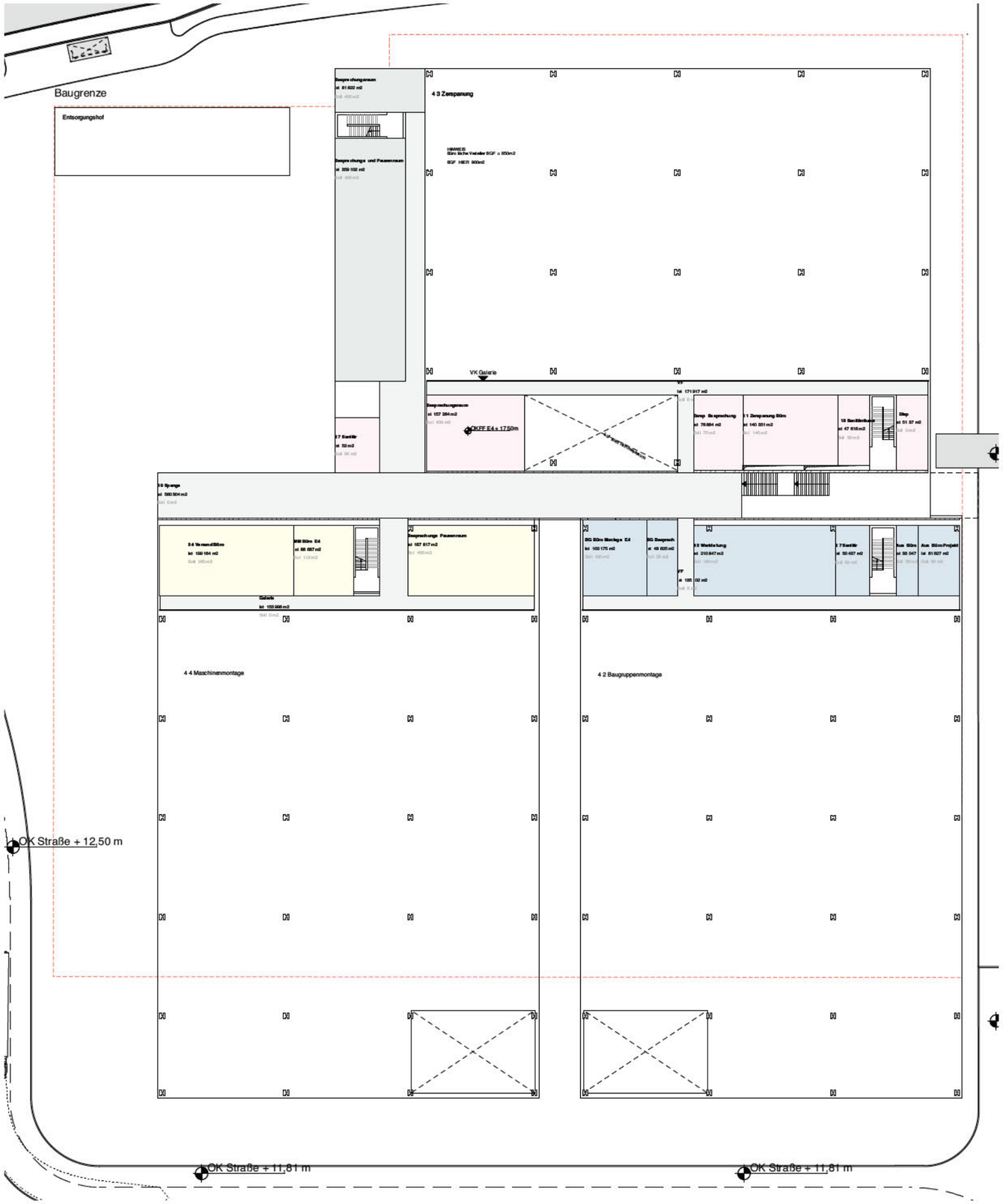
Alternative | Lageplan M 1:2500



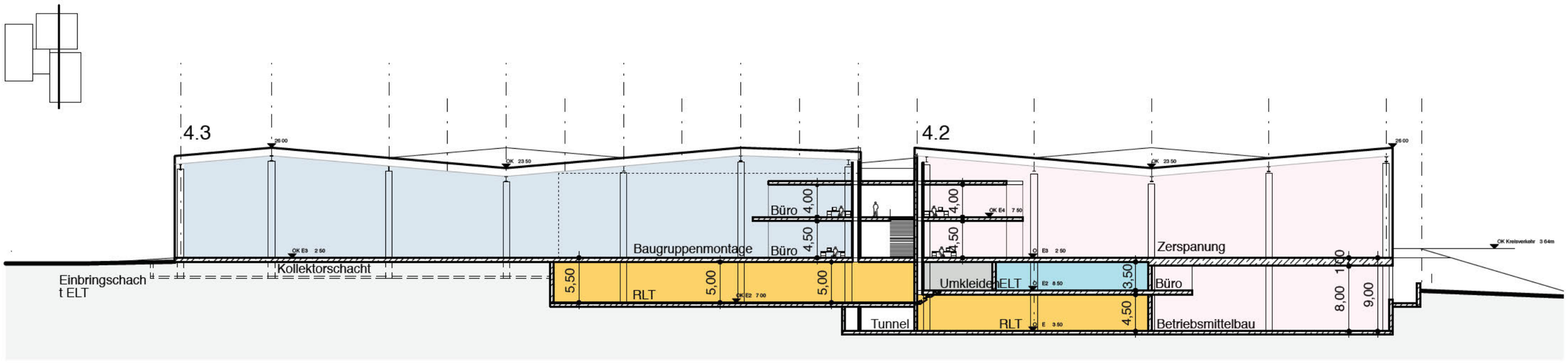
Alternative | Grundriss EG M1:750

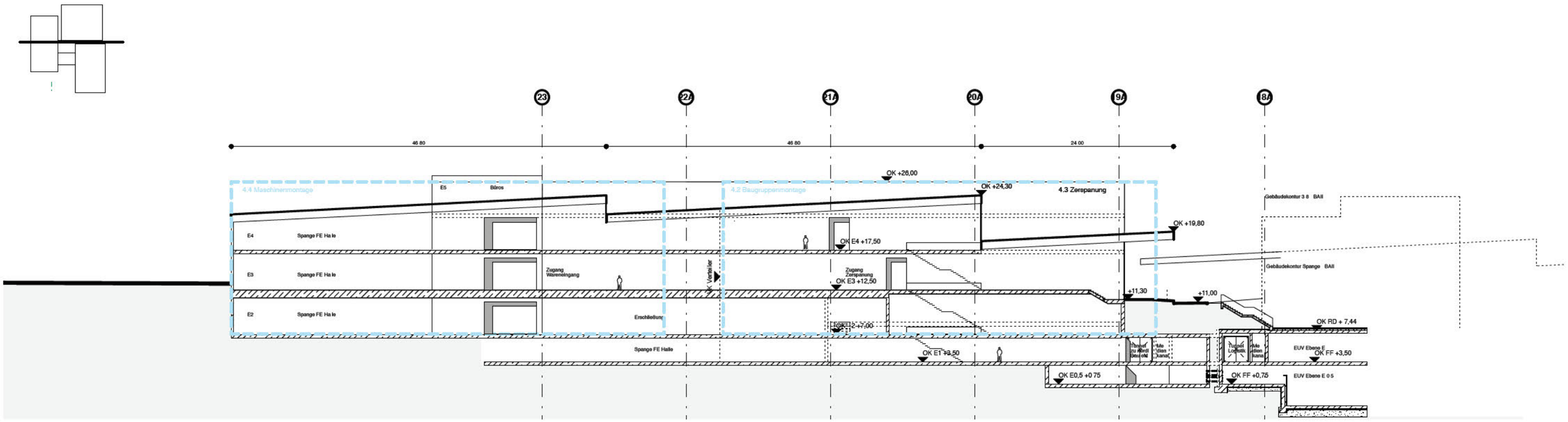


Alternative | Grundriss 1.OG M1:750



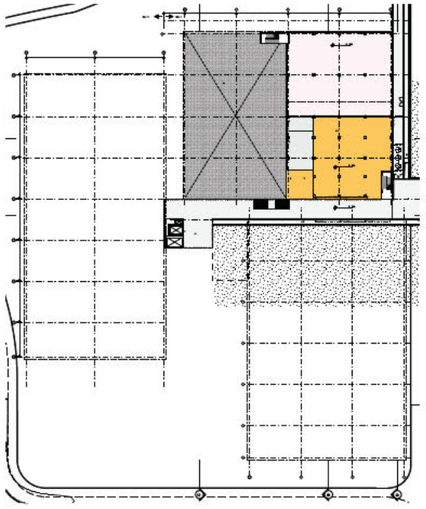
Alternative | Schnitte M 1:500



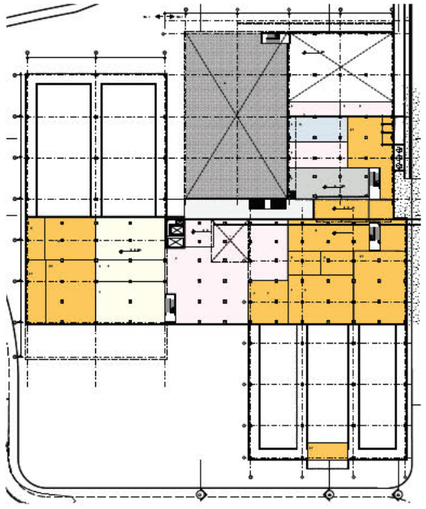


Gegenüberstellung Grundrisse

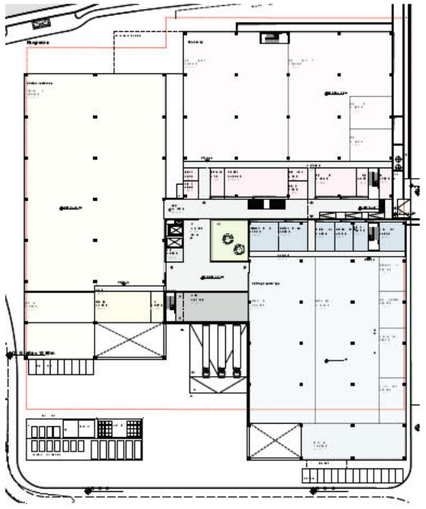
Aktuelle Planung



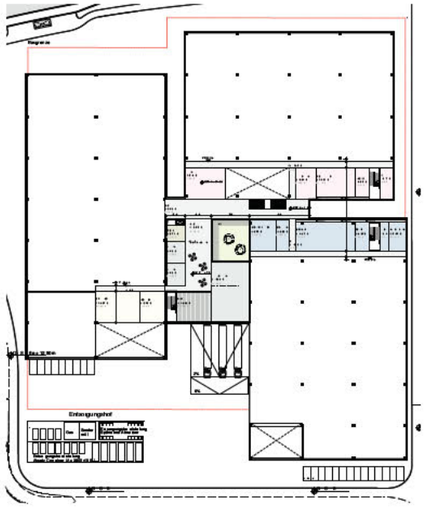
E1 +3,50



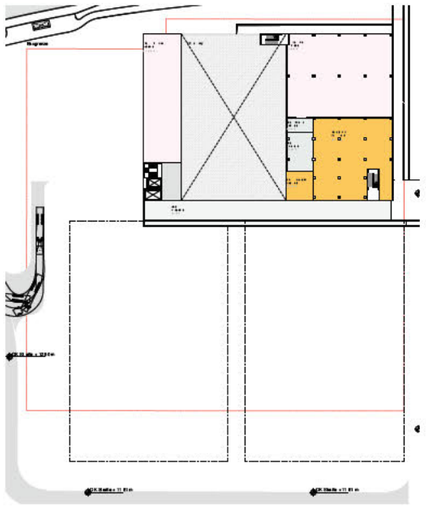
E2 +8,50

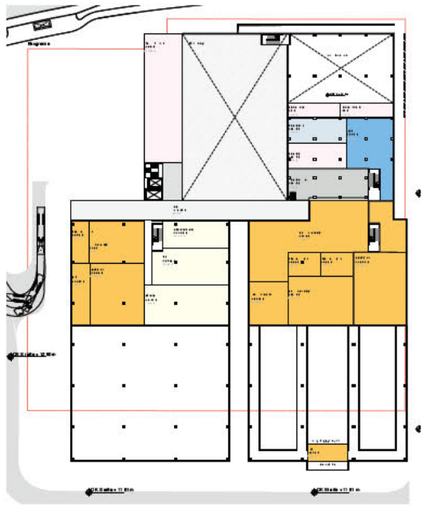


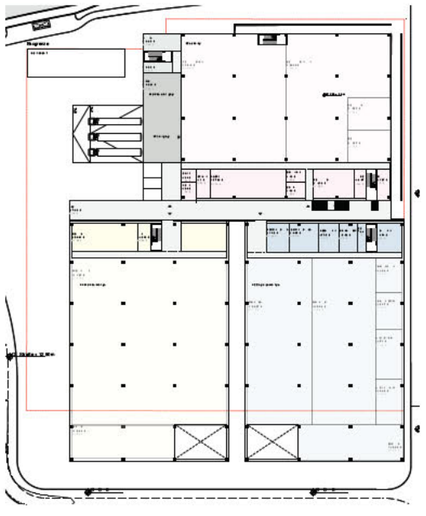
E3 +12,50

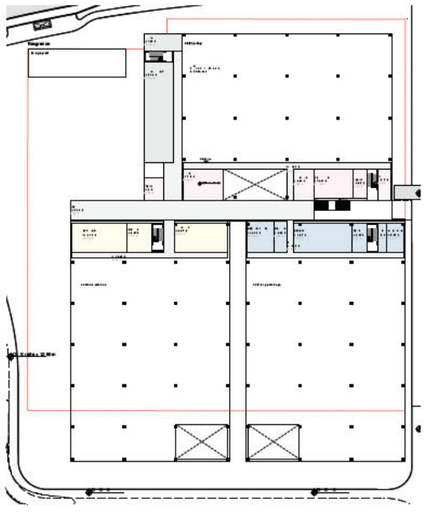


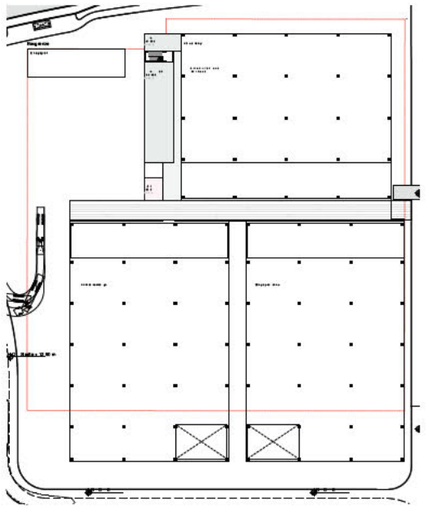
E4 +17,50







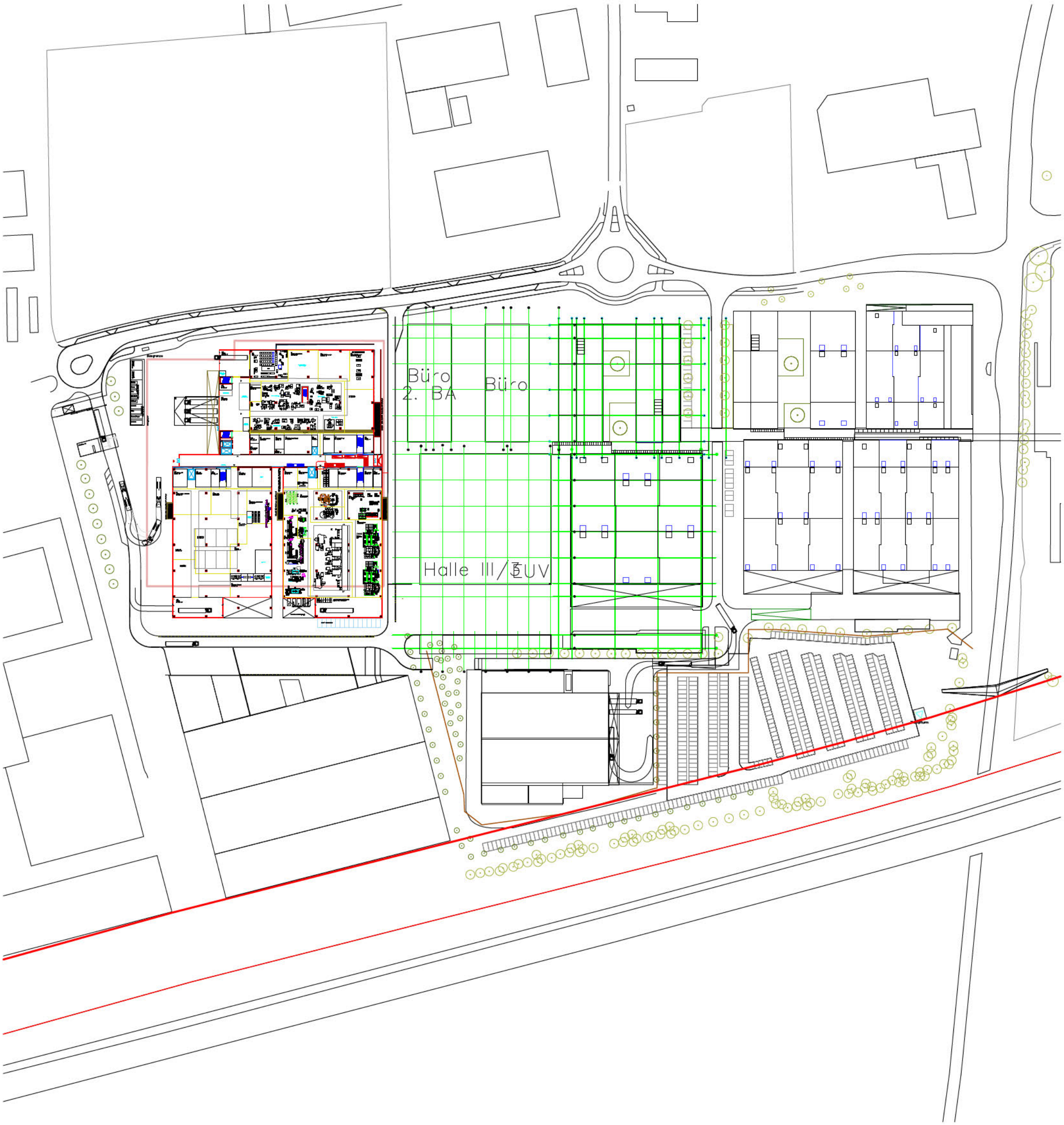


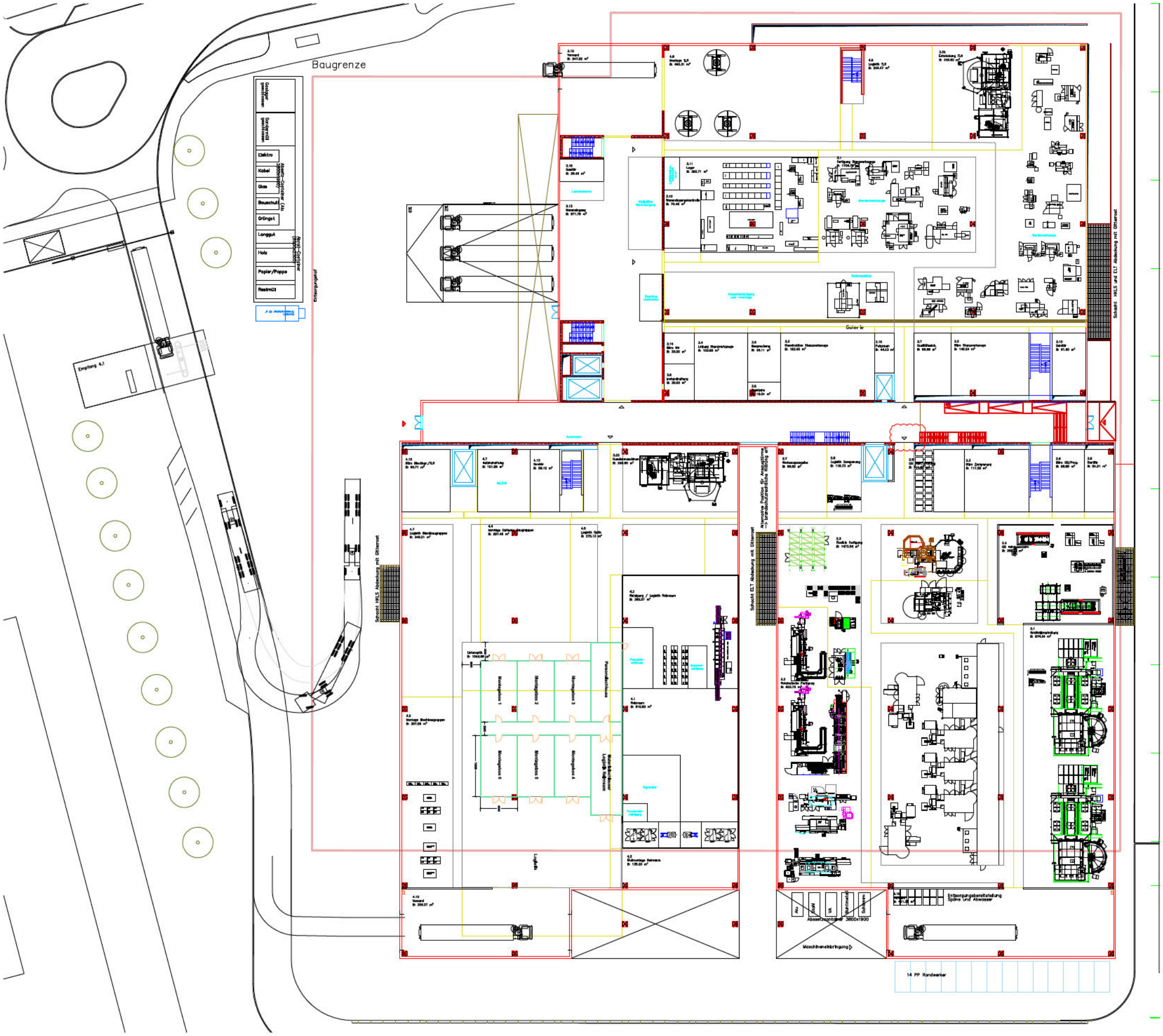


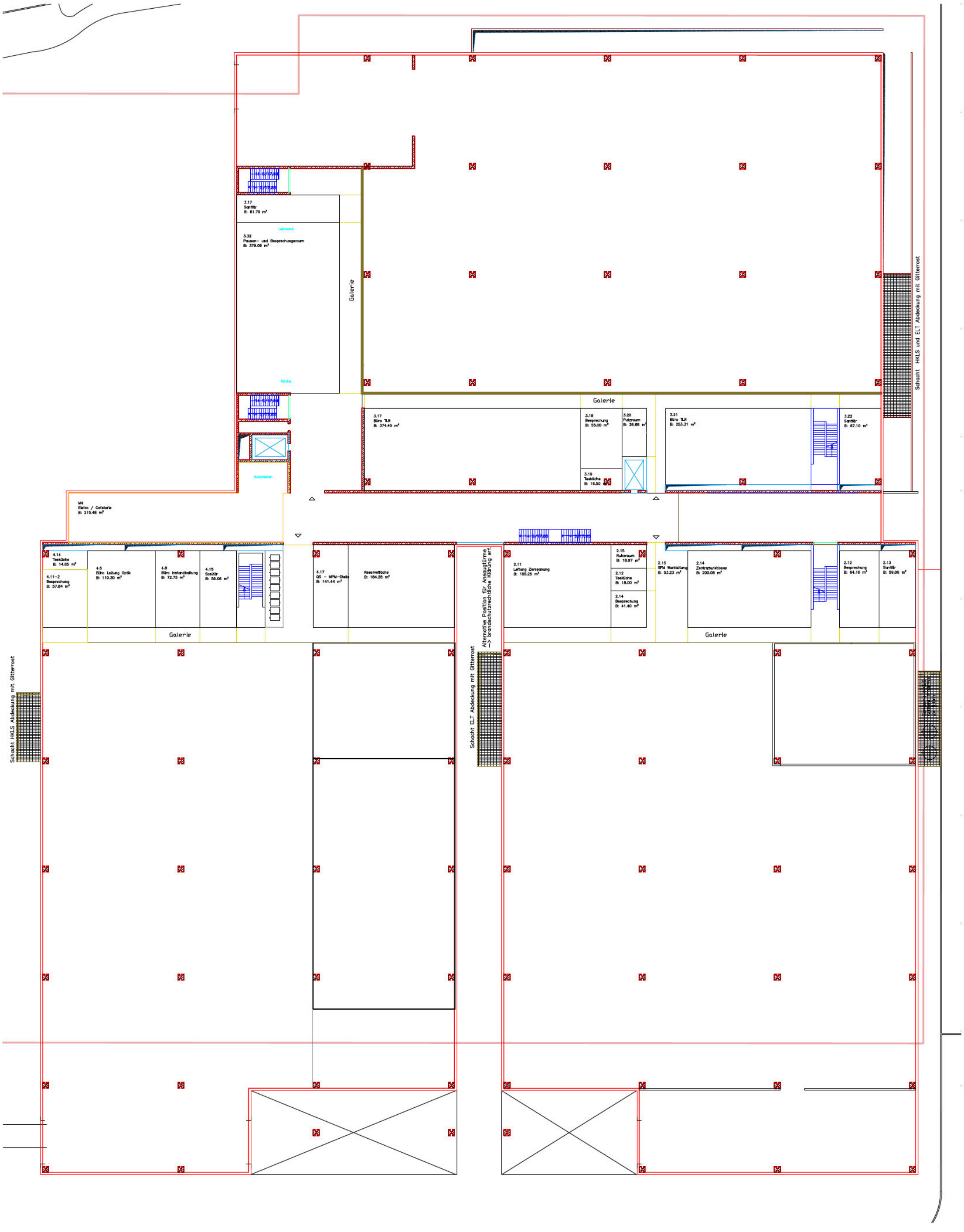
E5 +21,50

Alternative

Appendix O


Büro
2. BA
Büro
Halle III/IV


Baugrenze
Gastgeber gestellt
Sonderwerkz. gestellt
Elektro
Kabel
Glas
Bauschutt
Grüngut
Langgut
Holz
Papier/Pappe
Restmüll
Absetz-Container (Alu 3800x1900)
Entsorgungshof
Empfang 4.1
Schacht HRLS Abdeckung mit Gitterrost
Schacht ELT Abdeckung mit Gitterrost
Alternative Position für Anlagenstirnseite -> brandschutztechnische Klärung erf.
Montageplatz 1
Montageplatz 2
Montageplatz 3
Montageplatz 6
Montageplatz 5
Montageplatz 4
Fensterdichtlinie
Montageplatz Laufrohr Rohrraum
Laufrohr
Rohrraum
Fertigung Rohrschlosserei
Fertigung Rohrschlosserei
Lager
Versand
Versand
Lagerbock
Lagerbock
Lagerbock


3.17
Sanität
B: 61.79 m²
Leinwand
3.32
Pausen- und Besprechungsraum
B: 379.09 m²
Galerie
Küche
Automaten
3.17
Büro TLR
B: 374.45 m²
3.18
Besprechung
B: 55.00 m²
3.20
Putzraum
B: 38.88 m²
3.19
Teeküche
B: 16.50
3.31
Büro TLR
B: 253.31 m²
3.22
Sanität
B: 67.10 m²
Galerie
Schacht HKLS und ELT Abdeckung mit Gitterrost
M4
Bistro / Cafeteria
B: 215.48 m²
4.14
Teeküche
B: 14.85 m²
4.11–2
Besprechung
B: 57.84 m²
4.5
Büro Leitung Optik
B: 110.30 m²
4.8
Büro Instandhaltung
B: 72.75 m²
4.15
Sanität
B: 59.06 m²
Galerie
4.17
QS – MPM–Stelle
B: 141.44 m²
Reservefläche
B: 184.28 m²
Alternative Position für Ansaugtürme
—> brandschutzrechtliche Klärung erf.
2.11
Leitung Zerspanung
B: 185.25 m²
2.15
Ruheraum
B: 18.97 m²
2.12
Teeküche
B: 18.00 m²
2.14
Besprechung
B: 41.40 m²
2.15
SPM Werkleitung
B: 53.23 m²
2.14
Zentralfunktionen
B: 200.06 m²
Galerie
2.12
Besprechung
B: 64.16 m²
2.13
Sanität
B: 59.06 m²
Schacht HKLS Abdeckung mit Gitterrost
Schacht ELT Abdeckung mit Gitterrost

Besprechungsraum
st: 94 m2
Soll: 400 m2

Aufsicht Versand

4.3 Baugruppenmontage

4.3 Werkleitung
st: 93,9 m2
Soll: 180 m2

mit darüberliegendem Oberlicht

Luftraum

4.3 Werkleitung
st: 462,8 m2
Soll: 180 m2

4.4 Bürozone
= 600m2

Luftraum 106m2

.10 Sanitär
st: 26,5 m2

Galerie
st: 131,5 m2
Soll: 0 m2

Pumi/Lager

HALLE 4.3

E GESAMTFLÄCHE.
N FÜR
.IESSUNG SIND NOCH
.BGEZOGEN

BA II ← → BA I

4.4 Maschinenmontage

4.2 Zerspanung

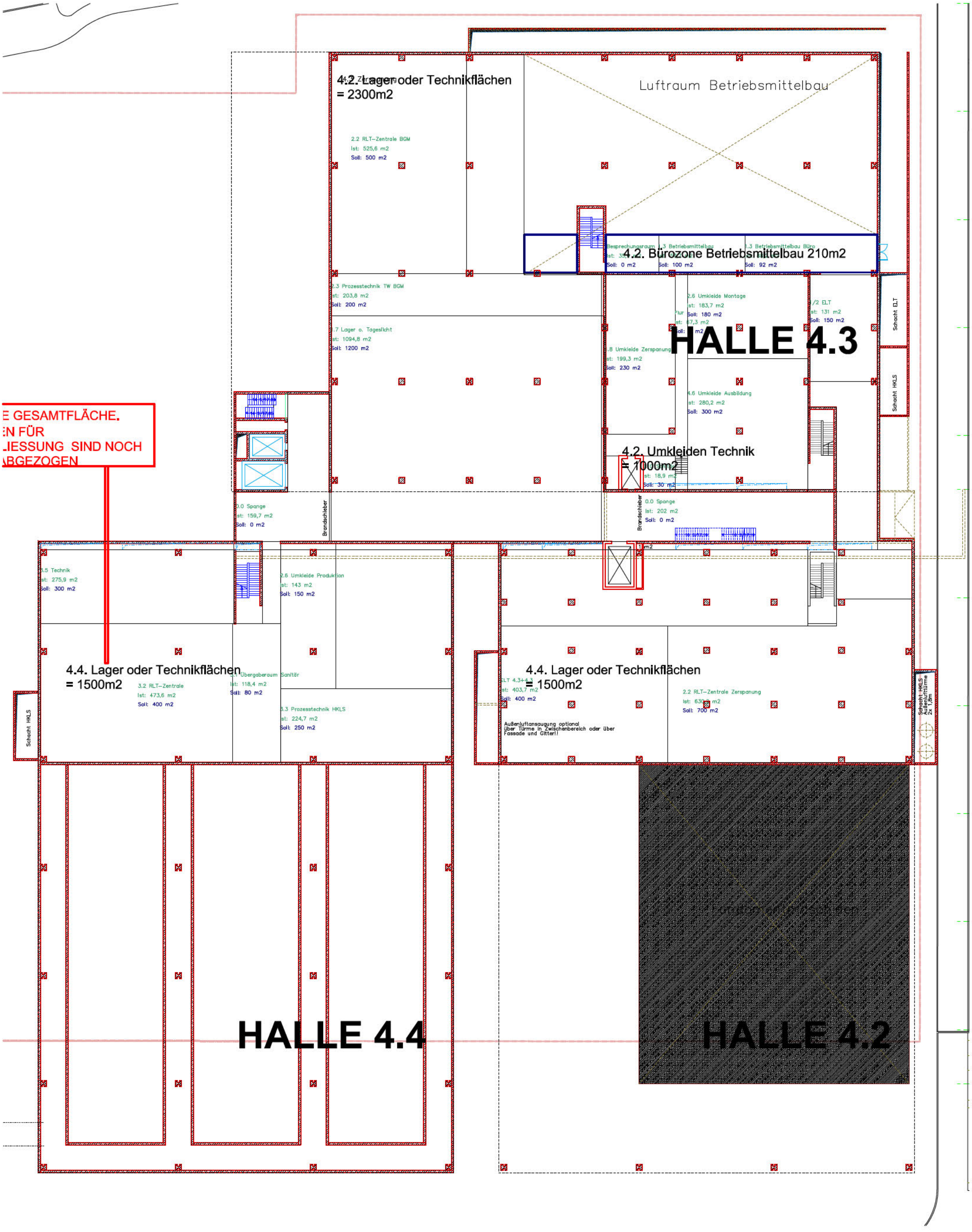
Aufsicht QS

Luftraum

Luftraum

HALLE 4.4

HALLE 4.2


4.2. Lager oder Technikflächen
= 2300m2
Luftraum Betriebsmittelbau
2.2 RLT–Zentrale BGM
Ist: 525,6 m2
Soll: 500 m2
4.2. Bürozone Betriebsmittelbau 210m2
Besprechungsraum
Soll: 0 m2
1.3 Betriebsmittelbau
Soll: 100 m2
1.3 Betriebsmittelbau Büro
Soll: 92 m2
2.3 Prozesstechnik TW BGM
Ist: 203,8 m2
Soll: 200 m2
2.6 Umkleide Montage
Ist: 183,7 m2
Soll: 180 m2
Flur
Ist: 67,3 m2
Soll: m2
/2 ELT
Ist: 131 m2
Soll: 150 m2
Schacht ELT
.7 Lager o. Tageslicht
Ist: 1094,8 m2
Soll: 1200 m2
HALLE 4.3
.8 Umkleide Zerspanung
Ist: 199,3 m2
Soll: 230 m2
4.6 Umkleide Ausbildung
Ist: 280,2 m2
Soll: 300 m2
Schacht HKLS
E GESAMTFLÄCHE.
:N FÜR
.IESSUNG SIND NOCH
ABGEZOGEN
4.2. Umkleiden Technik
= 1000m2
Ist: 18,9 m2
Soll: 30 m2
.0 Spange
Ist: 159,7 m2
Soll: 0 m2
Brandschieber
Brandschieber
0.0 Spange
Ist: 202 m2
Soll: 0 m2
m2
.5 Technik
Ist: 275,9 m2
Soll: 300 m2
2.6 Umkleide Produktion
Ist: 143 m2
Soll: 150 m2
4.4. Lager oder Technikflächen
= 1500m2
3.2 RLT–Zentrale
Ist: 473,6 m2
Soll: 400 m2
.1 Übergaberaum Sanitär
Ist: 118,4 m2
Soll: 80 m2
3.3 Prozesstechnik HKLS
Ist: 224,7 m2
Soll: 250 m2
Schacht HKLS
4.4. Lager oder Technikflächen
= 1500m2
ELT 4.3+4.3
Ist: 403,7 m2
Soll: 400 m2
2.2 RLT–Zentrale Zerspanung
Ist: 630 m2
Soll: 700 m2
Außenluftansaugung optional
über Türme in Zwischenbereich oder über
Fassade und Gitter!!
Schacht HKLS
Außenluftürme
2x 1,8m
HALLE 4.4
HALLE 4.2

E GESAMTFLÄCHE.
EN FÜR
LIESSUNG SIND NOCH
ABGEZOGEN

AB Zerspanung
Ist: 215,7 m2
Soll: 200 m2

1.3 Betriebsmittelbau
Ist: 1077,4 m2
Soll: 1000 m2

4.3. Betriebsmittelbau
= 1300m2

Büro AB Zersp.
Ist: 66,3 m2
Soll: 30 m2

Tunnel zu nördl. Baufeld Gefälle 6,8%

HALLE 4.3

4.2. Lager Technik
= 470m2

REFORM Werkstatt
Ist: [illegible] m2
Soll: 90 m2

SH Werkstatt
Ist: 69,8 m2
Soll: 110 m2

1.1 Übergaberaum Sanitär
4.2+4.3
Ist: 68,6 m2
Soll: 80 m2

Medienkanal

SH Lager Werkstatt
Ist: 186,5 m2
Soll: 90 m2

DD Decke lL EO
1,85 x 3,5 m

0.0 Spange
Ist: 1468,5 m2
Soll: 0 m2

BA II ⟵ ⟶ BA I

Übergang zu EUV

15m2

DD Decke lL EO
1,85 x 5,5 m

HALLE 4.4

HALLE 4.2

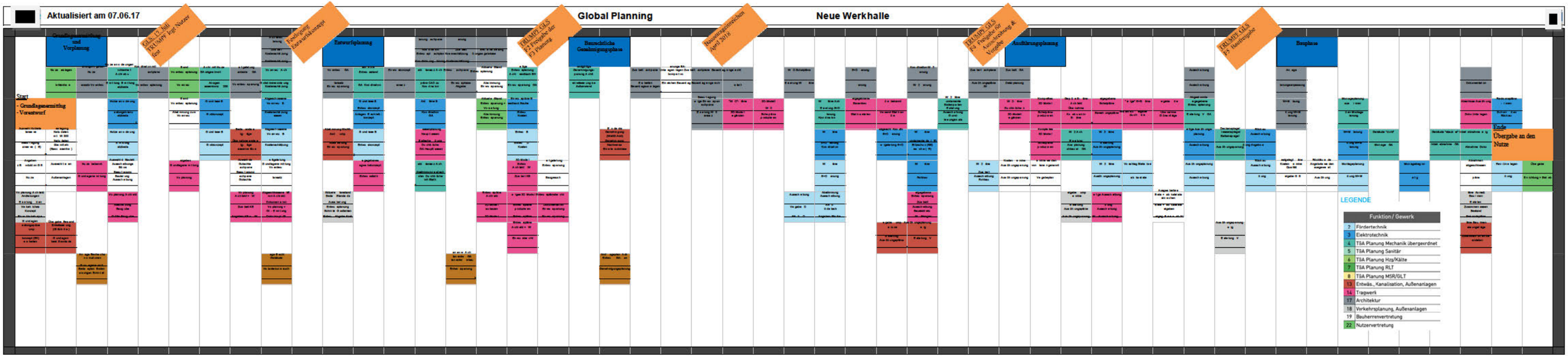
Pos.	Bereich	Ebene 1	Ebene 2	Ebene 3	Büro Ebene 3	Ebene 4	Ebene 5	Summe Büro	Mitarbeiter Produktion	Mitarbeiter Büro	Hakenhöhe [m]	Tageslicht	Unterkellerung	im UG	Bemerkung
2.1	Zerspanung Großanlagen			1700				0	14		6,5	+	-	-	Fundamentmaschinen, Einbringöffnung 4 x 4 m ebenerdig
2.2	Zerspanung Einzelmaschinen			1250				0	12		6,5	+	0	-	Flexible Kranabhängung an Hallendecke 1 t, Maschinen bis 25 t
2.3	Werkzeugausgabe			100				0	7			+	0	0	
2.4	Logistik Zerspanung			100				0	3			--	-	+	Lager für Rohlinge und bearbeitete Großbaugruppen, Aufzug 2,5 x 4,5 m, 5 t
2.5	Büro Zerspanung				120			120		6					
2.6	Sanitär				50			50							
2.7	QS Feinmessraum			350				0	8						
2.8	QS manuelle Prüfung				110			110	3		6,5	0	+	0	Klimaraum, Nähe zu 1.1 und 1.2
2.9	Büro QS/Programmierung				60			60		3					
2.10	Versand			400				0	2						
2.11	Leitung Zerspanung					185		185		9					
2.12	Besprechung					45		45				+	+	0	
2.13	Teeküche					15		15							
2.14	Ruheraum					15		15							
2.15	Sanitär					60		60							
2.16	Lager Zerspanung		1100					0							
	Gefahrstofflager		40												
2.17	Prozesstechnik Zerspanung		250					0				--	-	+	Technikflächen für Prozesskühlung, VE-Wasser, Kühlschmierstoff
2.18	Umkleiden		116					0				--	-	+	
2.19	RLT-4.2		700					0							
2.20	ELT-4.2		400					0							
	Summe Zerspanung	0	2.606	3.900	340	320	0	660	49	18					
3.1	Fertigung Stanzwerkzeuge			1700				0	30						Stickstoff, Späneentsorgung, Papier, Kartonagen, Restmüll, Holzpalleten, Schrott, Abwasser
3.2	Wareneingangskontrolle			100				0	3						
3.3	Lager			350				0	5	1					
3.4	Instandhaltung				30			30	3						
3.5	Leitung Stanzwerkzeuge				100			100		6					
3.6	Besprechung				50			50							
3.7	Teeküche				15			15							
3.8	Konstruktion Stanzwerkzeuge				180			180		13					
3.9	Putzraum				45			45							
3.10	Qualitätssicherung				85			85	2						
3.11	Büro Stanzwerkzeuge				140			140		10					
3.12	Sanitär				60			60							
3.13	Kundenmaschinen TLR			250				0							
3.14	Entwicklung TLR			250				0							
3.15	Versand			250				0							
3.16	Sanitär mit Behinderten-WC			60				0							
3.17	Wareneingang			450				0	7			+	+	0	3 LKW-Rampen
3.18	Büro Wareneingang				30			30		1					
3.19	Büro TLR					375		375		35					
3.20	Besprechung					55		55							
3.21	Teeküche					15		15							
3.22	Putzraum					40		40							
3.23	Büro TLR					250		250		25					
3.24	Sanitär mit Behinderten-WC					65		65							
3.25	Sanitär					60		60							
3.26	Mehrzweckraum					380		380							
3.27	Bistro / Cafeteria					215		215							
3.28	Zentralfunktionen						200	0		8					
3.29	SFM Werkleitung						50	0							
3.30	Besprechung						65	0				+	+	0	
3.31	Sanitär						60	0							
3.32	Lager TLR		100					0							
3.33	Lager Instandhaltung TWS		40					0							
3.34	Büro Betriebsmittelbau		150					0		10					
3.35	Besprechungsraum		40					0							
3.36	Teeküche		10					0							
3.37	Zerspanung Betriebsmittelbau	500						0	13		6,5	+	0	0	Bekranung siehe 1.2, ggf. Aufzug 3 x 5 m, 15 t und 2 x 4 m, 5 t
3.38	SYNCHRO Werkstatt	60						0							
3.39	Werkstatt Instandhaltung	150						0							
3.40	Lager Instandhaltung TW		300					0							
3.41	Büro Linienoptik		120					0		6					
3.42	Reinraum Linienoptik	500						0	12						ISO 7, Bekranung 1 t, Hakenhöhe 3,25 m, Höhe Reinraum 5,3 m + Technik min. 2 m
3.43	Logistik Linienoptik	500						0	6						
3.44	Umkleiden Produktion		277					0							
3.45	Prozesstechnik Reinraum		250					0							
3.46	Plenum Reinraum		500					0							
3.47	RLT-4.3		500					0							
3.48	ELT-4.3		400					0							
3.49	Übergaberaum Sanität	80						0							

Pos.	Bereich	Ebene 1	Ebene 2	Ebene 3	Büro Ebene 3	Ebene 4	Ebene 5	Summe Büro	Mitarbeiter Produktion	Mitarbeiter Büro	Hakenhöhe [m]	Tageslicht	Unterkellerung	im UG	Bemerkung
	Stanzwerkzeuge/TLR/Bemi	1.790	2.687	3.410	735	1.455	375	2.190	81	115					
4.1	Personalschleuse			50				0					+	0	
4.2	Reinraum TW			554				0	20			+	+	0	Abgetrennt von Zerspanung, freistehender Stahlbau, ggf. begehbaren Plenum, Hallenhöhe 7,5 m
4.3	Endmontage Reinraum			130				0	2						
4.4	Reinigung / Logistik Reinraum		200	366				0	2		5,5				Wasseraufbereitung in darunterliegender Ebene
4.5	Montage Optische Baugruppen			300				0	11		5,5	+	+	0	Abgetrennt von Zerspanung
4.6	Logistik Optik			270				0	2						
4.7	Büro Optik				100			100		5					
4.8	Leitung Optik					110		110		6					
4.9	Besprechung					60		60				+	+	0	
4.10	Teeküche					15		15							
4.11	Instandhaltung inkl. EW/DW				300			300	9			++	+	0	Lager in E1
4.12	Sanitär				55			55							
4.13	Büro Instandhaltung					70		70		6					
4.14	Sanitär					60		60							
4.15	Montage Blechbaugruppen			300				0	5		5	+	0	-	Bekranung 2 t, temporäre Unterbringung bis BF neu
4.16	Logistik Blechbaugruppen		350	250				0	2		6,5	-	+	0	Hochregallager, Aufzug 2,5 x 4,5 m, 5 t, temporäre Unterbringung bis BF neu
4.17	Montage TLR			500				0	5		6,5	+	0	-	Bekranung 10 t, Kranbahn auf 25 t ausgelegt
4.18	Logistik TLR		200	200				0	2		6,5	-	+	0	
4.19	Büro Blechbaugruppen/TLR				85			85		4					
4.20	Montage Betriebsmittelbau			400				0							
4.21	Versand			300				0	2			+	0	-	ebenerdig, Kranbahn durchgehend in Montage
4.22	QS - MPM-Stelle					140		140		1					
4.23	Prozesstechnik Reinraum		250					0							
4.24	Umkleiden		146					0				--	-	+	
4.25	RLT-4.4		400					0				--	-	+	
4.26	ELT-4.4		300					0							
4.27	Übergaberaum Sanität		80					0							
	Summe Optik/Blech/TLR	0	1.926	3.620	540	455	0	995	62	22					
	Gesamt	**1.790**	**7.219**	**10.930**	**1.615**	**2.230**	**375**	**3.845**	**192**	**155**					

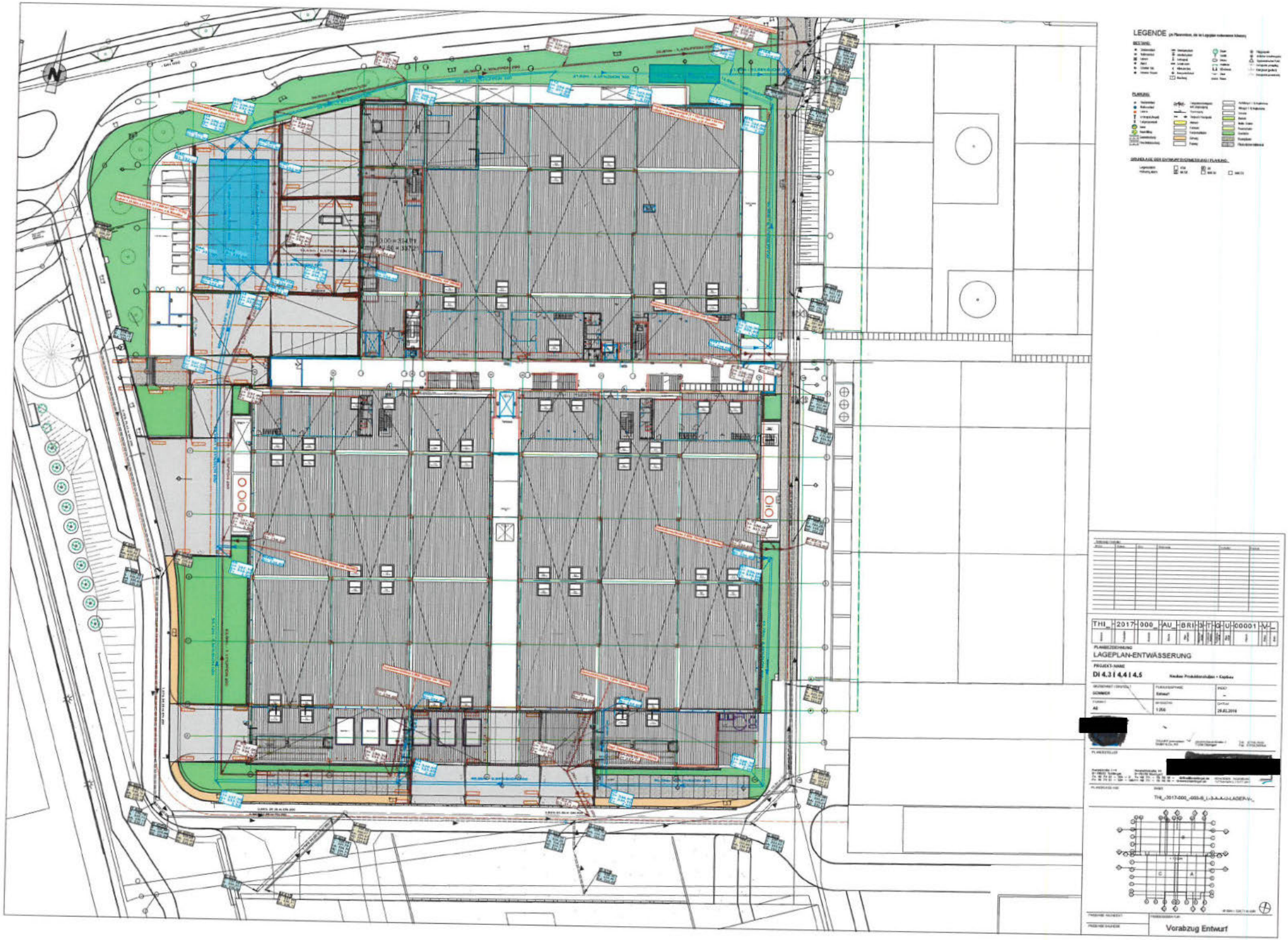
Legende:

Tageslicht	++	Blick ins Freie erwünscht, Sonneneinstrahlung unkritisch
	+	Blick ins Freie, Sonneneinstrahlung auf Maschinen möglichst vermeiden
	0	Tageslicht, temperaturkritisch, Sonneneinstrahlung unbedingt vermeiden
	-	Tageslicht erwünscht, aber nicht zwingend
	--	keine Dauerarbeitsplatz, kein Tageslicht erforderlich
Unterkellerung	+	möglich und unkritisch
	0	möglich, aber schwere Lasten
	-	nicht möglich, nicht sinnvoll
im UG	+	sinnvoll
	0	möglich, wenn entsprechende Schwerlastaufzüge vorhanden sind
	-	nicht möglich

Appendix P

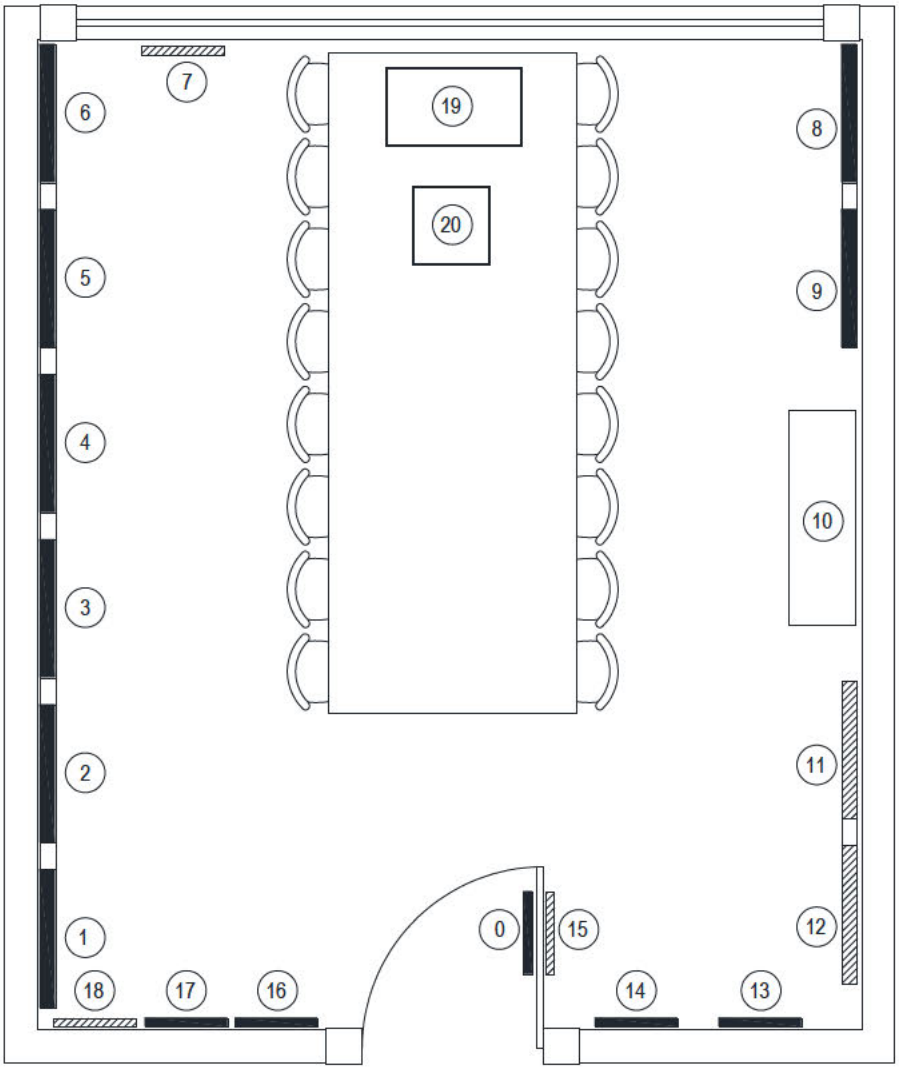

Aktualisiert am 07.06.17
Global Planning
Neue Werkhalle
EGLS 12 Voll FBUMPF Fgt. Nutzer Test
Fredegang Entwurfskonzept
FBUMPF EGLS F2 Freigabe der F3 Planung
Baurechtliche Genehmigungsphase
Nutzungsänderungsantrag April 2018
FBUMPF EGLS F5 Freigabe für Ausschreibung & Vergabe
FBUMPF EGLS F5 Ausführungsplanung
Grundlagenermittlung und Vorplanung
Entwurfsplanung
Ausführungsplanung
Bauphase
Start
- Grundlagenermittlung
- Vorentwurf
Ende
Übergabe an den Nutze
LEGENDE
Funktion / Gewerk
2 Fördertechnik
3 Elektrotechnik
4 TGA Planung Mechanik übergeordnet
5 TGA Planung Sanitär
6 TGA Planung Hzg/Kälte
7 TGA Planung RLT
8 TGA Planung MSR/GLT
13 Entwäs., Kanalisation, Außenanlagen
14 Tragwerk
17 Architektur
18 Verkehrsplanung, Außenanlagen
19 Bauherrenvertretung
22 Nutzervertretung

Appendix Q


LEGENDE
THI_2017_000_AU_BRI_STG_U_00001_V1_
LAGEPLAN-ENTWÄSSERUNG
Di 4.3 | 4.4 | 4.5
Vorabzug Entwurf

Appendix R

LDMT PROJECT ROOM FLOOR PLAN (May 2018)



Permanently fixed board

Removable board

0 Room Layout Plan

1 Week 1 (last week) board

2 Week 2 (this week) board

3 Week 3 board

4 Week 4 board

5 Week 5 board

6 Week 6 board

7 Exceptions Tracking Reporting

8 Action Plan whiteboard

9 Risk Matrix whiteboard

10 Document cupboard (contains architects plans)

11 5 main flows board

12 Holiday chart

13 Colour scheme

14 Overall GPA

15 Project Milestone Agenda (for today)

16 Description of lean process

17 Team ground rules

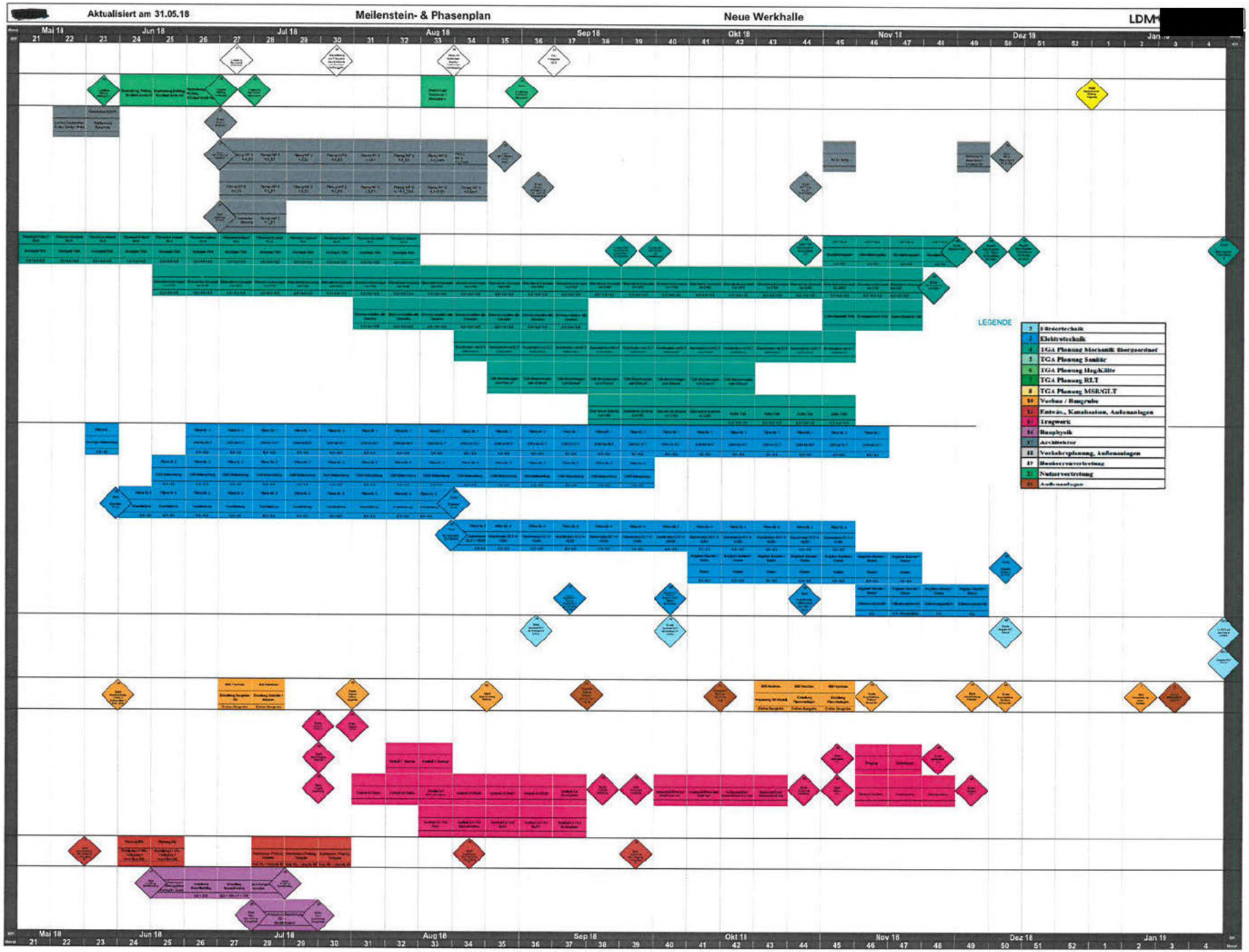
18 Delays and faults board

19 Post-It's suitcase

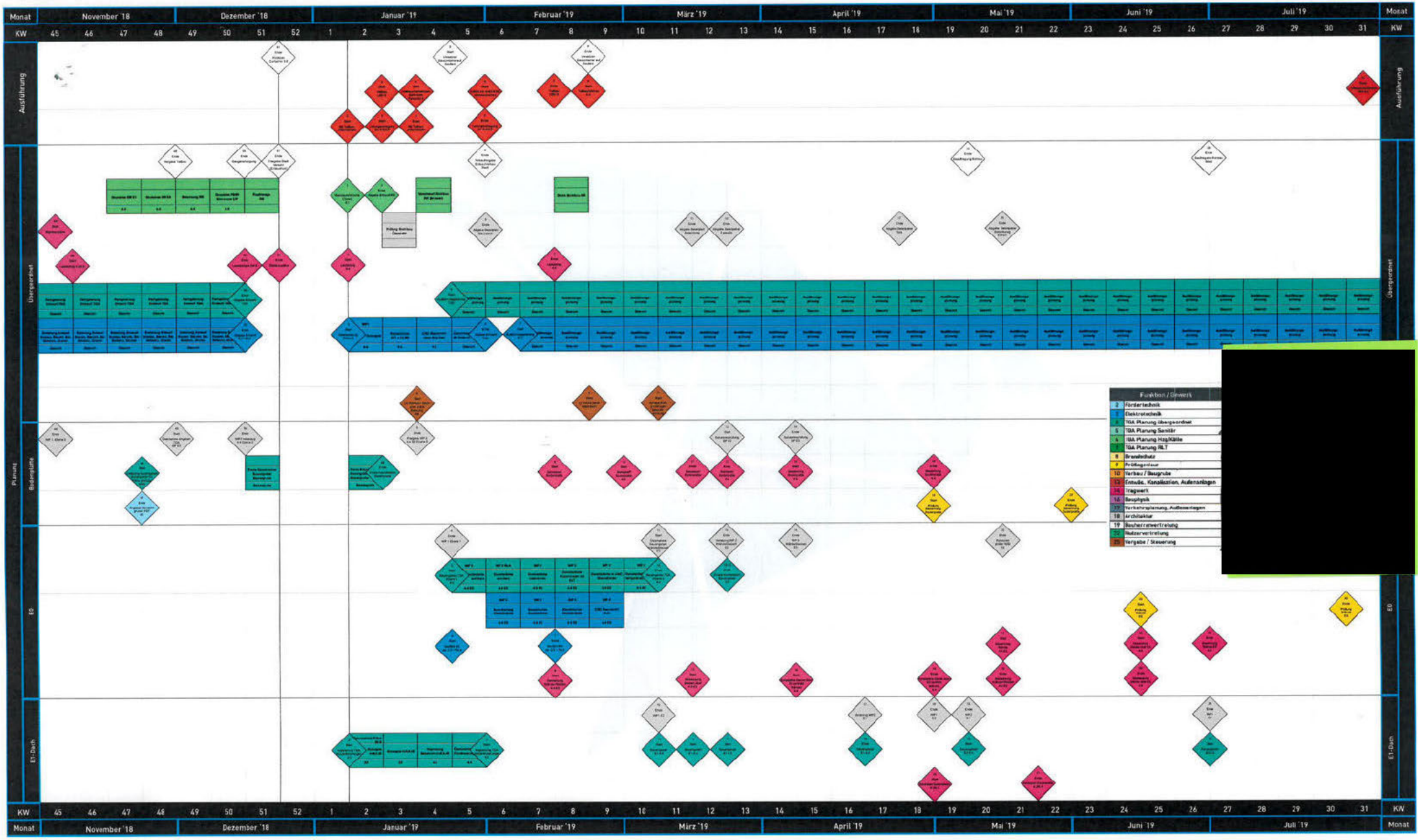
20 Glass box

Appendix S

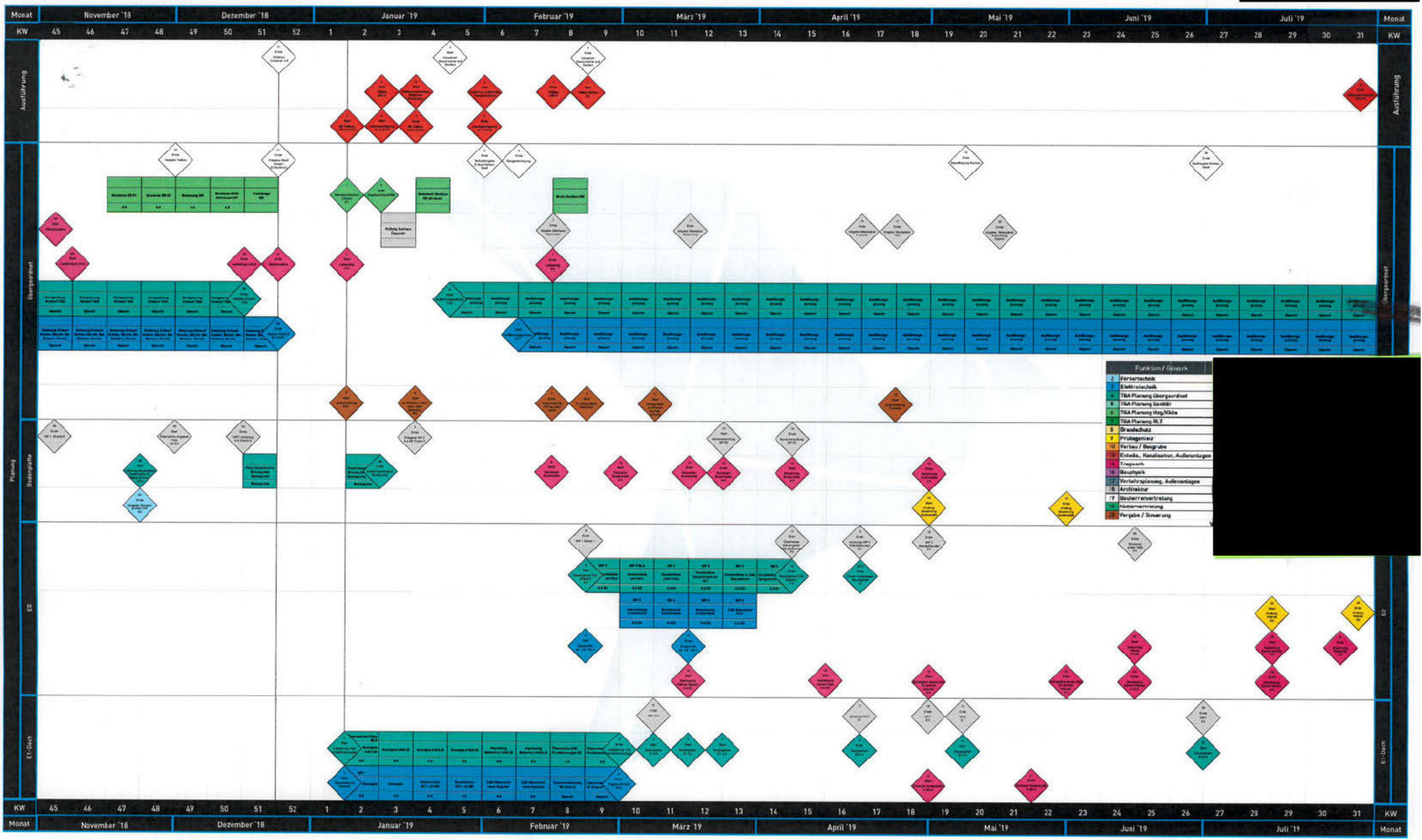
[redacted] Aktualisiert am 31.05.18 | Meilenstein- & Phasenplan | Neue Werkhalle | LDM[redacted]



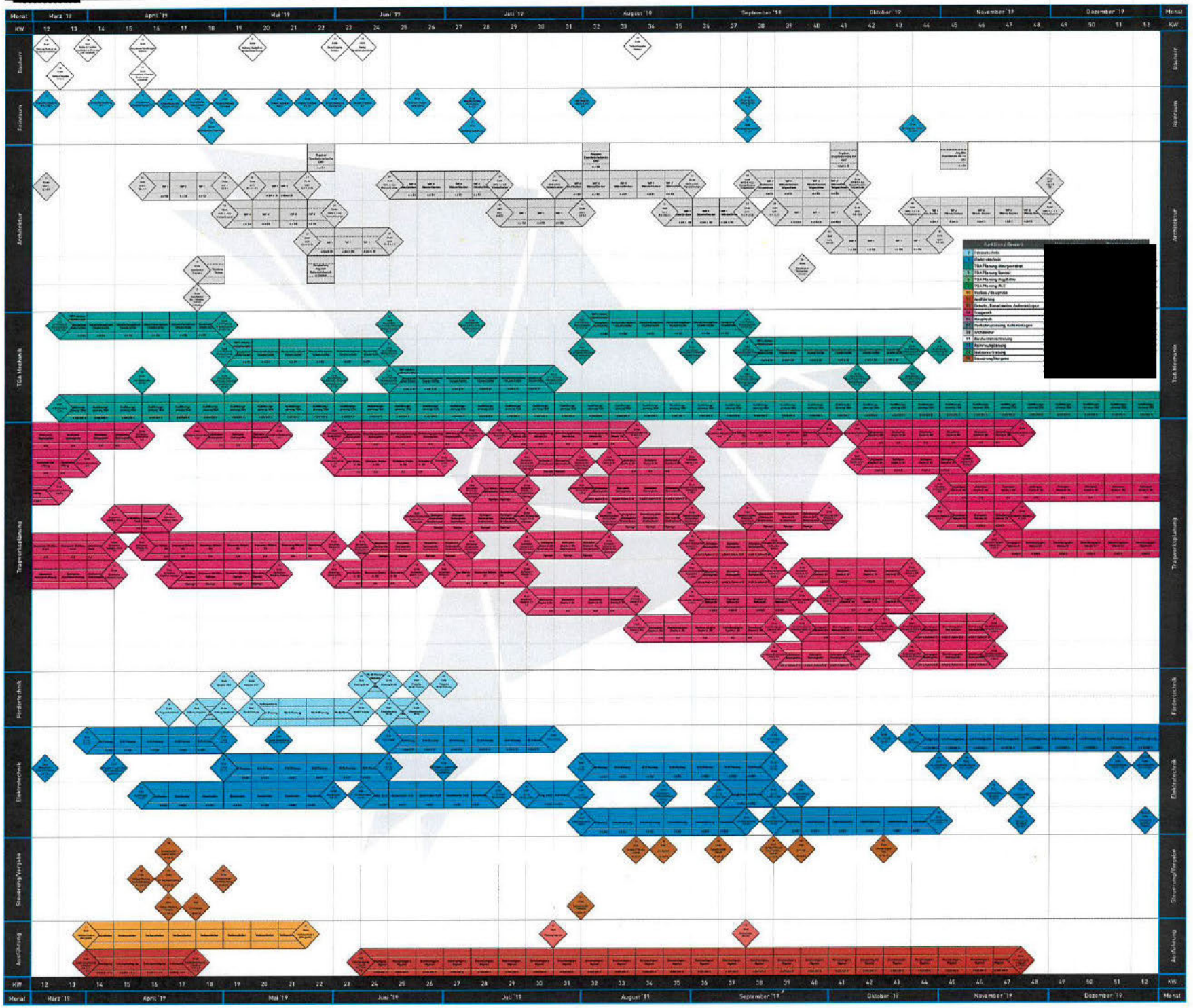
[redacted] Aktualisiert am: 08.11.2018 **Chapter Planning** Neue Werkhalle **LDM** [redacted]


Monat
November '18
Dezember '18
Januar '19
Februar '19
März '19
April '19
Mai '19
Juni '19
Juli '19
KW
45 46 47 48 49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Ausführung
Übergeordnet
Planung Bodenplatte
EG
EG
EG

[redacted] Aktualisiert am: 14.12.2018 **Chapter Planning** Neue Werkhalle [redacted]



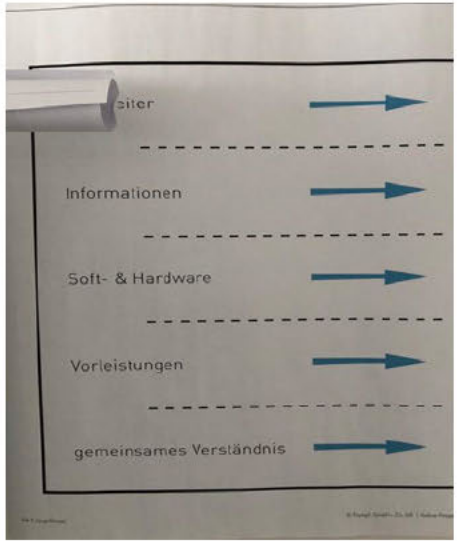
[redacted] Aktualisiert am: 14.03.2019 **Chapter Planning** Neue Werkhalle

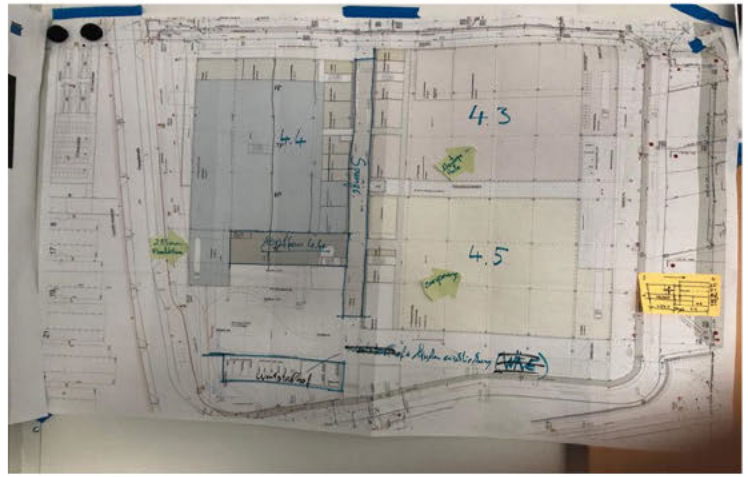


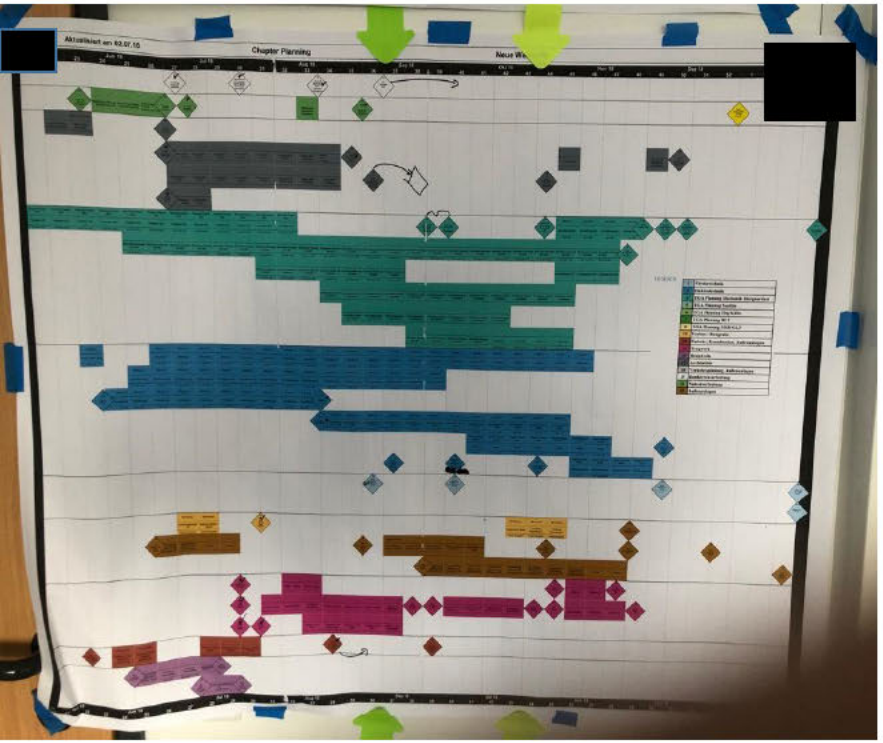
Appendix T

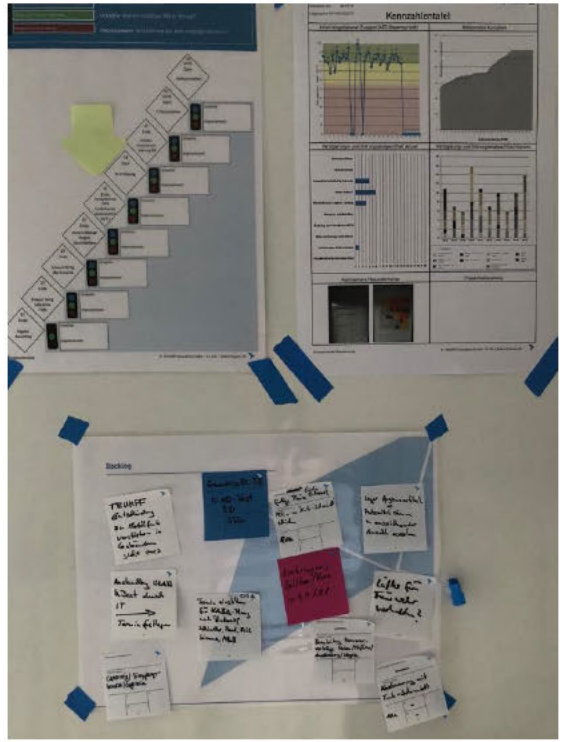
Chapter Planning
Global Planning
Section Planning
Lean Design Management
PLAN
DO
CHECK
ACT
Aktionsplan
Kennzahlen-tafel
Risikomatrix
POCA-Methode nach Shewhart und Deming

WUNSCH DES BAUHERRN
VORSCHLAG DES STATIKERS
VON DER BAUFIRMA ABGEFÜHRT
NACH DER SANIERUNG

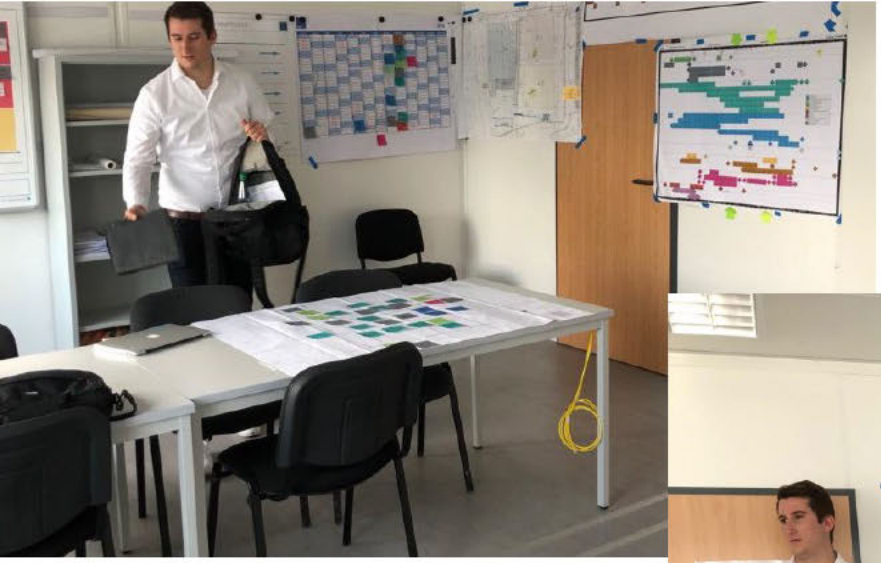

Informationen
Soft- & Hardware
Vorleistungen
gemeinsames Verständnis

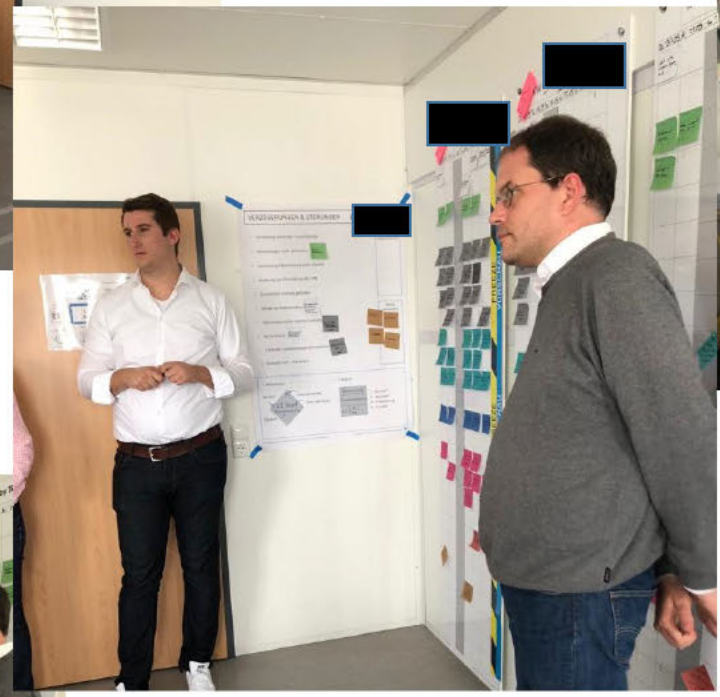

4.3
4.4
4.5

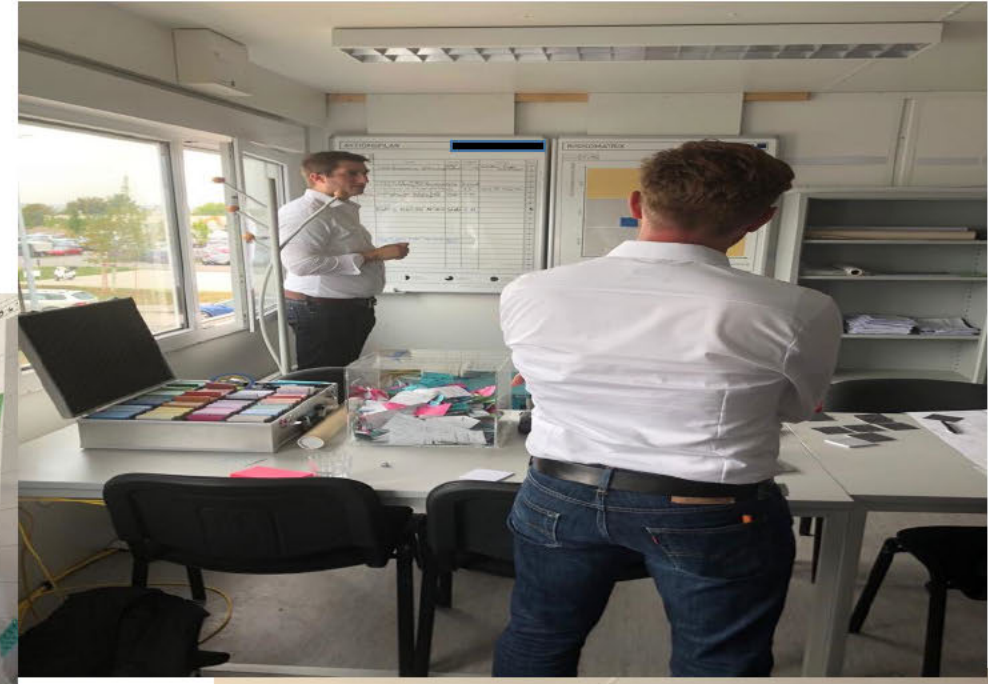

Chapter Planning

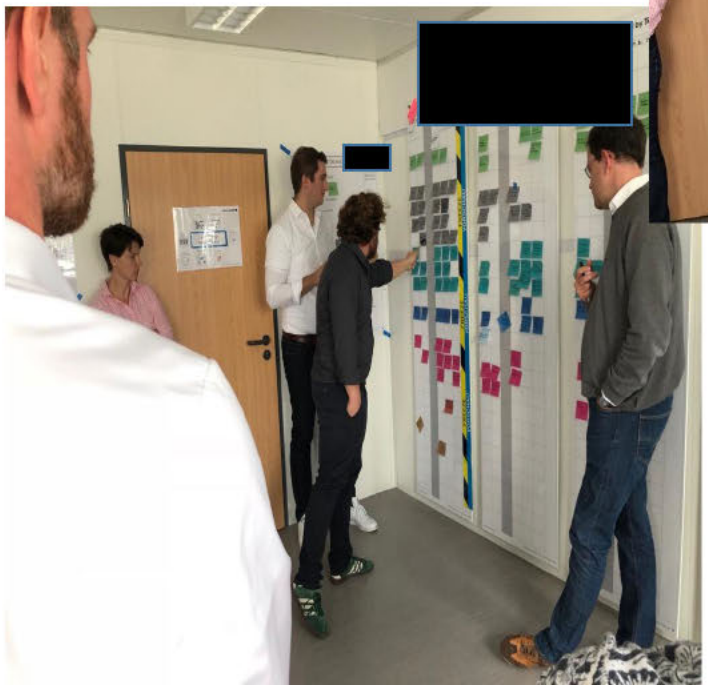

Kennzahlentafel
Backlog

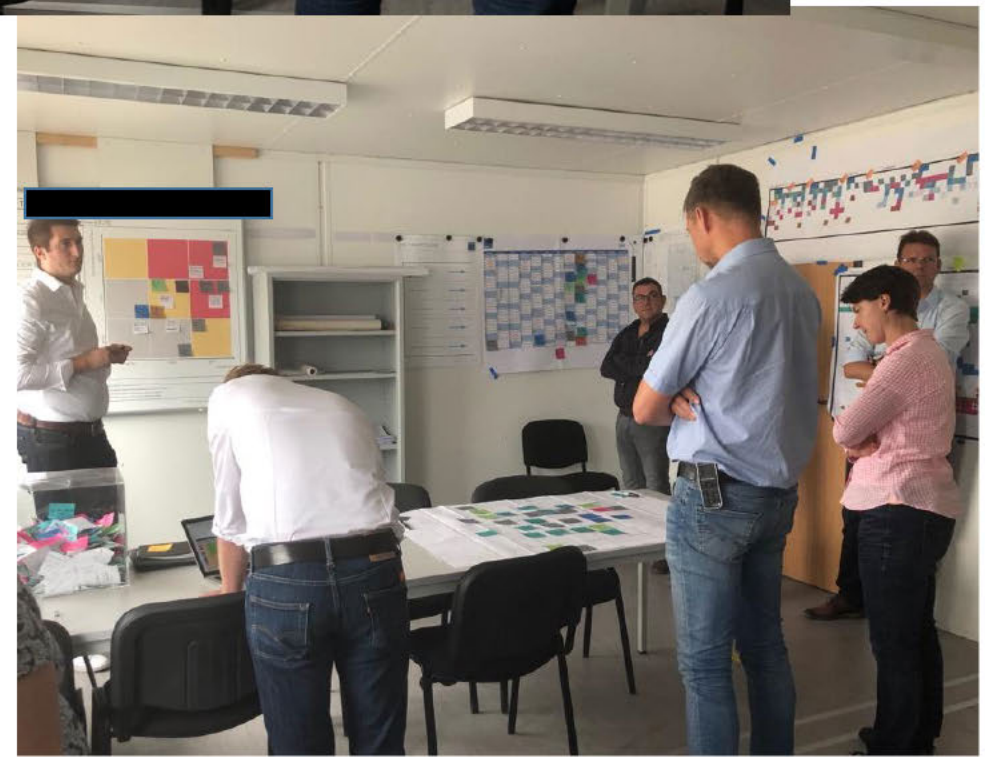
ERNST²
2018
Januar
Februar
März
April
Mai
Juni
Juli
August
September
Oktober
November
Dezember
Januar '19

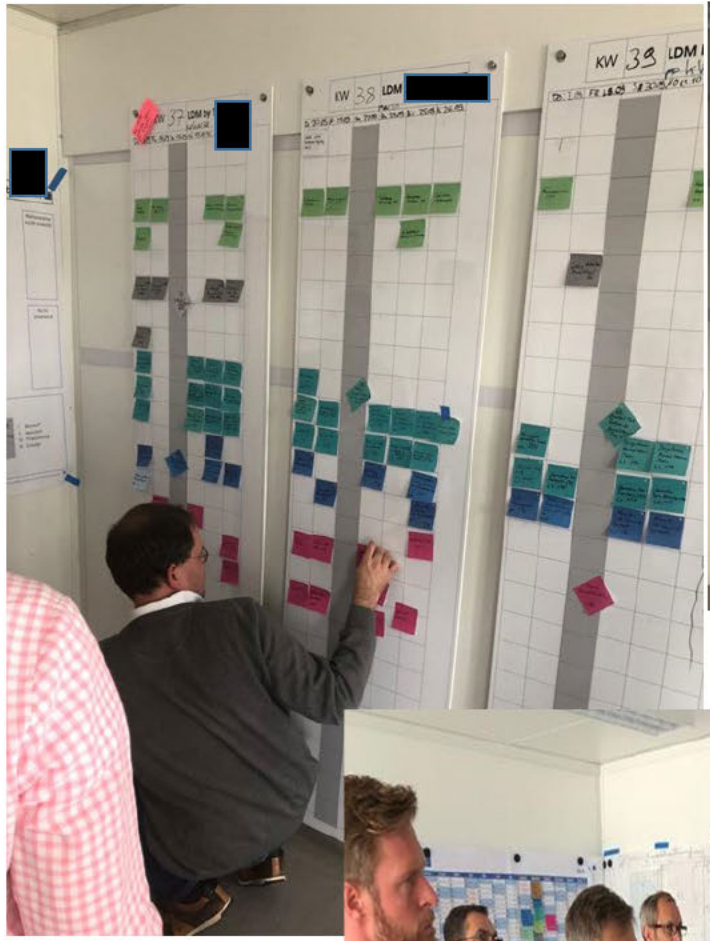


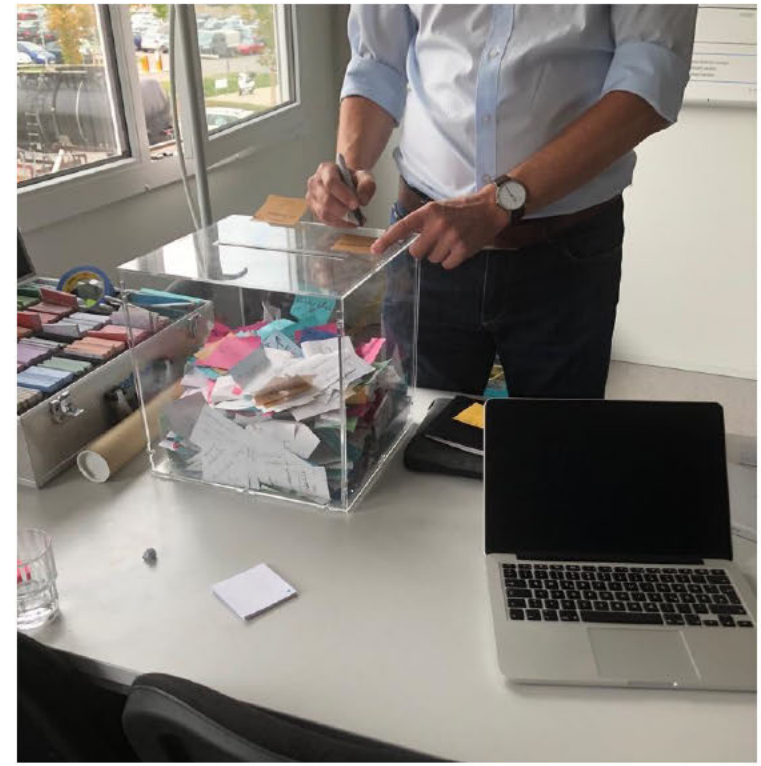









KW 39
KW 38 LDM



Appendix U

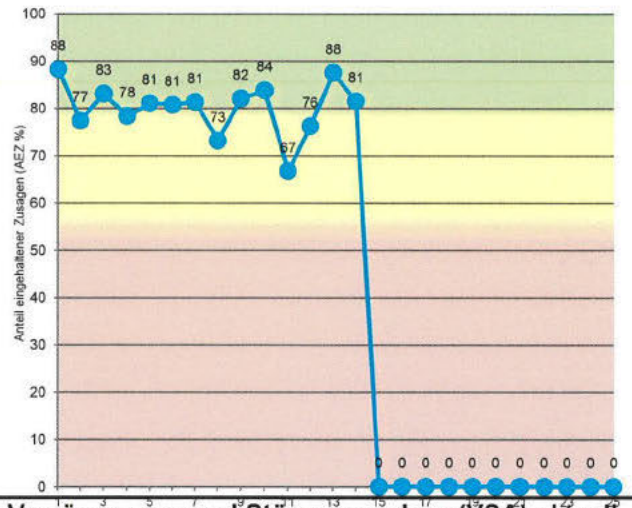
LDM [redacted]

Aktualisiert am: 11/04/2019

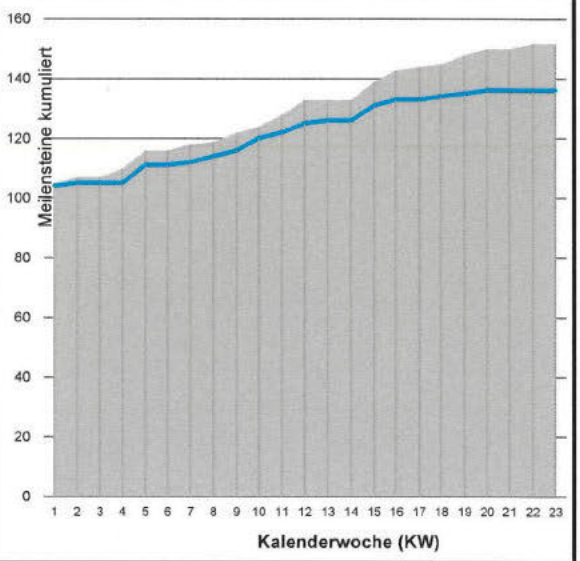
Vergangene KW KW 14/2019

Kennzahlentafel

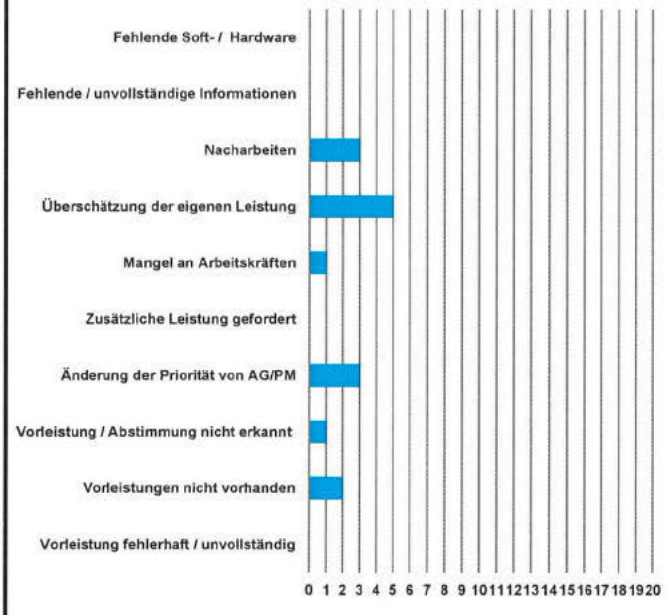
Anteil eingehaltener Zusagen (AEZ) Gesamtprojekt



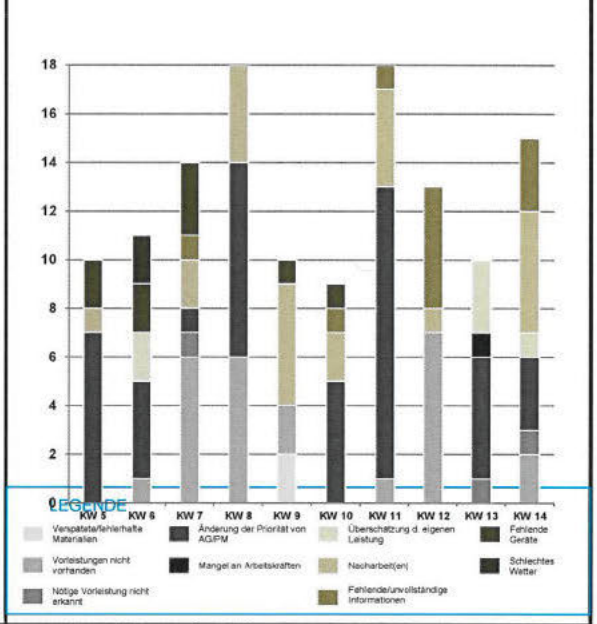
Meilensteine kumuliert



Verzögerungs- und Störungsanalyse (VSA) aktuell



Verzögerung- und Störungsanalyse (VSA) Histori



Kommentare / Besonderheiten

Projektmeilensteine

© [redacted]

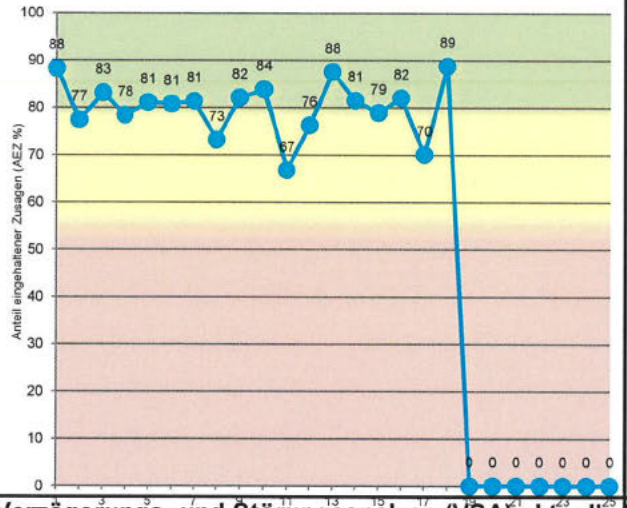
Aktualisiert am: 19/05/2019

Vergangene KW KW 18/2019

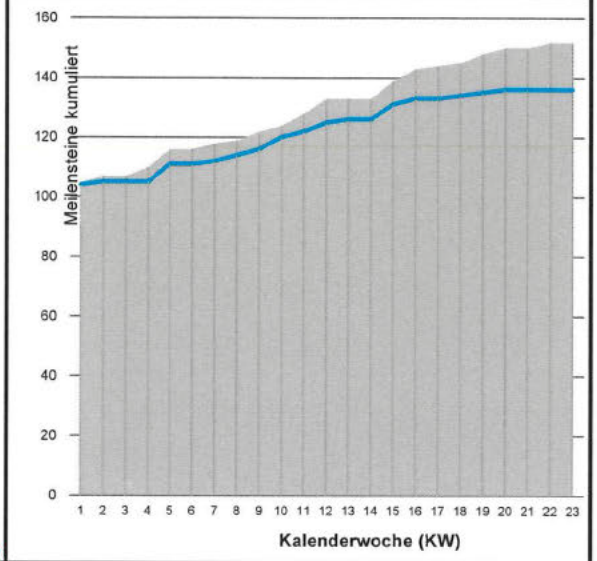
LDM [redacted]

Kennzahlentafel

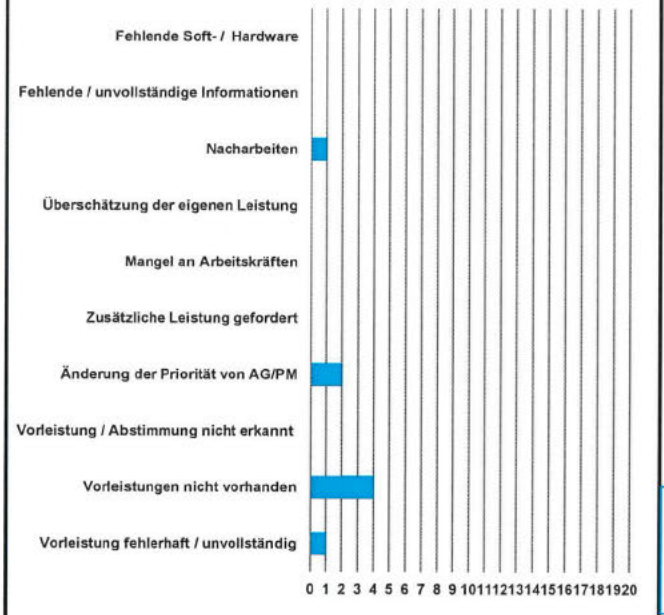
Anteil eingehaltener Zusagen (AEZ) Gesamtprojekt



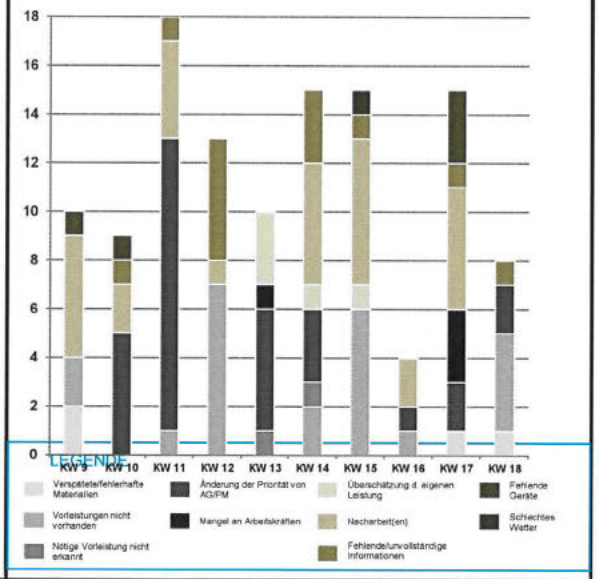
Meilensteine kumuliert



Verzögerungs- und Störungsanalyse (VSA) aktuell



Verzögerung- und Störungsanalyse (VSA) Histori



Kommentare / Besonderheiten

Projektmeilensteine

© [redacted]

Appendix V

April 2019- ground is broken

May 2019 – Project Room has moved into the building adjacent to construction site