THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Co-Constructed Work Design in Production: Toward Realizing Human-Centric Operations

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Cover:
The intertwined strands symbolize the dynamic relationship between organizational structures and human agency, placing the person at the center.
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ABSTRACT

The manufacturing industry is undergoing a transformation toward Industry 5.0, a paradigm emphasizing human-centricity alongside resilience and sustainability. While Industry 4.0 promised efficiency, anticipated gains were often limited by neglected human aspects. This thesis argues that to realize human-centric operations, research must move beyond static approaches to work design and examine the interplay between top-down structural conditions and bottom-up employee agency.

This thesis explores the dynamics of work design across the individual (micro), team (meso), and organizational (macro) levels in the manufacturing industry. Employing dialectical pluralism, the multi-methodological approach integrates exploratory qualitative interviews, a quantitative cross-sectional survey, and a longitudinal design science research study evaluating an intervention in multiskilled production teams within the Swedish manufacturing sector.

The findings reveal that work design in production is a co-construction process where bottom-up agency is contingent upon top-down structural conditions. At the micro level, misalignment between prescribed and perceived work characteristics drives front-line managers to redesign their work through compensatory job crafting. While handling immediate disturbances, this reactive crafting masks systematic design problems from senior management. At the meso level, an organizational learning structure demonstrates that deliberate top-down scaffolding facilitates constructive agency. By operationalizing dual team membership within multiskilled production teams, the organization effectively bridges the individual and organizational levels through team-based integration.

Furthermore, the results challenge the assumed universality of motivational models in highly standardized contexts. In this setting, work characteristics show strong associations with employee well-being, often bypassing expected motivational pathways. Moreover, the transition to human-centric work design introduces novel systemic challenges. The research identifies a paradox of success where successful upskilling initiatives increase internal mobility, inadvertently destabilizing the very teams they were designed to strengthen.

In conclusion, this thesis conceptualizes work design not as a static assignment but as a dynamic co-construction process. To place human needs at the center of the production process, organizations must foster responsible autonomy, ensuring that the interplay between standardized systems and the need for human-centric work design feeds into organizational learning processes rather than reactive coping.

Keywords: work design, human-centric operations, Industry 5.0, job crafting, organizational learning, lean production, self-determination theory, front-line managers

LIST OF APPENDED PAPERS

This thesis is based on the work contained in the following papers.

Paper 1.

Edén, E., Ollila, S., & Wänström, C. (2026). Designing managerial work in production: Front-line managers' job crafting. Accepted for publication *in International Journal of Operations and Production Management*.

This paper was accepted for publication in April 2026.

Paper 2.

Edén, E., Wänström, C., & Larsman, P. (2026). Work design and well-being in manufacturing: Rethinking motivation pathways in standardized work settings. Submitted to *Scandinavian Journal of Psychology*.

Paper 3.

Wänström, C., Edén, E., Kaulio, M., Kullberg, S., Hallin, M., Rapp Ricciardi, M., Skagert, K., & Larsman, P. (2026). An organisational learning model as a foundation for multiskilled production teams. Invited for resubmission to *Journal of Operations Management*.

This paper received a "revise and resubmit" decision in April 2026.

Paper 4.

Edén, E. (2026). Designing human-centric intervention studies in operations management: An empirically grounded framework and design principles. Submitted to *Production & Manufacturing Research.*

A previous version of this paper was presented at the *EurOMA conference 2025* in Milan, Italy.

AUTHOR CONTRIBUTIONS

Paper 1

Elin Edén was the main author and conducted much of the work independently, including holding most interviews, doing main parts of the data analysis, and writing the first draft. Carl Wänström participated in interviews with senior managers, while Susanne Ollila participated in analyzing those interviews and creating a data structure. All three authors joined in theoretical considerations and discussions, as well as editing and expanding the early draft to a full paper. Edén and Ollila conducted main revisions of the paper during the review process.

Paper 2

Elin Edén was the main author and responsible for the study design, in discussion with the other authors. All three authors participated in designing the questionnaire and planning the data collection. Edén and Wänström collected data. Other project members (not authors of this paper) also participated in data collection. Edén performed the analysis and wrote the paper with guidance from Larsman.

Paper 3

Elin Edén was the second author of this paper and participated in data collection as well as data analysis and writing. She contributed to large parts of the theoretical framework, method, findings, and discussion. Wänström was the main author, leading the writing process and contributing to substantial parts of the introduction and theory, as well as findings and discussion. The study was planned by all authors. Edén, Kullberg, and Kaulio analyzed data from Case A, while Wänström and Hallin analyzed data from Case B. Wänström, Edén, and Kaulio took a lead in planning and writing the paper.

Paper 4

Elin Edén was the sole author of this paper. Insights in this paper were inspired by discussions within the project group (consisting of the authors of Paper 3).

To Magnus

I am who I am because I had you.

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Endure, my heart: you have borne worse than this.

— Homer, *The Odyssey*

This PhD journey has been an unprecedented time in my life. While pursuing a PhD is transformative in itself, it is what happened outside that shook my whole world.

The pandemic, the birth of my youngest, and then the tragic day that changed everything.

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Elin Edén,

Mölndal, April 2026.

But endurance had always been my virtue, and I kept on.

— Madeline Miller, *Circe*

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1. INTRODUCTION

This introductory chapter establishes the foundation for the thesis by exploring the transition toward human-centric operations within the manufacturing industry. It begins by outlining the strategic imperative of placing human needs at the center of production systems, followed by an examination of the dual nature of work design and its empirical context in contemporary manufacturing. Subsequently, the chapter addresses the current limitations of static work design models and introduces a multi-level approach to bridge these gaps. Finally, the chapter concludes by presenting the overall aim and the specific research questions that guide the thesis.

1.1 The imperative for human-centric operations

The manufacturing industry is currently undergoing a transformation. While the initial wave of digitalization in Industry 4.0 promised efficiency through automation and interconnection, realized gains have often fallen short due to neglect of the human factor (Grosse et al., 2023). Research increasingly highlights that a one-sided focus on technology risks creating "phantom profits", with underperforming systems (Neumann & Dul, 2010; Neumann et al., 2021). Consequently, the paradigm is shifting toward Industry 5.0, which emphasizes a resilient, sustainable, and human-centric industry (European Commission, 2021, 2024). The EU defines human centricity as "a multidimensional framework that places human needs, characteristics, motivation, and experiences at the center of design, development, and implementation of technological solutions and organizational practices that not only meet functional requirements, but also enhance human well-being, capabilities, skills, and working conditions" (European Commission, 2024, p. 12). In this context, the design of work is no longer merely a matter of operational efficiency for organizations; it is a strategic necessity for attracting talent, fostering continuous learning, and ensuring long-term competitiveness. For operations management (OM), the challenge lies in moving beyond technocentric approaches to place human needs and interests at the center of the production process, not only at the level of individual jobs but also across teams and systems.

1.2 The dual nature of work design

We know that work design – the content and organization of tasks and roles – is a primary predictor of both employee well-being and organizational performance (Parker, 2014). Historically, manufacturing work has been shaped by top-down scientific management and lean principles, often characterized by standardization and repetitive tasks (Parker et al., 2017).

While efficient, these environments can limit autonomy and motivation. To counter this, organizational psychology has long established that job resources, such as autonomy and social support, are essential for satisfying psychological needs and for fostering motivation and job satisfaction (Hackman & Oldham, 1976; Morgeson & Humphrey, 2006; Bakker & Demerouti, 2007; Parker, 2014; Deci et al., 2017). Furthermore, employees are not passive recipients of work design; they actively engage in job crafting to reshape their tasks and relationships to better fit their needs and abilities (Wrzesniewski & Dutton, 2001). Thus, modern work design must be understood as a dynamic outcome of the interplay between top-down structural conditions and bottom-up agency.

1.3 The empirical context: Work design in contemporary manufacturing

To fully grasp the interplay between structural conditions and human agency, it is necessary to first define the environment in which this research takes place. Contemporary manufacturing is characterized by intense global competition, rapid technological development, and a growing reliance on technology-driven production systems (Neumann et al., 2021). In practice, these large-scale, standardized production systems translate into mass or batch shop floor environments with tightly coupled flows, where operators perform highly repetitive assembly or machine-tending tasks tied to short cycle times (Parker et al., 2017; Cullinane et al., 2013). In the Scandinavian context, this development has been linked to a gradual shift from earlier sociotechnical work designs toward lean-inspired line organizations with increased standardization and tighter daily control of production (Oudhuis & Tengblad, 2020).

Within this context, lean production has become the dominant organizational paradigm, driving efficiency through waste reduction, continuous improvement, and strict process control. Although theoretically an integrated socio-technical system, practical lean implementations often overemphasize efficiency and standardization at the expense of social practices, thereby increasing work intensity and limiting autonomy in low-complexity jobs (Cullinane et al., 2013). At the same time, recent research highlights the potential of lean as a learning system, where continuous improvement routines and team structures can support reflection, capability development, and multilevel organizational learning (Kristensen et al., 2022; Saabye et al., 2022). Realizing this potential, however, requires leadership that creates social integration mechanisms that support the adoption and use of new digital technologies in daily operations (van Dun et al., 2026).

The transition to Industry 4.0 intensifies these dynamics, as advanced automation and data analytics heighten the cognitive demands on operators and front-line managers. While promising higher efficiency, these technological benefits are difficult to realize unless human

capabilities and learning structures are developed in parallel (Neumann et al., 2021). Consequently, the emerging Industry 5.0 paradigm advocates for human-centric production, where technological and organizational designs explicitly support employee well-being, learning, and resilience (European Commission, 2021; Neumann et al., 2021; Grosse et al., 2023).

In this thesis, the term manufacturing is used to denote the industry and organizational setting, whereas production refers to the design and operation of shop floor systems and processes within that setting. The empirical studies in this thesis are situated in the Swedish manufacturing sector, with a primary focus on the automotive industry. Characterized by intense global competition, rapid technological development, and long-standing lean production practices, this environment places high demands on both efficiency and resilience. This provides a relevant context for examining the interplay between formal structures and human agency, and for exploring how human-centric work design can be pursued in practice.

1.4 The limitations of static work design models in production

In production, work design has traditionally been conceptualized in OM as a static, manager-driven process, whereas organizational psychology emphasizes employees' active role in shaping their work. However, in standardized, lean production environments, we still lack sufficient understanding of how this interplay between top-down structural conditions and bottom-up agency actually unfolds in practice. Drawing on Petropoulos et al. (2026), this traditional top-down view emphasizes the allocation of resources, the assignment of roles and tasks, and the integration of tasks between and within organizational levels to align with goals and strategy. Within this thesis, these elements constitute the top-down structural conditions of work design. However, this top-down perspective overlooks how employees actually cope with and adapt to these prescribed work characteristics through bottom-up agency.

For instance, the work design of front-line managers (FLMs) remains underexplored. FLMs serve as a critical bridge between strategic goals and daily operations (Townsend & Kellner, 2015), yet they face increasing pressure to balance efficiency with employee well-being. We lack a deeper understanding of how these managers cope with and craft their roles when caught between top-down demands for standardization and the bottom-up reality of shop floor constraints and uncertainties.

Furthermore, despite extensive studies on lean and motivating work design (Parker, 2003; de Treville & Antonakis, 2006; Conti et al., 2006; Cullinane et al., 2013) aimed at supporting psychological needs and employee well-being, and despite the theoretical potential of lean as a learning system (Kristensen et al., 2022), the industry still struggles to make space for

development and learning in practice. While motivating work design addresses motivation, evolving toward learning and future-oriented practices requires a structure for organizational learning supported by a strategic alignment of management practices. Although concepts like ambidexterity (balancing efficiency and flexibility) are well known, companies often lack the "scaffolding" required to support learning (Saabye et al., 2022). Empirical knowledge is limited regarding how to design organization-level structures that facilitate continuous learning without sacrificing the efficiency inherent in lean production (Secchi & Camuffo, 2019).

Finally, the specific mechanisms linking work design to well-being in highly standardized contexts remain debated, as general motivational models may not fully capture the reality of the shop floor with its tension between strict process control and human needs (de Treville & Antonakis, 2006; Cullinane et al., 2013).

These gaps are not isolated but span multiple organizational levels, highlighting a need to understand their continuous interplay. They concern how organization-level structures support learning and autonomy, how team-level practices create or constrain space for development, and how individual employees and front-line managers actively cope with and reshape their work under the constraints of lean production.

1.5 Bridging the gap: A multi-level approach

This thesis addresses the specific gaps identified in the literature – namely, the limited empirical knowledge regarding how to design organization-level structures that facilitate continuous learning without sacrificing the efficiency inherent in lean production, the debated mechanisms linking work design to well-being in highly standardized contexts, and the underexplored reality of how front-line managers in production cope with and craft their roles. These issues are addressed by adopting a multi-level perspective on work design. Because most management phenomena span multiple levels, changes implemented at one organizational level inevitably have direct implications for the other levels, necessitating a holistic view (Hitt et al., 2007; Molina-Azorín et al., 2020). Therefore, the team level must be explicitly recognized alongside individual and organizational domains to capture the full scope of these dependencies.

To clarify the tension between distinct research areas with differing epistemologies, this multi-level approach serves as a bridge. Operations management traditionally views work design through top-down structural conditions, lean principles, and standardization. In contrast, organizational psychology emphasizes bottom-up agency, job crafting, psychological needs, and employee well-being. By investigating the interplay between the macro level (organizational strategies and lean structures), the meso level (teams and groups), and the micro level (individual experience and job crafting), this research explicates the "in-between" of these

perspectives. It argues that, to realize the vision of Industry 5.0 and human-centric work design, we must move beyond isolated studies of individual well-being or organizational performance. As noted by Hitt et al. (2007) and Molina-Azorín et al. (2020), focusing on a single level risks suboptimization. By explicating how top-down structural conditions enable or constrain bottom-up agency, this thesis contributes to a more comprehensive understanding of the interplay between standardized systems and the emerging need for human-centric work design. Ultimately, balancing these dynamics is a strategic necessity for attracting talent, fostering continuous learning, and ensuring long-term competitiveness, thereby placing human needs and interests at the center of the production process.

To further clarify this gap, it is useful to contrast how operations management and organizational psychology have traditionally approached work design. Within OM, despite a historical awareness of sociotechnical systems (e.g., Oudhuis & Tengblad, 2020), the transition to standardized lean production has cemented a predominantly structural, top-down perspective. Normative models, whether traditional lean production systems or emerging Industry 4.0 and 5.0 frameworks, are frequently conceptualized as relatively stable configurations that can be designed and then implemented to optimize system performance (e.g., Neumann et al., 2021). Within these macro-level perspectives, human-centricity is often framed as an intended property or outcome of the system design, rather than as a dynamic, negotiated process unfolding in daily operations.

Conversely, research within organizational psychology and work design provides profound insights into how specific work characteristics influence individual motivation, well-being, and learning (e.g., Parker et al., 2017; Deci et al., 2017). However, this micro-level focus often abstracts away the hard operational constraints of the manufacturing environment. For instance, theories of proactive employee behavior, such as job crafting (Wrzesniewski & Dutton, 2001), generally assume a degree of structural flexibility and individual autonomy that is rarely present in tightly standardized, high-paced production flows (Cullinane et al., 2013).

Consequently, a critical theoretical and empirical gap remains at the intersection of these disciplines. The field lacks a synthesized understanding of the friction that occurs when top-down normative OM models collide with bottom-up human agency on the shop floor. We know too little about how frontline personnel actively manage and compensate for misaligned structural designs, or what specific organizational and methodological challenges emerge when attempting to introduce human-centric interventions – such as continuous learning structures and multiskilled teams – into volatile and standardized environments. Addressing this gap requires moving beyond static, single-level conceptualizations of work design to investigate the dynamic, multilevel interplay between rigid structural constraints and human agency.

These theoretical and empirical gaps form the starting point for the present thesis and are addressed through three research questions, outlined in the next section. In short, we know surprisingly little about how human-centric work design can be realized in practice under the structural constraints of lean production.

1.6 Aim and research questions

Addressing these gaps is essential if manufacturing firms are to translate Industry 5.0 ideals into concrete practices that both sustain performance and protect human well-being. The present thesis responds to this need through three research questions. Together, they move from individual mechanisms (RQ1), via the interaction between structural conditions and human agency (RQ2), to the organizational and methodological challenges of implementing human-centric work design in practice (RQ3).

The aim of this thesis is to explore the dynamics of work design across individual, team, and organizational levels in the manufacturing industry, in order to understand how human-centric operations can be realized in an Industry 5.0 context. Specifically, it investigates how the interplay between top-down structural conditions and bottom-up employee agency influences motivation, well-being, and learning.

1.6.1 Research question 1

The first research question focuses on the individual level, where work characteristics are known to be central determinants of motivation, well-being, and performance (Parker et al., 2017; Bakker & Demerouti, 2007; Deci et al., 2017). However, most empirical work on work design and self-determination theory has been conducted in relatively flexible or knowledge-intensive settings, whereas highly standardized, lean-based production environments impose strict temporal and procedural constraints that may alter how work characteristics operate (de Treville & Antonakis, 2006; Cullinane et al., 2013). By examining how specific work characteristics relate to motivation, stress, job satisfaction, and learning opportunities among operators in such contexts, RQ1 addresses the need for more fine-grained, context-sensitive evidence on the mechanisms linking work design to individual outcomes in contemporary manufacturing.

RQ1. In what ways do work characteristics influence individual outcomes such as motivation, well-being, and learning in standardized production contexts?

1.6.2 Research question 2

The second research question shifts attention to the interplay between top-down structural conditions and bottom-up agency in shaping work design at individual and team levels. Traditional operations management views largely conceptualize work design as a managerial task of allocating resources, defining roles, and specifying processes (Petropoulos et al., 2026; Neumann et al., 2021). Conversely, research on job crafting and proactive behavior demonstrates that employees actively alter their tasks, relationships, and boundaries to create a better fit with their needs and capabilities (Wrzesniewski & Dutton, 2001; Parker, 2014). In lean production, this interaction is particularly salient, as standardized routines, tight performance pressures, and closely coupled flows constrain the structural flexibility and autonomy often assumed in job crafting research (Conti et al., 2006; de Treville & Antonakis, 2006; Cullinane et al., 2013). RQ2 therefore examines the ways in which this interaction unfolds in practice, investigating how bottom-up agency is exercised to navigate the tension between standardized structures and daily operational realities. By doing so, it contributes to a multilevel understanding of work design as an ongoing, co-constructed process rather than merely a static top-down structure.

RQ2. How do top-down structural conditions and bottom-up agency interact to shape work design at individual and team levels in manufacturing environments?

1.6.3 Research question 3

The third research question addresses the organizational and methodological implications of attempting to implement human-centric work design under conditions of standardization and volatility. While Industry 5.0 frameworks emphasize human-centricity, advocating for worker well-being (European Commission, 2021, 2024), empirical reviews of lean implementations show that such production concepts can also intensify work and negatively affect employee health, especially in manual, low-complexity jobs (Hasle et al., 2012; Cullinane et al., 2013). Furthermore, research on Industry 4.0 and human factors warns that technology-driven production systems that neglect human capabilities and limitations risk creating “phantom profits,” where expected performance gains are undermined by mismatches between system demands and human resources (Neumann & Dul, 2010; Neumann et al., 2021).

To counteract these risks, organizational learning and ambidexterity research emphasize the need for deliberate structures to support exploration and capability building alongside exploitation. Recent work on lean-oriented change demonstrates that such learning interventions require deliberately designed structures that allocate time, space, and roles for

reflection without undermining ongoing operations (Saabye et al., 2022). However, introducing these human-centric interventions into real-world manufacturing settings inevitably generates systemic friction. RQ3 therefore explores how interventions – such as multiskilled teams and loop-model learning structures – unfold over time, what unintended consequences they generate, and how contextual volatility challenges conventional research designs. In doing so, it contributes both theoretical insights into human-centric production and methodological guidance for evaluating interventions in dynamic industrial environments.

RQ3. What are the organizational and methodological implications and emergent challenges of implementing human-centric work design?

2. FRAME OF REFERENCE

This chapter establishes the theoretical foundation for the thesis by first exploring the shift from tech-focus to human-centricity and the transition toward Industry 5.0. It then describes the Swedish context and the movement from sociotechnical work design to lean production. Following this positioning, the chapter examines the theoretical foundations of work design alongside the concept of job crafting. A multilevel perspective on work design in production environments is subsequently presented to capture the organizational complexity. Finally, the chapter provides a concluding synthesis, outlining a conceptual framework of work design and redesign in production.

2.1 From tech-focus to human-centricity: the shift toward Industry 5.0

Industrial digitalization has long been dominated by the concept of Industry 4.0 (I4.0), where the primary focus has been on technical efficiency through automation and interconnected systems. However, a purely technology-centric perspective often overlooks the human factor, risking negative consequences such as stress, monotony, and system dysfunction (Neumann et al., 2021).

As a theoretical response, Industry 5.0 (I5.0) places the worker at the center of the production process. Ivanov (2023) describes I5.0 as an evolution in which resilience, sustainability, and human-centricity are integrated into value-creating systems to ensure long-term viability. Grosse et al. (2023) argue that the transition to I5.0 requires the design of production systems that balance perceptual, cognitive, and physical demands so that technology supports rather than limits the human worker. However, Reiman et al. (2021) note a gap between theory and practice; even technologically mature companies often reduce human factors (HF) to reactive safety measures. To bridge this gap, a broader perspective is required – one that moves beyond physical ergonomics to include psychosocial and organizational factors strategically in the early design phases of technology adoption.

2.1.1 The interdependence of social and technical systems

To provide such a perspective, previous research on technological transformation often relies on sociotechnical theory, emphasizing that social, technical, and organizational dimensions must be developed in unison. One-sided investments in technology can be counterproductive. For example, Tortorella et al. (2023) show that technologies for data collection can have a negative effect on performance if they are not integrated with effective organizational practices, whereas

technologies that convert data into action tend to reinforce good routines. Marcon et al. (2025) emphasize that successful companies understand the interdependence between these factors, for instance, that a technical upgrade requires a corresponding social upgrade in the form of new skills.

2.1.2 Competence, innovation, and well-being

The transition to a more human-centric industry places new demands on the workforce and on required competencies. Carminati et al. (2025) identify an urgent need to integrate digital, green, and resilient skills into educational initiatives, as current programs often fail to meet the industry's needs. Competence development is not just a matter of employability but also a driver of innovation. Horvat et al. (2025) show that combining advanced technology with competence development and active employee involvement increases the likelihood of generating product innovations. Bellingan et al. (2024) found that training interventions increasing workers' competence not only improved well-being but also enhanced factory performance through reduced rework and staff turnover. This indicates that investments in human capital create a positive spiral, benefiting both the individual and the organization.

2.1.3 The role of leadership and front-line management

Leadership plays a crucial role in navigating these changes. Van Dun and Kumar (2023) highlight that technical implementation requires social enablers, particularly transformational leadership and emotional intelligence, to manage the anxiety that new technology may provoke. While top management sets the vision, the role of middle and front-line managers is critical in operationalizing human-centricity. Januszek et al. (2024) show that middle managers do not just implement decisions but actively influence top management's commitment, where their attitude toward change programs (such as lean) determines how successful the implementation becomes throughout the organization. Front-line managers act as a vital link between strategy and daily operations, fostering resilience by navigating uncertainties and interruptions (Townsend & Kellner, 2015; Karltun et al., 2023). Their role extends beyond meeting production targets to actively supporting lean practices, employee well-being, and continuous learning (Simões et al., 2024; Huo et al., 2022; Wallo et al., 2013). Consequently, their attitude toward change determines the success of implementation on the shop floor.

2.1.4 Lean as a foundation for digital transformation

A central question in the literature is how new technology relates to established production philosophies like lean. However, the path to integration is not straightforward; Hines et al. (2026) note that the exact nature of how these two approaches relate, or should relate, remains somewhat ambiguous. Frank et al. (2024) highlight that the integration of lean and digital technologies creates tensions that must be managed through dynamic balance for the integration to lead to benefits such as enhanced problem-solving capabilities and social performance. Furthermore, quantitative research shows that I4.0 should not be seen as a replacement for lean. Frank et al. (2025) found that while lean practices directly improve worker outcomes and performance, I4.0 technologies mainly have a positive effect when implemented via lean. Buer et al. (2018) showed that "soft" lean practices are often overlooked, emphasizing the necessity of incorporating social aspects into the transformation. When successful, this integration allows digital tools to contribute to organizational learning processes (Powell et al., 2024).

To achieve this success, the focus must shift to the employees. Hines et al. (2026) argue that successful implementation benefits both the organization and the employees but relies heavily on how employees perceive the change, highlighting the importance of team autonomy and catering to human needs. Consequently, to understand how to achieve this human-centricity while maintaining the efficiency inherent in lean, it is necessary to look more deeply into the principles of work design. The next sections therefore turn to the Swedish manufacturing context and to contemporary work design theories.

2.2 The Swedish context: from sociotechnical work design to lean production

The Swedish automotive and engineering industries form a historically distinctive setting for examining the tension between standardized production systems and human-centric work design. Sweden has long been characterized by strong unions, an interventionist state, and ambitious reforms in industrial democracy, leading to extensive legislation on co-determination and employment protection, as well as state-supported workplace development programs. At the same time, Tengblad and Andersson (2024) show that while these reforms gave employees a formal voice, they did not fundamentally change management's decision-making power or the focus on efficiency. This combination of strong institutions and continued reliance on efficiency-driven work designs mirrors a broader international pattern in which enriched work design principles enjoy substantial theoretical support but only partial implementation in practice (Parker, 2014).

On the shop floor, Sweden gained international recognition during the 1970s and 1980s for sociotechnical work designs in companies such as Volvo and Scania, where semi-autonomous work groups, long work cycles, and enriched tasks were introduced to combine efficiency with more meaningful work (Oudhuis & Tengblad, 2020). These experiments were strongly influenced by the sociotechnical systems tradition, which emphasizes the joint optimization of technical and social systems and has historically been closely associated with Scandinavian autonomous work groups (Parker et al., 2017). The Volvo Uddevalla plant serves as a prime example: rather than using a traditional assembly line, cars were built in parallel flows by small teams with long work cycles and holistic responsibility for complete vehicles. Empirical analyses of the Uddevalla plant show that this sociotechnical design successfully addressed operators' basic psychological needs, although this depended heavily on leadership quality and often struggled to meet productivity targets (Medbo & Wänström, 2025). This resonates with wider evidence that autonomous work groups and team-level autonomy are consistently associated with positive attitudinal outcomes, yet display more mixed effects on performance depending on factors such as task interdependence, operational uncertainty, and the broader organizational system (Parker, 2014; Parker et al., 2017).

Despite their psychological benefits, as product variety, global competition, and technological complexity increased, these sociotechnical configurations gradually gave way to lean production systems. Oudhuis and Tengblad (2020) demonstrate this shift in the case of Scania: around 1990, the company still operated several sociotechnical arrangements with broad operator responsibility, while by 2017 the Scania Production System was dominated by line organization, short and standardized work cycles, daily control routines, and tightly specified team structures. This development implies that the original Scandinavian work-life model has been partly marginalized in practice, even as formal co-determination and value statements such as "respect for the individual" remain in place.

Against the backdrop of this dual heritage, contemporary Swedish automotive manufacturing brings together strong traditions of employee influence with lean production logics that tighten standardization and increase work intensity. This makes the Swedish automotive sector a highly relevant context for this thesis, which explores how top-down structural conditions in lean production interact with bottom-up agency at the micro and meso levels. Specifically, it examines how front-line managers compensate for misaligned work design through job crafting, how organizational learning structures such as the loop-model can scaffold constructive forms of responsible autonomy in multiskilled teams, and how these multilevel dynamics shape the prospects for genuinely human-centric work design in an Industry 5.0 era, in which companies are expected to use advanced technology while still designing work in a way that supports employees. Such a multilevel and dynamic focus aligns with calls for more

contextualized, longitudinal, and multi-level studies that link individual, team, and system-level work design processes, including both top-down structures and bottom-up crafting and proactivity (Parker, 2014; Parker et al., 2025).

2.3 Theoretical foundations of work design

Work design is a multilayered process involving the management of tasks (determining, allocating, grouping, and integrating) and roles (responsibility, authority, and interactions). It is primarily concerned with human work, rather than machines (Petropoulos et al., 2026). The research field has undergone significant development over the past century. Historically, production work was shaped during the industrial revolution and through scientific management (Taylor, 1911), moving toward increasing job simplification. This culminated in production lines, such as those at Ford, which were characterized by low autonomy and simple tasks. Despite their efficiency, these designs often led to dissatisfaction and high turnover among workers, prompting a shift toward motivational theories (Parker et al., 2017).

2.3.1 Motivational and health-oriented models

In response to the negative effects of simplified jobs, motivational theories emerged. One of the most influential is Hackman and Oldham's (1976) job characteristics model (JCM). This model identifies five core dimensions – skill variety, task identity, task significance, autonomy, and feedback – as essential for generating internal motivation. According to the theory, these characteristics lead to three critical psychological states: experienced meaningfulness, experienced responsibility, and knowledge of results. When these states are present, they result in positive outcomes such as high internal motivation, job satisfaction, and work quality, while reducing absenteeism and turnover. Hackman and Oldham (1976) also emphasized the individual's "growth need strength" as a moderator, where individuals with a strong need for personal development respond more positively to enriched jobs. Later research has found only limited support for some of these specific propositions, such as the moderating role of growth need strength, while strongly supporting the basic links between core job characteristics and attitudinal outcomes (Parker, 2014).

Alongside the JCM, other approaches emerged. The sociotechnical systems perspective sought to optimize both the technical and the social aspects of work, leading to the development of autonomous work groups. These groups have been shown to increase job satisfaction, although their effect on productivity varies (Parker et al., 2017). Furthermore, Karasek's job demands-control model (Karasek, 1979) focused on health, proposing that the risk of stress-

related ill health is highest when demands are high and control is low. This was later developed by Bakker and Demerouti (2007) into the job demands-resources (JD-R) model. The JD-R model categorizes the work environment into job demands (e.g., work pressure, emotional demands) and job resources (e.g., autonomy, feedback). Demands drive a health-impairment process, potentially leading to exhaustion, while resources drive a motivational process leading to engagement. A core premise of the model is the interaction between these factors, where resources mitigate the adverse effects of high demands. While much research supports the dual-path logic, evidence for the proposed demand–resource interaction is more mixed (Parker, 2014).

2.3.2 Integrative and contextual perspectives

To address the need for a more comprehensive view, research has moved toward integrative and interdisciplinary perspectives combining psychology, ergonomics, and engineering. Morgeson and Humphrey (2006) criticized previous measures for being incomplete and developed the work design questionnaire (WDQ). They expanded the concept of work design to include three major categories: motivational, social, and contextual characteristics. Their study showed that while both task- and knowledge-related characteristics increase job satisfaction, it is primarily knowledge requirements that lead to higher training and compensation needs. They also highlighted social factors, such as social support and interdependence, as well as contextual factors like physical demands, which had previously been overlooked in purely motivational models. Parker (2014) argues that work should be designed to promote learning and development, support physical and mental health, and facilitate ambidexterity – the ability to balance control (for efficiency) and flexibility (for innovation). In these more recent approaches, the terms “work design” and “work characteristics” are used instead of “job design” and “job characteristics” to emphasize a broader perspective in which work is not static but is continuously designed and redesigned.

Research has also moved toward understanding how work design is influenced by its environment. Morgeson et al. (2010) argue that work design is shaped by both occupational and organizational contexts. The occupational context influences design through specific values and reward systems, whereas the organizational context exerts influence through factors such as organizational climate, technical systems, and structure. For example, a mechanistic structure may limit opportunities for autonomy, while a strong safety climate may make certain design features more prominent.

2.3.3 Work design in teams

Although job design initially focused on individuals, the sociotechnical systems approach introduced the importance of autonomous work groups (Parker et al., 2017). Evidence suggests that self-management within these groups enhances productivity (Campion et al., 1993), yet Morgeson and Campion (2021) note that such designs involve trade-offs between flexibility and risks such as free-riding. Consequently, optimal functioning requires specific conditions rather than random assignment. Williams et al. (2010) found that teams thrive under transformational leadership and high autonomy but struggle when there is a mismatch in members' proactivity, indicating that consistency in personality composition is crucial for maintaining effective social norms. Ultimately, reinforcing the importance of the work structure itself, Campion et al. (1993) demonstrate that the specific design of roles and tasks – such as task variety and task significance – remains a fundamental predictor of team outcomes.

2.3.4 Technological influence and automation

The future of work design is increasingly shaped by automation. Organizations face a choice where automation can either replace monotonous tasks, resulting in more complex and skilled jobs for humans, or lead to increased algorithmic control with reduced autonomy (Petropoulos et al., 2026). Parker et al. (2017) highlight the need for more intervention studies and a systems perspective that considers multilevel factors (individual, team, organization) to understand how work design can best adapt to technological development while promoting productivity and well-being. To fully understand these dynamics in a manufacturing context, it is necessary to examine how these theoretical principles interact with the dominant production philosophy: lean production.

2.3.5 Work design and lean production

Work design is a complex field characterized by the need to balance different, often conflicting, organizational goals. Research has long shown that there is no single best way to design work; instead, different perspectives lead to different outcomes. Campion and Thayer (1985) identified four main approaches: motivational, mechanistic, biological, and perceptual/motor. Their research revealed clear trade-offs: a motivational design tended to increase job satisfaction, while a mechanistic design promoted efficiency, often at the expense of employee satisfaction. These findings were confirmed and expanded by Campion (1988), who concluded that individual differences among employees played a smaller role than the design of the job itself. The conclusion was that an interdisciplinary approach is necessary to understand the costs

and benefits associated with design choices. Although the conflict between efficiency and well-being has long been viewed as inevitable, later research has questioned whether it must be a zero-sum game. Morgeson and Campion (2002) showed that trade-offs can be minimized through redesign. They found that an integrated design could increase satisfaction without compromising efficiency.

In modern times, the mechanistic perspective has found its clearest expression through the implementation of lean production. Shah and Ward (2003) stated that lean practices lead to substantially improved operational performance regardless of contextual factors such as unionization, although firm size plays a role in the likelihood of implementation. However, the lean philosophy's focus on standardization and efficiency also has a downside. Parker (2003) demonstrated in a longitudinal study that lean production can have negative effects on employee well-being, particularly on assembly lines where autonomy is limited. She found that this led to reduced organizational commitment and increased depression. This is supported by Conti et al. (2006), who found that job demands in lean environments (high pace, ergonomic strain) increase stress. Interestingly, Conti et al. (2006) noted a nonlinear relationship where stress could decrease at very high levels of implementation, suggesting that a well-functioning system may reduce frustration, even if the fundamental issues remain.

Given that lean production dominates the industry, researchers have sought ways to make these jobs more motivating despite the constraints. De Treville and Antonakis (2006) argue that traditional job design models do not fully fit the lean context because they emphasize choice autonomy (freedom to choose how to work), which lean actively minimizes. Instead, they propose the concepts of responsible autonomy and work facilitation. If employees are given resources and responsibility for the outcome, rather than the method, motivation can arise even in tightly controlled processes. Cullinane et al. (2013) build on this by proposing an integrated model in which lean is viewed as an environment with both high demands and potentially high resources. If management provides resources such as social support, feedback, and opportunities for decision-making (boundary control), the negative health effects of a high work pace can be counteracted. It is not about abandoning efficiency requirements but about balancing them with the right type of support and autonomy.

From Campion and Thayer's (1985) early insights into trade-offs to today's complex lean systems, it is clear that a one-sided focus on either mechanistic efficiency or psychological motivation is insufficient. While the lean philosophy originally had a strong focus on developing people as well as products (Liker & Hoseus, 2008), many lean implementations have failed to take human aspects into account and have instead focused on lean tools (Hines et al., 2004; Hines, 2022). Since research indicates that focusing solely on tools neglects the human aspect of developing people, the challenge lies in structuring the production environment to support both

performance and growth. This requires shifting the perspective from viewing lean merely as a production method to viewing lean as a learning system, thereby exploring the role of organizational learning.

2.3.6 Lean as a learning system and organizational learning processes

If lean is to support both efficiency and human development, it must be conceptualized as a learning system. Kristensen et al. (2022) emphasize that sustainable competitive advantage stems from balancing short-term efficiency with long-term learning. While lean literature has traditionally prioritized efficiency, Kristensen et al. (2022) argue that quality and improvement are achieved through the learning organization, necessitating a "learning-to-learn" approach.

This capability becomes even more critical in the context of Industry 4.0 adoption. Saabye et al. (2022) argue that a purely technocentric approach is insufficient for digital transformation. Instead, organizations must institutionalize organizational learning by creating a "scaffold" of supportive structures. This includes establishing group coaching, developing leaders as learning facilitators, and fostering systematic problem-solving. Saabye et al. (2022) posit that such a supportive learning environment is a prerequisite for successfully navigating the complexities of modern production.

To understand the mechanics of such a system, one must look at the theoretical foundations of organizational learning. Organizational learning is a multilevel process that originates with the individual but is realized through collective interaction. Crossan et al. (1999) describe the individual foundation as consisting of intuition – the recognition of patterns and possibilities – and interpretation, where individuals make sense of these insights. However, for these individual insights to benefit the wider organization, they must be refined through social interaction. This leads to integration at the group level, where diverse individual perspectives are integrated into shared understanding and collective action (Crossan et al., 1999). This dynamic involves a tension between a feedforward process of exploration and a feedback process of exploitation.

This transition from individual interpretation to group integration relies on the social climate. Edmondson (1999) argues that psychological safety, a state in which members feel secure enough to take interpersonal risks, is a prerequisite for effective group learning. Since team learning constitutes a building block for broader organizational capabilities, it cannot be left to chance. Instead, senior management must actively prioritize and structure routines that facilitate this learning (Harvey et al., 2022), while simultaneously safeguarding the openness and creativity required for innovation (Edmondson, 1999).

In this thesis, lean is therefore treated neither as inherently harmful nor as inherently beneficial, but as a production philosophy whose human impact depends on how its practices are embedded in work design and learning structures.

2.3.7 From static work design to dynamic work redesign

Finally, contemporary research emphasizes that work design is not static but requires continuous redesign. Petropoulos et al. (2026) describe this as a spectrum of interventions: from traditional managerial redesign (top-down) to negotiated arrangements such as idiosyncratic deals, and finally to employee-driven initiatives such as job crafting. While historical models largely viewed the employee as a passive recipient of a designed job, modern perspectives increasingly recognize the individual's agency in actively reshaping their tasks and roles to fit their needs and skills.

2.4 Job crafting

Job crafting has emerged as a central concept in organizational psychology to describe how employees actively shape their own work roles. It complements traditional theories of job design by shifting the focus from top-down approaches (where management designs the work) to bottom-up approaches (where the individual shapes the work) (Parker et al., 2025; Wrzesniewski & Dutton, 2001).

2.4.1 Definitions

The concept was originally introduced by Wrzesniewski and Dutton (2001) as a psychological, physical, and social act wherein employees mold, reshape, and redefine their jobs. From this perspective, job crafting involves changing three types of boundaries: task boundaries (the type and number of activities performed), cognitive boundaries (how one views the work as a whole), and relational boundaries (the nature of interactions with others at work). Later research, such as that by Tims and Bakker (2010) and Tims et al. (2012), has operationalized job crafting through the lens of the JD-R model. Here, job crafting is defined as self-initiated changes made to balance job demands and job resources with personal needs and abilities. They identify three primary dimensions: increasing job resources, increasing challenge demands, and decreasing hindrance demands.

Newer conceptualizations attempt to integrate these perspectives. Bruning and Campion (2018) emphasize that job crafting is a volitional and intentional act aimed at improving the job

for the individual, rather than merely making temporary adjustments. They propose a model based on both roles and resources, in which crafting can occur through approach or avoidance behaviors. Similarly, Zhang and Parker (2019) suggest that job crafting can be categorized by orientation (approach vs. avoidance), form (behavioral vs. cognitive), and content (resources vs. demands), resulting in eight specific types of crafting.

2.4.2 Drivers

Why do employees engage in job crafting? These drivers can be grouped into three broad categories: individual needs, person-job fit, and contextual enablers or constraints. According to Wrzesniewski and Dutton (2001), it arises from three fundamental individual needs: the need for control, the need for a positive self-image, and the need for connection with others. Motivation to craft often arises when these needs are not met by the current job design. Within the JD-R framework, person-job misfit is seen as the primary driver; an imbalance between demands and resources triggers employees to restore equilibrium (Tims & Bakker, 2010; Tims et al., 2012). Niessen et al. (2016) complement this by describing drivers in terms of ability/self-efficacy and need satisfaction. The context also plays a crucial role. Wrzesniewski and Dutton (2001) note that high levels of monitoring and strict task interdependence can constrain the opportunity to craft, whereas Tims and Bakker (2010) and Zhang and Parker (2019) highlight that autonomy, support, and task interdependence can facilitate the behavior.

2.4.3 Consequences

The effects of job crafting are predominantly positive for the individual, though more complex for the organization. Research points to increased engagement, better person-job fit, and higher well-being (Bruning & Campion, 2018; Tims et al., 2012). However, Zhang and Parker (2019) and Bruning and Campion (2018) note that approach crafting generally yields positive effects, while avoidance crafting (reducing demands) often leads to negative outcomes. Parker et al. (2025) suggest that job crafting changes the individual's perceived work characteristics over time, which in turn influences outcomes such as well-being and performance.

2.4.4 Work design, job crafting, and motivation

To understand the underlying motivational processes, job crafting and work design are often linked to self-determination theory (SDT). SDT posits that the quality of motivation is critical in the workplace, distinguishing between autonomous motivation, which is characterized by a

sense of volition and willingness, and controlled motivation, which is driven by external pressure or internal guilt. To facilitate autonomous motivation and its associated benefits, such as high-quality performance and employee well-being, organizations must support the three basic psychological needs for competence, autonomy, and relatedness. Consequently, effective practice requires shifting away from controlling management styles and pay-for-performance schemes toward autonomy-supportive contexts, where managers acknowledge employees' perspectives, offer choices, and minimize coercion to avoid thwarting these fundamental needs (Deci et al., 2017).

According to Van den Broeck et al. (2016), work characteristics such as autonomy and skill variety are strongly linked to the satisfaction of the basic psychological needs. Research indicates a clear directionality in this relationship: satisfied needs lead to motivation, not the other way around (Olafsen et al., 2018). When these needs are met through effective work design or successful job crafting, autonomous motivation (intrinsic and identified regulation) is promoted. This form of motivation is linked to positive outcomes such as reduced stress and higher job satisfaction (Trépanier et al., 2023). Conversely, the thwarting of needs, caused by factors such as high job demands or role overload, can lead to burnout (Fernet et al., 2013). De Cooman et al. (2013) confirm this chain, where job characteristics influence need satisfaction, which in turn drives work effort. Similar needs – need for control over job and work meaning, need for positive self-image, and need for human connection with others – are also considered antecedents for job crafting in the conceptualization of job crafting theory (Wrzesniewski & Dutton, 2001).

Furthermore, SDT applies a multilevel perspective to explain how the workplace context directly influences individual outcomes. The theory illustrates that factors at the organizational and group levels, such as managerial styles and corporate policies, serve as social antecedents that either support or thwart the employee's basic psychological needs (Deci et al., 2017). By linking these macro-environmental conditions to micro-level psychological processes, the model explains how the broader organization shapes the individual's autonomous motivation and wellness. Moreover, SDT suggests that organizations should move beyond static job descriptions by encouraging employees to take initiative and make choices about how to perform their own work tasks (Deci et al., 2017). Such flexibility in job characteristics supports the need for autonomy and allows individuals to experience their work as more meaningful, which is essential for sustaining high-quality motivation and well-being.

2.4.5 Job crafting in lean production

However, a critical tension remains in the literature regarding how these bottom-up initiatives interact with highly standardized environments. While job crafting is generally positive, uncoordinated crafting in a tightly coupled production system could theoretically disrupt flows or standard operating procedures. Therefore, understanding the alignment, or misalignment, between management's top-down design and employees' bottom-up crafting is crucial for realizing the benefits of Industry 5.0.

2.5 A multilevel perspective on work design in production environments

Understanding work design in complex production environments requires moving beyond a single level of analysis. As argued in the introduction, focusing exclusively on organizational strategies (such as lean implementation) or solely on individual psychology (such as motivation) risks leading to suboptimization, where interventions at one level create unintended consequences at another. Most management problems involve multilevel phenomena, yet research often utilizes a single lens, yielding an incomplete understanding of the interplay between individual actions and organizational context (Hitt et al., 2007). By adopting a multilevel perspective, it becomes possible to analyze how production work is shaped at the intersection of individual experience, team dynamics, and organizational structures. This approach recognizes that organizational entities reside in nested arrangements, where individuals are embedded within teams, which in turn are embedded within departments and the larger organization (Molina-Azorín et al., 2020).

2.5.1 The macro level: Organizational context, systems, and structure

Consistent with integrative perspectives on work design (Morgeson & Humphrey, 2006), the macro level constitutes the broader organizational context that frames the work. In this thesis, this level encompasses the "rules of the game" set by production philosophies like lean and by the strategic shift toward Industry 5.0. As Morgeson et al. (2010) argue, such organizational contexts – including climate, technical systems, and structure – do not just surround the work but actively shape it.

This level examines structural contradictions, such as the tension between maximizing throughput and ensuring long-term learning and innovation. In multilevel research, these macro variables often act as contextual factors that exert a downward influence on lower levels (Molina-Azorín et al., 2020). Consequently, this level creates an organizational infrastructure, such as digital manufacturing platforms and standardized operating procedures, that enforce

specific ways of working. For example, a corporate decision to implement algorithmic management or short-term contracts changes the micro level experience of job security and autonomy. To ignore these macro influences is to risk misinterpreting behavior at the micro level (Hitt et al., 2007).

2.5.2 The meso level: Groups and teams

The meso level serves as a critical bridge between the individual and the organization. In production environments, this primarily includes production teams but can also include autonomous work groups, improvement cells, or other work groups. At this level, routines and communication patterns that coordinate individual actions into group results can be studied. Klein and Kozlowski (2000) identify distinct types of team constructs relevant here, particularly shared properties such as team cohesion or safety climate, which originate in the shared experiences of team members.

The meso level is where the prescribed work from the macro level is interpreted and adapted. For instance, a production team might develop a workaround routine to bypass a rigid protocol imposed by management, collectively redesigning how the work is actually executed. Consequently, the meso level acts as a filter for top-down policies, shaping how they are experienced by the individual. It is also the level at which individual learning is captured and transformed into organizational knowledge (Crossan et al., 1999), and where structural barriers (such as shift patterns) can hinder knowledge sharing.

2.5.3 The micro level: Individual experience and agency

The micro level focuses on the individual operator, team leader, or front-line manager. While experimental psychology often views the individual in isolation, a multilevel perspective views the individual as a knowledgeable actor deeply connected to their environment. The primary goal at this level is to understand the experiences, how individuals perceive and interpret their work design. Researchers must examine how objective facts, such as cycle times or task complexity, are actually felt and negotiated by the worker.

Furthermore, the micro level highlights that production workers are not passive receivers of job descriptions. Instead, they exercise agency through job crafting (Wrzesniewski & Dutton, 2001; Cullinane et al., 2017). Human agency, defined by Bandura (2006) through the core properties of intentionality, forethought, self-reactiveness, and self-reflectiveness, provides the psychological foundation for job crafting. It is these four mechanisms that enable the employee to actively change their task boundaries, relational boundaries, and cognitive task boundaries

(Wrzesniewski & Dutton, 2001). Thus, employee agency represents the manifestation of human agency at work, whereby employees intentionally influence their work boundaries. This implies that they physically or mentally adjust their tasks and relationships to better fit personal strengths or to cope with production constraints. Such individual-level phenomena are crucial because micro-level constructs, such as individual attitudes, motivation, and behaviors, ultimately underpin collective outcomes (Klein & Kozlowski, 2000).

2.5.4 Linking the levels

To create human-centric production systems, it is necessary to understand how the macro, meso, and micro levels interact. As Hitt et al. (2007) argue, analyzing these levels in isolation yields an incomplete understanding, as organizational entities reside in nested arrangements (Molina-Azorín et al., 2020). The theoretical framework of this thesis illustrates that these levels are inextricably linked through top-down contextual influences and bottom-up behavioral responses.

2.5.4.1 From macro to micro. The macro level, defined by organizational strategies and production philosophies like lean, establishes the context that exerts a downward influence on individual experiences. For instance, the choice between a mechanistic or motivational work design (Campion & Thayer, 1985) at the organizational level directly dictates the job characteristics available to the individual. If the macro-level implementation of lean focuses solely on technical efficiency and tools, as critiqued by Hines (2022), it risks creating a work environment characterized by high demands and low autonomy. According to the JD-R model, this imbalance drives a health-impairment process for the individual (Bakker & Demerouti, 2007). Conversely, when the organization creates a "scaffold" of supportive structures – such as systematic problem-solving and learning routines (Saabye et al., 2022) – it provides the necessary resources to foster autonomous motivation and well-being, as posited by SDT (Deci et al., 2017).

2.5.4.2 Meso level integration. The meso level, or group level, is a filter between organizational structures and individual perceptions of work design, but it also acts as a bridge for organizational learning processes. While an individual may form an intuition or insight, Crossan et al. (1999) describe how social interaction at the group level is required to integrate this into shared understanding and collective action. Shared team properties originate from behaviors and cognitions of individual team members (Klein & Kozlowski, 2000). Leadership also plays a role at this level, where managers can mitigate the resistance and anxiety associated

with technological change (van Dun & Kumar, 2023), thereby translating macro-level digital transformation goals into micro-level acceptance and engagement. Cullinane et al. (2013) suggest that while lean environments create high demands (macro), management can provide compensating resources at the group level, such as social support and feedback, to mitigate negative effects on the individual (micro). De Treville and Antonakis (2006) introduce the concept of responsible autonomy, where the group acts as a mediator through which employees receive resources and responsibility for outcomes. This allows the organization to maintain standardized processes (macro) while still satisfying the individual's need for internal motivation (micro) through a sense of ownership at the team level (meso). The meso level acts as the structural link that aligns the organization, ensuring that top-down demands are met with adequate bottom-up support and collective learning.

2.5.4.3 From micro to macro. Finally, the micro level exerts an upward influence on the system through individual action. Employees actively engage in job crafting to align their tasks with their basic psychological needs for competence, autonomy, and relatedness (Wrzesniewski & Dutton, 2001; Deci et al., 2017). When individuals successfully craft their jobs to increase resources or challenge demands (Tims et al., 2012), this can lead to improved performance and innovation that benefits the wider organization. However, a tension exists here: uncoordinated bottom-up crafting can conflict with the standardization required by lean production. Therefore, the successful linking of these levels relies on "responsible autonomy" (de Treville & Antonakis, 2006), whereby individual agency is exercised within the boundaries of organizational goals, turning the friction between efficiency and human needs into a driver for organizational learning.

2.6 Concluding synthesis: A conceptual framework of work design and redesign in production

Building on the previous sections, this concluding synthesis brings together Industry 5.0, lean production, work design, job crafting, and organizational learning into an integrated framework. Achieving the Industry 5.0 vision of human-centricity requires designing work that yields positive effects simultaneously at the organizational level (e.g., productivity, resilience) and at the individual level (e.g., well-being, motivation). Focusing on one at the expense of the other risks creating "phantom profits" or system dysfunction. This risk of suboptimization is amplified by the inherent tension between the normative models of lean production and the ambition for human-centric work design, as discussed in the context of the Swedish automotive industry. Therefore, to conceptually reconcile these competing demands and ensure that the system is not

suboptimized during redesign efforts, a multilevel perspective is essential. Work design in production is not a static state but a dynamic interaction across three nested levels:

2.6.1 The macro level: Organizational strategy and structure

At the macro level, the organization establishes the structural "rules of the game" through its strategy and production philosophy (such as lean production or Industry 5.0 standards). As shown in the framework, this level exerts a top-down work redesign influence by defining and redefining organization-level sets of work characteristics. However, the literature emphasizes that this cannot simply be a technical mandate, since a pure focus on tools risks neglecting human development (Hines, 2022). Instead, the macro structure must function as a "scaffold" for learning and problem-solving (Saabye et al., 2022), creating a supportive context that balances efficiency with the necessary resources for organizational learning (Kristensen et al., 2022).

2.6.2 The micro level: Individual experience and agency

At the micro level, the framework highlights that individuals are not passive recipients of the work design dictated by these top-down structures. Instead, they exercise individual agency, primarily through job crafting behaviors (Wrzesniewski & Dutton, 2001). This generates a bottom-up work redesign flow, where employees actively mold their tasks and relational boundaries to align with their basic psychological needs for competence, autonomy, and relatedness (Deci et al., 2017). This level represents the lived experience of work, where individual work characteristics are realized and negotiated.

2.6.3 The meso level and responsible autonomy

Integration occurs at the meso level (groups and teams), which acts as the bridge between organizational structure and individual agency. The framework identifies responsible autonomy (de Treville & Antonakis, 2006) as a mechanism for reconciling the tension between the standardized requirements of lean production at the macro level and the need for agency at the micro level. To operationalize this responsible autonomy, the literature suggests a need for specific structures for organizational learning. By integrating systematic learning routines into daily operations, multiskilled teams can theoretically transform individual job crafting into collective capabilities. Consequently, by granting teams and individuals ownership over

outcomes rather than just methods, the system allows for distinct forms of bottom-up crafting to coexist constructively within a top-down lean production structure.

2.6.4 Positioning the thesis

In conclusion, work design in production is best understood as a continuous interplay between top-down structural conditions and bottom-up individual agency. The transition to an Industry 5.0 paradigm places new demands on manufacturing firms, where the ability to foster responsible autonomy becomes a key organizational capability. This requires that the pursuit of macro-level efficiency actively supports, rather than suppresses, micro-level well-being and innovation. However, while normative models such as lean production and Industry 4.0 are well established, there is a lack of knowledge regarding the specific organizational learning structures and multilevel dynamics that allow these models to function in a human-centric manner in practice. This constitutes the point of departure for this thesis. By exploring these multilevel dynamics, the thesis aims to demonstrate how organizations can practically bridge the gap between lean production standardization and human-centric ideals.

3. METHODOLOGY

This chapter outlines the methodological framework employed in the thesis. It begins by presenting the research setting and the empirical setting, focusing on the LOOP project and the participating manufacturing companies. Following this, the research approach and strategy, as well as the overarching research design, are defined. The chapter then details the specific procedures for data collection and data analysis. Subsequently, it addresses research quality, followed by a discussion on the challenges with collecting and analyzing data in this setting. The chapter then proceeds to articulate the scientific approach and methodological stance, highlighting the grounding in dialectical pluralism. Finally, the chapter concludes with ethical and methodological considerations, alongside a reflection on the author's preconceptions and the role of the researcher.

3.1 Research setting

The research in this thesis has mainly been conducted within the research project "Leadership and Organizational Model for Innovative, Efficient, and Socially Sustainable Production Teams" (LOOP), financed by Vinnova within FFI (The Strategic Vehicle Research and Innovation Programme) and running from January 2021 to October 2024. The research project can be described as a multiple-case study employing a design science research (DSR) approach. The timeline of the research is depicted in Figure 1. Note that this shows the data collection phases, while the writing phases of the papers have been extended beyond the research project.

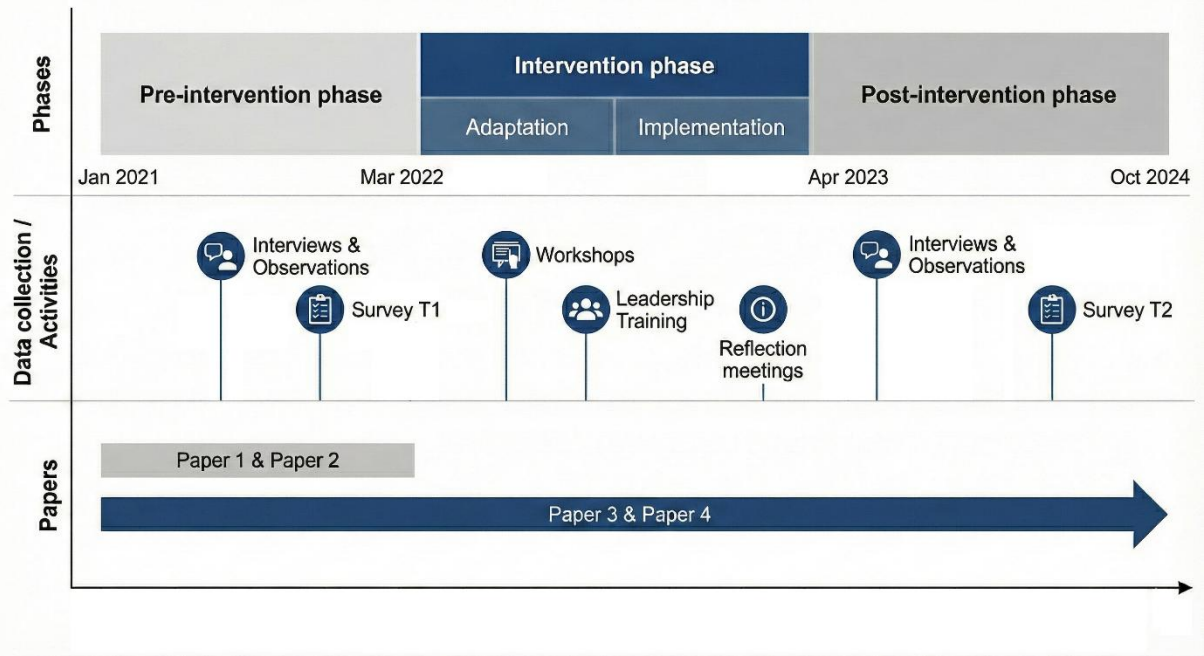

Figure 1. Timeline of the research

Participating research partners in the LOOP project group were Chalmers University of Technology, the University of Gothenburg, Research Institutes of Sweden (RISE), and KTH Royal Institute of Technology. At the beginning of the project, four companies participated. Three were large automotive companies (one OEM and two component manufacturers), and the fourth was a small turning and milling company. After the first pre-intervention phase, one component manufacturer left the project due to the loss of a major customer. Consequently, data from this company were available for the pre-intervention phase only. Due to the small company's lack of front-line managers and formal production teams, it was excluded from the papers in this dissertation. To supplement the research, a fourth large company from the water-pump industry was included specifically for the studies in Paper 1.

The empirical studies (Papers 1–3) focus on the four resulting large companies, as summarized in Table I. Paper 1 and Paper 2 utilized data from the pre-intervention phase only. As shown in the table, Paper 1 includes all four companies (Cases A, B, C, and D), whereas Paper 2 includes three of these (Cases A, B, and D). Paper 3, which reflects the DSR approach, focuses on two of these settings (Cases A and D) to evaluate the loop-model. Paper 4 is a methodological paper that builds on insights from the LOOP project rather than empirical data from case companies, and is therefore not described below under data collection or data analysis. More details about the operations design and work organization of these companies are available in the papers.

The research project followed a longitudinal design divided into four distinct phases: pre-intervention, adaptation, implementation, and post-intervention. Initially, the pre-intervention phase focused on mapping existing practices and organizational contexts through mixed methods, establishing a baseline via interviews, observations, and a questionnaire survey. This was followed by the adaptation phase, which contextualized the theoretical framework to specific organizational settings through collaborative workshops. These sessions utilized initial survey data to facilitate the development of company-specific model adaptation and to identify necessary technical specialist roles, while concurrent leadership training equipped implementation teams with essential coaching skills. Subsequently, the implementation phase operationalized these designs by establishing multiskilled production teams and integrating operators into technical specialist structures. Researchers actively supported this process through structured follow-up meetings and workshops to address challenges and ensure that the model was effectively blended with existing infrastructures. Finally, the post-intervention phase involved repeating the initial data collection instruments, including follow-up interviews and a second questionnaire, to evaluate the longitudinal effects on work design and organizational learning. Unfortunately, due to a high turnover rate between the pre-intervention phase and the post-intervention phase, a quantitative evaluation of the outcomes of the intervention was not statistically feasible. The phases and the intervention are more thoroughly explained in Paper 3.

These project characteristics – multiple companies, a longitudinal intervention design, and substantial organizational dynamics – strongly shaped the methodological choices and limitations discussed in the subsequent sections and in the quality reflections of this chapter.

3.2 The empirical setting

This dissertation is based on studies conducted within the Swedish manufacturing sector, with a primary focus on the automotive industry. This industry is characterized by intense global competition and rapid technological development. These factors, combined with increasing requirements for resilience and sustainability, place significant demands on production development to ensure continued profitability. All companies in the studies have adopted lean production as a concept to meet efficiency and productivity targets. The participating companies are referred to herein as Case A, Case B, Case C, and Case D. Table I outlines their respective operations design and work organization.

Table I. Overview of case companies

		Case A	Case B	Case C		Case D
Operations design	*Manufacturing process types*	Mass process	Batch process	Mass process	Batch process	Mass process
	Basic layout types	Cell/product layout (AGVs/line)	Cell layout	Cell layout (mini lines)	Cell layout	Product layout (conveyor belt)
	Type of planning	Assembly to order	Make to stock	Make to stock	Make to stock	Assembly to order
Work organisation	*Operators' main job tasks*	Assemble	Control, load and unload	Assemble	Control, load and unload	Assemble
	Work shifts	2-4	4-5	1-4	1-4	2
	Cycle time	≈ 1 min	Variation	≈ 1 min	Variation	≈ 7 min
	Daily management	Yes	Yes	Yes	Yes	Yes
	Front-line managers' span of control	≈ 40-45	≈ 30	≈ 25-50		≈ 35-40
Included in papers	*Paper 1*	x	x	x		x
	Paper 2	x	x			x
	Paper 3	x				x

(Adapted from Paper 1)

3.3 Research approach and strategy

Given the complexity of the research problem, this thesis is grounded in a stance of dialectical pluralism (Johnson, 2017), a multi-paradigmatic approach in which different philosophical perspectives and methods are allowed to coexist and to be brought into explicit dialogue rather than being forced into a single unified worldview. A single methodological paradigm would offer only a partial understanding of the phenomenon. Unlike approaches that seek to merge methodological differences into a single consistent worldview, dialectical pluralism values the insights provided by different paradigms. It posits that engaging with the tensions between various modes of inquiry leads to a richer understanding of reality (Greene & Hall, 2010).

Within this dialectically pluralist stance, each methodological strand plays a distinct but complementary role:

Depth and context: The qualitative inquiry (Paper 1) provides deep, context-dependent insights into the underlying mechanisms and social constructions of the phenomenon of work design and redesign.

Breadth and generalizability: The quantitative study (Paper 2) offers a broader perspective, allowing for the measurement of variables and the identification of general patterns of how work design relates to motivation and well-being.

Utility and solution: The DSR study (Paper 3) focuses on the practical application of knowledge, designing and evaluating artifacts to address specific problems – in this case, a model for redesigning work with a team-level focus.

The dialectical aspect is realized when integrating these parallel findings. By placing the results in dialogue with one another, a synthesis is created in which the qualitative depth contextualizes the quantitative breadth. The DSR study further adds a practical dimension to this mix. Thus, the contribution of this thesis is not merely the sum of separate papers but the insights emerging from the interplay between these distinct perspectives.

Importantly, dialectical pluralism characterizes the way the findings of the parallel studies are brought into dialogue in this cover essay (kappa), rather than prescribing a specific mixed-methods procedure within each individual paper.

3.4 Research design

To address the research questions and capture the multifaceted nature of work design in production, this research employs a multi-methodological approach. Recognizing that work design is not merely a static structural arrangement but a dynamic co-constructed process, different methodological lenses were required to explore, explain, and influence the phenomenon. Consequently, the research design integrates qualitative, quantitative, and design science research strategies to ensure a strong methodological fit. In terms of mixed-methods typologies, the overall design can be understood as a convergent parallel design, in which qualitative and quantitative strands are conducted in parallel and integrated at the interpretation stage (Creswell, 2022), as further discussed in Section 3.9.

Given that the interplay between formal job design and individual adaptation is deeply embedded in the organizational context, a single method would be insufficient to capture both the nuances of individual experiences and the generalizability of structural relationships. Therefore, this thesis adopts a complementary design in which inductive inquiry allows for theory building regarding the "how" and "why" of work redesign, while deductive analysis tests established theories in the specific context of standardized manufacturing. Furthermore, to bridge the gap between theory and practice, an interventionist approach is included to develop and evaluate actionable solutions for organizational challenges.

Accordingly, the specific methods were selected to align with the distinct purpose of each sub-study. Paper 1 utilizes a qualitative, inductive case study design to explore the emerging phenomenon of front-line manager job crafting. Paper 2 employs a quantitative cross-sectional design to test the applicability of motivational theory in standardized work settings. Finally,

Paper 3 adopts a design science research approach to develop and evaluate an artifact for organizational learning.

Design science research (DSR) is a research approach that addresses real organizational problems by generating knowledge that bridges practice and theory (Holmström et al., 2009; van Aken et al., 2016). The research advances through solution incubation and solution refinement to develop means-end propositions and substantive theory, which can subsequently be abstracted into formal theory (Holmström et al., 2009). To implement organizational change and achieve pragmatic validity, the outcome of this research is formulated as field-tested and grounded technological rules, also defined as design propositions (van Aken et al., 2016). The development of these solution concepts is structured using CIMO-logic, requiring an explicit linkage between the Context of the problem, the Intervention taken, the Mechanism triggered, and the expected Outcome (Denyer et al., 2008; van Aken et al., 2016). By employing this framework, the research strategy ensures the generation of robust and valid knowledge capable of resolving practical challenges while simultaneously contributing to academic theory.

The following sections detail the data collection and analysis procedures employed in each paper.

3.4.1 Levels of theory, measurement, and analysis

In multilevel research, it is important to distinguish between the level of theory, the level of measurement, and the level of analysis (Hitt et al., 2007). In the context of work design in production environments, this distinction is particularly important because the reality of the factory shop floor is inherently nested; operators work within teams, which in turn function within the larger organization. Consequently, this study aligns these three perspectives to ensure methodological rigor. The level of theory refers to the specific entity that the research aims to explain or generalize about. For instance, when we theorize about an operator's or front-line manager's perception of autonomy, the focal unit is the individual. However, when we discuss concepts such as group climate or team coordination, the theoretical focus shifts to the group level. It is important to note, as Molina-Azorín et al. (2020) point out, that even if we are interested in a team-level phenomenon, we often rely on data collected from individuals. This leads us to the level of measurement, which describes the source of the data. In this study, the primary measurement occurs at the individual level through surveys or interviews with operators and front-line managers. However, simply collecting individual-level data does not automatically allow us to make claims about the team. The aggregation of data is not without difficulties; there is not always agreement among operators in a team about shared experiences. Therefore, collective team constructs are difficult to measure. Still, different methods, such as

interviews, observations, workshops, and coaching sessions, have allowed for a more comprehensive understanding of how teams were affected by the intervention in Paper 3. Finally, the level of analysis is dynamic, depending on the specific question being addressed. By being clear about the different units of analysis for each stage of the inquiry, this thesis aims to capture the complexity of work design without misrepresenting the experiences of individuals or the structural reality of the organization.

3.5 Data collection

The specific data collection techniques utilized across the appended papers are outlined below and summarized in Table II.

The primary data collection method in Paper 1 consisted of in-depth, semi-structured interviews with 15 front-line managers and 12 senior managers, covering core topics related to front-line managers' work and the conditions provided by the organization to conduct the job. The interviews were designed to capture the duality of the front-line manager's role by contrasting the formal organizational perspective with the individual experience. To achieve this, two distinct interview guides were employed to probe the differing realities of senior management and front-line managers. For senior managers, the inquiry focused on the prescribed work characteristics, exploring the organizational expectations placed on the role, how the work was formally designed, and the support structures and resources provided to facilitate execution. Conversely, the interviews with front-line managers aimed to elicit their subjective perceptions of the work situation and the actual conditions under which they operated. Rather than relying on prespecified categories, the dialogue was open-ended, encouraging respondents to describe what they found rewarding or challenging and to articulate the specific actions they took to influence their own work design. This approach allowed for the inductive discovery of job crafting behaviors as mechanisms used to bridge the gap between the role's formal demands and its practical realities. These interviews were complemented by non-participant observations, in which researchers shadowed two front-line managers for a total of 15 hours to document actual task sequences, and by a focus group with three managers to discuss and deepen insights from the interviews and observations.

The instrument incorporated validated scales to measure key constructs, specifically the Work Design Questionnaire (WDQ; Morgeson & Humphrey, 2006) for job characteristics, the Need Satisfaction at Work Scale (NSa-WS; Tafvelin & Stenling, 2018) for basic psychological need satisfaction, the Multidimensional Work Motivation Scale (MWMS; Gagné et al., 2015) for motivation, the Stress/Energy Questionnaire (Kjellberg & Iwanowski, 1989) for stress, and

the Copenhagen Psychosocial Questionnaire (COPSOQ III; Berthelsen et al., 2020) for job satisfaction.

Paper 3 utilized a design science research (DSR) approach, employing qualitative methods within a longitudinal framework divided into pre-intervention, adaptation, implementation, and post-intervention phases. The data collection was extensive, beginning with semi-structured interviews, shadowing of front-line managers, and structured observations of production teams to map current practices. During the intervention phase, data was generated through adaptation workshops, cross-company workshops, leadership training sessions, and structured follow-up meetings, with researchers documenting the process via field notes.

Table II. Methods used in appended papers

	Paper 1	Paper 2	Paper 3
Quantitative		X	
Survey		X	
Qualitative	X		X
Interviews	X		X
Observation	x		X
Focus group	x		X
Workshops			X
Reflection meetings			X

3.6 Data analysis

In Paper 1, we used an exploratory qualitative approach to learn more about how front-line managers perceived their work, and expectations from senior managers on their role. Consistent with the explorative research design, the data analysis followed a systematic four-step inductive approach inspired by the Gioia methodology (Gioia et al., 2013), aimed at grounding theory development in the empirical data. Initially, a first-order analysis comprising open coding of interview transcripts and time-stamped field notes was conducted. This coding process stayed close to the informants' language and practice to generate in-vivo first-order concepts. Subsequently, a second-order analysis akin to axial coding (Strauss & Corbin, 1998) was performed, where the first-order concepts were grouped into second-order themes by seeking patterns and relationships. Through iterative refinement, this resulted in ten second-order themes that clarified the work design and work situation of front-line managers, as well as the

actions taken to influence their work. In the third step, the analysis moved to a higher level of abstraction by iterating between the data and job crafting theory, which yielded four aggregate theoretical dimensions: prescribed work characteristics, perceived insufficient work characteristics, job crafting, and redesigned work. Finally, an inductive model was built to explicate the dynamic relationships among the emergent concepts. By integrating contextual insights from observations and focus groups, the analysis highlighted how a misalignment between senior managers' prescribed work characteristics and front-line managers' perceived reality triggers job crafting practices to enable task accomplishment.

In paper 2, we used a quantitative approach to study how work design relates to psychological need satisfaction, motivation, and well-being. Prior to the main analyses in Jamovi 2.6.44, a rigorous data screening process was conducted. Missing data were minimal and confirmed to be missing completely at random (MCAR), based on Little's MCAR test, and missing values were therefore handled using full information maximum likelihood (FIML). Assumptions for maximum likelihood estimation were evaluated; during this process, amotivation was excluded early on due to a pronounced floor effect and lack of variance, thereby reducing model complexity. Linearity was confirmed, and calculations of the variance inflation factor (VIF) indicated an absence of problematic multicollinearity (O'Brien, 2007).

Separate confirmatory factor analyses were conducted to establish construct validity for all multi-item measures. The basic psychological need satisfaction model and the two-factor outcome model (job satisfaction and stress) demonstrated good to excellent fit, whereas the work design model was refined into an acceptable six-factor solution after the exclusion of two items with low factor loadings. For work motivation, identified and introjected regulation exhibited a Heywood case and were merged into a single composite factor; this merging is consistent with previous research highlighting the difficulties of separating specific motivational regulations when applying the Multidimensional Work Motivation Scale (Gagné et al., 2026). External material regulation and two additional problematic items were also removed, resulting in a three-factor motivation model with acceptable fit.

Following the validation of the measurement models, the hypothesized pathways between the variables were tested within a path analysis framework. To handle the complex nature of this model, the analysis relied on manifest variables (mean indices) rather than on a full structural equation model with latent variables, which facilitated convergence and kept the analytical approach parsimonious (Hair et al., 2019). The fully saturated model estimated direct and indirect effects using a bootstrap procedure to calculate standard errors. Exogenous variables and disturbance terms of endogenous variables were allowed to co-vary, and all potential direct paths were included. A final diagnostic assessment using Harman's single-factor test showed no substantial evidence of common method bias (Podsakoff et al., 2003).

In Paper 3, we used a design science research approach, which is a suitable methodology to design and test a model for organizational change while also generating knowledge about such changes (Holmström et al., 2009; van Aken et al., 2016). Data analysis was conducted in accordance with CIMO logic (Denyer et al., 2008; Kalaiarasan et al., 2023), using the categories of Context, Intervention, Mechanisms, and Outcome as deductive themes in a thematic analysis (Braun & Clarke, 2006). Transcripts and documents were categorized into these themes, after which emerging subthemes were reviewed, defined, and named. Due to the nature of the CIMO categories, data from the different phases of the research process were used selectively to substantiate each theme.

Paper 4 draws upon the same empirical foundation as Paper 3, utilizing data from the longitudinal multidisciplinary intervention study (the LOOP project). However, rather than evaluating the intervention itself, the focus here is on the methodological challenges and opportunities inherent in researching human-centric aspects within a dynamic production context, through qualitative and quantitative data collection techniques. This approach allowed for a comprehensive examination of the research process, highlighting the interplay between methodological choices and the specific constraints of the manufacturing environment.

These contextual and design characteristics, including the unplanned shift from a planned longitudinal evaluation to a cross-sectional survey in Paper 2, have important implications for research quality and the kinds of inferences that can be drawn, which are addressed in the final sections of this chapter.

3.7 Research quality

Given the multi-methodological nature of this thesis, assessing research quality requires a nuanced approach, as a single set of quality criteria is insufficient to cover the breadth of the research. This compilation comprises three empirical studies, and the quality of this thesis is motivated by evaluating specific criteria for each. This includes assessing the trustworthiness of the qualitative approach in Paper 1, evaluating the validity and reliability of the quantitative methods in Paper 2, and examining the rigorous design and evaluation cycles of the design science research (DSR) strategy with a longitudinal intervention in Paper 3.

3.7.1 Trustworthiness in qualitative research

For the qualitative components of this thesis, I have adopted the criteria of trustworthiness established by Lincoln and Guba (1985). These criteria serve as an alternative to positivist measures, focusing instead on credibility, transferability, dependability, and confirmability.

Credibility, which parallels internal validity, ensures that the study measures or observes what it intends to, is appropriate for the context, and is believable from the participant perspective. To strengthen credibility, this research employed data triangulation by utilizing different sources of information to corroborate findings. Furthermore, respondent validation played a central role, particularly in the DSR process. Through focus group discussions, feedback meetings, and adaptation workshops, findings and proposed designs were continuously presented back to the participants to ensure accurate interpretation and relevance.

Transferability concerns the extent to which findings can be meaningfully applied to other contexts. Rather than seeking statistical generalization, the qualitative findings in this thesis aim for analytical generalization. To facilitate this, the research provides thick descriptions of the study contexts, including organizational characteristics, production systems, and the specific conditions under which data were collected. These rich accounts enable readers to make informed judgments regarding the relevance and transferability of the findings to their own settings.

Furthermore, dependability and confirmability were addressed to ensure the stability and objectivity of the research. Dependability was supported through transparent methodology sections, documenting the evolution of coding structures and methodological choices over time. Confirmability was strengthened by grounding interpretations closely in the empirical material, for example by systematically linking themes to illustrative quotations, and by reflecting on the researcher's position and assumptions to reduce the risk that conclusions merely mirror prior expectations rather than the data.

3.7.2 Validity and reliability in quantitative research

To ensure rigor in the quantitative research presented in Paper 2, established criteria for validity and reliability were applied throughout the analytical process (Bell et al., 2019). As a foundational step for statistical validity, data integrity was evaluated by confirming that missing values were missing completely at random (MCAR). Consequently, missing data were handled using full information maximum likelihood (FIML), a method chosen because it preserves statistical power and reduces bias compared to traditional listwise deletion. Furthermore, assumptions for maximum likelihood estimation were verified through the inspection of skewness, kurtosis, and boxplots, alongside tests confirming linearity and an absence of problematic multicollinearity.

Validity was primarily approached through the lens of construct validity, aiming to ensure that the survey instruments accurately captured their intended theoretical concepts. This was initially addressed by utilizing established instruments, specifically the Work Design

Questionnaire, the Need Satisfaction at Work Scale, and the Multidimensional Work Motivation Scale, alongside validated measures for job satisfaction and stress. Construct validity was then empirically verified and refined by conducting separate confirmatory factor analyses for each of these specific areas. During these analyses, items with factor loadings below the 0.50 threshold were excluded from the work design and work motivation models to maintain measurement precision.

Furthermore, when evaluating work motivation, a substantial empirical overlap between identified and introjected regulation resulted in a Heywood case. To resolve this collinearity and establish a valid and stable measurement model, these two dimensions were merged into a single composite factor. This specific structural modification aligns with previous methodological observations regarding the complexities of isolating distinct motivational regulations when applying the Multidimensional Work Motivation Scale (Gagné et al., 2026).

Reliability, representing the consistency of the measures, was subsequently assessed for all finalized measurement models to guarantee stable results. Internal consistency was evaluated by calculating Cronbach's alpha for the created mean indices, confirming that the coefficients fell within the acceptable to excellent range and that the retained items within each scale measured the same construct coherently. Finally, the overall quality of the quantitative data was further strengthened by explicitly addressing the potential threat of common method bias, which is inherent to self-reported cross-sectional data. By applying Harman's single-factor test, an unrotated exploratory factor analysis demonstrated that a single factor accounted for clearly less than half of the total variance, providing confidence that common method bias was not a pervasive issue skewing the validity of the tested pathways (Podsakoff et al., 2003).

Given the cross-sectional design, the identified pathways should be interpreted as associations consistent with the theorized model rather than as definitive evidence of causal mediation (Stone-Romero & Rosopa, 2008).

3.7.3 Quality in design science research

The third methodological component, the design science research approach in Paper 3, requires a distinct set of quality criteria focused on utility and relevance. As this thesis resides at the intersection of operations management and engineering at a technical university, the design perspective is central. Romme (2003) argues that in management and business studies, design serves as a bridge between theory and practice. It moves beyond merely explaining existing phenomena (science mode) to creating systems that work better (design mode). In DSR, the primary goal is the creation of an artifact that solves a relevant problem (Holmström et al., 2009). Therefore, quality is demonstrated through the rigorous relevance of the design process,

ensuring that the artifact is grounded in the existing knowledge base, and through the utility of the solution as demonstrated through evaluation (van Aken et al., 2016). This creates a synergy where the pragmatic aim of changing an organization is balanced with a rigorous research focus.

In Paper 3, rigor was supported by grounding the designed loop-model in established theories of work design, organizational learning, and multiskilling, as well as by documenting iterative cycles of problem diagnosis, design, implementation, and refinement together with practitioners. Relevance and utility were addressed by co-designing and testing the artifact in two manufacturing companies within the LOOP project, focusing on real challenges related to team-based production, multiskilling, and autonomy. However, evaluating utility in complex organizational settings presents significant challenges. The initial ambition for Paper 3 was to evaluate the artifact using longitudinal quantitative data to measure specific effects on team performance. This proved difficult due to high staff turnover and changing team compositions during the project period, which made a reliable longitudinal statistical analysis infeasible. Instead, the evaluation relied more heavily on qualitative data and proximal indicators of utility (e.g., participant feedback, observed changes in team practices, and perceived improvements in learning and autonomy), highlighting the importance of adaptability and multiple sources of evidence in DSR evaluation strategies.

3.7.4 Synthesizing quality across studies

Across the three empirical papers, research quality is thus judged against criteria that are appropriate to their respective methodological traditions, while the thesis as a whole adopts a pluralistic stance. For the qualitative and design-oriented work in Papers 1 and 3, trustworthiness and design rigor/utility are central; for the quantitative work in Paper 2, the focus is on construct validity, reliability, and careful handling of the limitations of cross-sectional, nonexperimental data. Taken together, these complementary criteria support a robust, though methodologically diverse, account of work design, motivation, and organizational change in standardized manufacturing settings. However, the extent to which these quality criteria could be fully realized was strongly shaped by the empirical context of the LOOP project and the dynamics of the participating organizations. The following section elaborates on key challenges related to collecting and analyzing data in this setting.

3.8 Challenges with collecting and analyzing data in this setting

As highlighted in Paper 4, conducting human-centric research within a production context presents specific methodological challenges due to the dynamic nature of the environment. The

most severe challenges for data collection and analysis emerged during the intervention phases and primarily affected the planned longitudinal evaluation. The high variability of the setting, characterized by external disturbances such as fluctuations in demand or component shortages, makes it difficult to isolate the impact of an intervention from other simultaneous changes. A significant hurdle discussed in Paper 4 is the difficulty of using longitudinal research instruments that rely on repeated measures of the same individuals. High turnover rates among shop floor workers can severely compromise the validity of statistical analyses, such as longitudinal SEM, as the population changes too rapidly to allow for tracking individual experiences over time.

Furthermore, Paper 4 illustrates how interventions can create unintended consequences that affect data availability; for example, increasing operators' competence through training may lead to them being recruited for other positions, effectively draining the project of its participants. Additionally, the multidisciplinary approach required compromises regarding data collection methods. Differences in epistemic views between disciplines, such as the conflict between the need for population stability in psychological research and the reality of the OM context, resulted in the exclusion of certain survey scales and qualitative methods such as diary studies.

Finally, because companies tend to adapt interventions to their specific local context, ensuring full implementation and comparability between cases remains a persistent challenge for analysis. While such adaptation is desirable from a practical improvement perspective, it complicates efforts to evaluate effects using standardized measures and to aggregate findings across sites. Collectively, these challenges help to explain why the quantitative study in Paper 2 ultimately relied on cross-sectional baseline survey data from the mapping phase, and why the evaluation of the artifact in Paper 3 drew more heavily on qualitative evidence and proximal indicators of utility rather than on the originally envisaged longitudinal statistical models.

3.9 Scientific approach and methodological stance

Early in my doctoral studies, I was tasked with defining my epistemological and ontological position. While this exercise emphasized the importance of taking a stand rather than defaulting to a convenient "middle ground", or "lagom" as we say in Sweden, I found it challenging to commit exclusively to a single worldview. For me, the choice of perspective is not about avoiding a decision but about acknowledging that reality is multifaceted. Different aspects of the world require different tools to be understood.

If I wish to understand individual perceptions and meanings, a constructivist approach with qualitative interviews is appropriate. Conversely, if I aim to identify correlations and structural patterns at the group level, a post-positivist approach using quantitative measurement is more

suitable. To adhere strictly to one paradigm would be reductionist; attempting to understand human behavior solely through numbers ignores the subjective construction of meaning, while relying only on qualitative data misses the broader tendencies and structural realities that shape those meanings.

Therefore, I do not view objectivity and subjectivity as mutually exclusive forces that must be chosen between. Instead, I adopt a stance that allows for complexity, recognizing that while humans are unique in their meaning-making, they also exhibit shared patterns on a macro level.

3.9.1 Dialectical pluralism

To accommodate this complexity, this thesis adopts a stance of dialectical pluralism (Johnson, 2017). Unlike pragmatism, which primarily focuses on what works to solve a problem and often seeks to smooth over philosophical differences (Morgan, 2007), dialectical pluralism explicitly engages with the tensions between different paradigms (Shannon-Baker, 2016). It posits that actively listening to the dialogue and the differences between divergent perspectives leads to a richer and more comprehensive understanding of reality (Greene & Hall, 2010).

When employing a multi-methodological approach, pragmatism is often the default choice. As Shannon-Baker (2016) notes, pragmatism is excellent for focusing on practical solutions and shared meaning-making – "truth is what works". This aligns well with the design science research component of this thesis (Paper 3). Romme (2003) distinguishes between the sciences (focused on explaining patterns), the humanities (focused on understanding human experience), and design (focused on creating systems). DSR sits in the latter, adopting a pragmatic orientation to solve practical problems.

While a pragmatic approach would have been a convenient fit in relation to the DSR component of this thesis (given its focus on utility and artifacts), I found it too "safe". It risks downplaying the fundamental epistemological differences between the studies. I am interested not just in the practical solution, but in how the deep, subjective understanding of work design interacts with the objective, measurable outcomes of it. Thus, adopting pragmatism as the sole overarching philosophy for this thesis felt insufficient. Shannon-Baker (2016) distinguishes pragmatism from dialectical pluralism, noting that while pragmatism emphasizes convergence and utility, dialectical approaches are better suited for addressing divergent ideas and tensions in the data.

Since this thesis involves distinct parallel studies that sometimes point in different directions, dialectical pluralism is the more appropriate fit. As described by Johnson (2017), this approach allows me to engage with the differences – the convergence and divergence – between the findings. Rather than smoothing over the conflict between the post-positivist and constructivist

elements to find a pragmatic middle, I allow them to exist side-by-side. This dialectical tension generates a depth of understanding that neither paradigm, nor a purely pragmatic focus on utility, could achieve on its own.

Thus, I view my research as a multi-paradigmatic conversation:

Paper 1 takes a constructivist, inductive approach. By asking participants about their work experiences without imposing prior hypotheses, I allowed insights to emerge "bottom-up". This honors the nuances of their lived experience.

Paper 2 adopts a post-positivist, quantitative approach. Here, the goal was to identify statistical relationships between work design, motivation, and outcomes on a group level – providing "hard facts" that are less susceptible to the cherry-picking bias sometimes found in qualitative interpretation.

Paper 3, utilizing DSR, introduces an interventionist perspective, aiming to actively change reality rather than merely observing it (van Aken et al., 2016) to establish a structure for organizational learning.

Paper 4 examines the methodological and epistemological challenges of conducting human-centric OM research, particularly within the context of Industry 4.0/5.0. It distinguishes between multidisciplinary approaches and interdisciplinary approaches, noting that true integration is often hindered by differing epistemic views.

3.9.2 A convergent design with analytical synthesis

Creswell (2022) describes a convergent mixed methods design as one where qualitative and quantitative data are collected concurrently to provide a more complete understanding. In this thesis, the studies were conducted in parallel rather than sequentially. While a sequential design (e.g., using qualitative insights to build a survey) offers clear chronological logic, the parallel design allowed each method to operate on its own terms, without being prematurely constrained by the findings of the others.

The synthesis in this dialectical pluralism therefore occurs not during the data collection, but in the analytical integration presented in this cover essay (kappa). Here, the papers are placed side-by-side to illuminate both convergence (where findings align) and divergence (where they capture different slices of reality).

3.9.3 Paradigmatic tensions

To explicate the methodological position of this thesis, it is necessary to acknowledge the theoretical landscape in which it resides. Since Kuhn (1962), science has been understood as

operating within paradigms, overarching worldviews that define what constitutes legitimate knowledge. Burrell and Morgan (1979) famously mapped these social science paradigms along axes of subjectivity/objectivity and regulation/change, creating a framework that often forces researchers to pick a side.

On one side of this spectrum lies the post-positivist tradition (Paper 2), rooted in the logic of Popper (1959). Here, the focus is on falsifiability and the pursuit of objective truths; reality is viewed as external and measurable, even if our measurements are imperfect. On the opposite side lies the social constructivist tradition (Paper 1), defined by Berger and Luckmann (1966), who argue that reality is not discovered but socially constructed through human interaction. In this view, knowledge is inherently subjective and tied to the specific context.

Historically, these traditions have been viewed as incompatible. Lincoln and Guba (1985; 1994) argued that because the ontological and epistemological assumptions of positivism and constructivism are contradictory, they cannot be combined. They advocated for "naturalistic inquiry" (later constructivism) and the concept of trustworthiness as a replacement for positivist validity, suggesting that a researcher cannot hold both worldviews simultaneously.

However, sticking strictly to one paradigm limits the scope of inquiry. Johnson and Onwuegbuzie (2004) challenge the "incompatibility thesis" posed by purists like Lincoln and Guba. They argue that mixed methods research offers a superior approach to monomethod studies because it allows researchers to overcome the weaknesses of a single paradigm. By adopting a pluralist or pragmatic stance, researchers can bridge the divide.

This thesis aligns with Johnson and Onwuegbuzie's view. Attempting to understand the complex phenomenon of work design solely through quantitative metrics (Popper's legacy) would be reductionist, missing the nuances of lived experience. Conversely, relying only on constructivist interpretation (Berger & Luckmann's legacy) risks missing broader structural trends. Therefore, a mixed-method approach is not a refusal to choose, but a strategic decision to capture a fuller picture.

3.9.4 Reflections on measurement and complexity

The value of a pluralistic approach became particularly evident when facing the realities of measurement in dynamic organizational contexts. Originally, the quantitative data collection among the production teams was intended to support a longitudinal structural equation modeling analysis of work design, motivational processes, and well-being. Capturing data at multiple time points would, from a post-positivist perspective, have provided a stronger basis for inferences about causal pathways and the effects of work design over time. However, the high degree of staff turnover and internal mobility between departments meant that a

substantial portion of the original participants were no longer present in their initial teams at the second point of measurement.

This attrition highlights the inherent limitations of relying solely on quantitative measurement in fluid social contexts. As Klein and Kozlowski (2000) note in their discussion of multilevel theory, measuring team properties becomes deeply problematic when team composition changes, raising the conceptual question of whether it can even be considered the same team. A narrowly post-positivist, variable-centered perspective might be inclined to treat such attrition primarily as a failed longitudinal design. Yet, through a pluralistic lens, this methodological hurdle becomes a meaningful empirical finding in itself, vividly illustrating the instability and dynamic nature of the studied work context.

Consequently, the planned longitudinal analysis could not be realized, necessitating a pivot to the cross-sectional design presented in Paper 2. While this adaptation allowed for a comprehensive evaluation of the initial baseline data, it introduced significant constraints regarding causal inference. As highlighted in methodological evaluations of research designs, valid inferences about sequential processes hinge on strong internal validity, including clear temporal precedence and effective control of confounding variables, conditions most closely approximated in randomized experiments within special-purpose settings (Stone-Romero & Rosopa, 2008). In contrast, the resulting nonexperimental cross-sectional study offers only a relatively weak basis for drawing firm causal conclusions, as temporal ordering between predictors, mediators, and outcomes cannot be definitively established. Against this backdrop, the sequential pathways examined in Paper 2 – linking work design, basic psychological need satisfaction, motivation, and health and well-being – should be interpreted as associative patterns consistent with the self-determination theory process model, rather than as definitive evidence of causal pathways over time. The contribution of the study thus lies in delineating plausible motivational pathways and in identifying which theoretically proposed links receive empirical support in this specific manufacturing context, while acknowledging the boundary conditions imposed by the design.

Conversely, attempting to bypass these longitudinal measurement challenges by relying solely on qualitative data would have introduced its own methodological biases. A primary concern in qualitative approaches evaluating workplace dynamics is social desirability, where participants may report overly positive outcomes in order to please researchers, protect their organization, or appear committed to their work (Nederhof, 1985). This phenomenon is generally less pronounced in anonymous survey responses, further underscoring the necessity of a pluralistic approach that balances the inherent strengths and weaknesses of different methodological paradigms when studying complex organizational realities.

3.9.5 Conclusion

By embracing dialectical pluralism, I argue that the tension between the "lived experience" (Paper 1) and the "measured reality" (Paper 2) is not a problem to be solved, but a productive space for generating knowledge. This approach aligns with the need for multidisciplinary collaboration (discussed in Paper 4), where progress depends on the ability to engage in continuous dialogue across different epistemic traditions. Ultimately, this thesis asserts that to understand the full complexity of work design, we must be willing to look through multiple lenses – sometimes separately, sometimes together, but always with an awareness of what each lens reveals and conceals.

3.10 Ethical and methodological considerations

To ensure transparency and research integrity, the following sections outline the ethical considerations regarding the LOOP research project, as well as the use of AI tools in the research process.

3.10.1 Ethical review and participant protection

The LOOP research project was subject to an ethical review and was approved by the Swedish Ethical Review Authority (Dnr 2021-02686). This was deemed necessary as the questionnaire included items regarding stress and job satisfaction, which could be perceived as sensitive personal data related to health. Additionally, the intervention affected the participants' work situation, further motivating the need for an ethical review.

The additional interviews conducted independently of the project did not involve sensitive personal data requiring ethical approval. All respondents were informed that their participation was voluntary and were asked for consent before interviews were recorded. Survey data were analyzed only when written consent was provided. To protect participant confidentiality, all companies and individuals have been anonymized in both the papers and this thesis.

3.10.2 Use of AI tools

During the writing of this thesis, the AI tools Scopus AI, Paperguide, Microsoft Copilot, Google Gemini 3.1, Perplexity Education Pro, and ChatGPT-5 were used to assist in searching for relevant literature (complementing standard databases such as Web of Science, Scopus, and Google Scholar). Additionally, these tools were used to improve language and text structure and to serve as a sounding board for testing arguments and refining ideas.

AI was not used to generate research data or to replace my own critical judgment. All analyses, interpretations, and conclusions are my own. I have verified and reviewed all references, sources, and suggestions generated by AI tools and take full responsibility for the content.

3.11 Author's preconceptions

A researcher's background inevitably shapes the preconceptions brought into the research process. While eliminating subjectivity is impossible, transparency regarding its influence is important for the integrity of the studies.

3.11.1 Academic background and interdisciplinary lens

My academic journey began with a year of History of Ideas and Science (first term) and Psychology (second term) before I entered Chalmers University of Technology to study Industrial Engineering and Management. Although I enjoyed my engineering studies, I felt that a piece was missing. I wanted to reflect more and understand deeper layers; the focus felt heavily tilted toward what works, rather than why it works or why it is desirable. Consequently, I studied Practical Philosophy in parallel with my engineering studies and later added additional Psychology and other courses.

Today, I hold two master's degrees, the first being in Industrial Engineering and Management, and the second in Psychology. I have never felt fully rooted in a single discipline but have rather moved across boundaries with an interdisciplinary mindset. This background is perhaps why I value dialectical pluralism; I am driven by a curiosity to view phenomena from multiple perspectives. I find the intersection of management and psychology particularly fascinating and see great value in integrating psychological insights into Operations Management.

Beyond intellectual curiosity, I carry a normative belief that efficiency and well-being are not mutually exclusive. This ethical stance drives my motivation to find solutions that benefit both the company and the individual.

3.11.2 Industry experience

Beyond academia, I have experience working in industry, primarily in a smaller company with a different structure than the large organizations in this thesis. My understanding of large-scale operations comes mainly from summer jobs in production during my studies. These experiences

gave me insight into the realities of production work, and the conversations I had there sparked my curiosity about how people actually experience their work.

My first master's thesis was conducted at one of the case companies of the LOOP project, many years before this project started. It was conducted during a transition from autonomous work groups to line production, where I studied employee involvement. Thus, I have long been interested in the human perspective of work design – it is no coincidence that my dissertation focuses on this area.

3.11.3 Managing preconceptions in the research process

While I entered this project with certain preconceptions, I strove to maintain an open mind regarding the participants' own experiences. In the interview study for Paper 1, which launched my research, I initially expected to capture themes related to leadership. However, by remaining open to the data, other interesting aspects emerged, specifically job crafting.

Regarding the survey study, results are naturally dependent on the questions asked. My background in psychology made me eager to include comprehensive scales (such as the full WDQ) to capture a complete picture of how work design affects need satisfaction, motivation, and well-being. Additional outcome variables were also considered. However, the initial draft proved unreasonably long. The research group had to prioritize hard to make the survey acceptable for the operators. Consequently, not all work characteristics were included – a compromise between my academic ideals and practical constraints.

3.11.4 The role of the researcher

With my training in psychology, I am generally most comfortable with an outsider perspective – a researcher observing the context without becoming part of it (Evered & Louis, 1981). This approach characterizes the data collection for Papers 1 and 2 (the pre-intervention phase). My engineering background was an asset in these interactions. Familiarity with production terminology allowed me to build rapport and reduced the academic distance in an environment that can sometimes be skeptical of "soft" sciences.

The intervention study in the LOOP project (Papers 3 and 4), however, required a different approach. Following design science research principles, we assumed a more active role. While the participants shaped and executed the intervention, we provided the framework (the loop-model) and coaching. In this phase, we acted as active agents (Holmström et al., 2009), thereby influencing the object of study to a greater extent. This shift in roles was necessary for the DSR approach but is important to acknowledge when interpreting the different parts of this work.

Using both modes of inquiry (insider/outsider) gives a more comprehensive picture of the breadth and depth of organizational phenomena (Evered & Louis, 1981). From an educational point of view, it has also been beneficial for me to have the privilege of combining different types of research modes and methods during my doctoral studies.

4. SUMMARY OF APPENDED PAPERS

This chapter presents a summary of the four appended papers that constitute the foundation of this thesis, illuminating the dynamics of work design across individual, team, and organizational levels in manufacturing. While each paper addresses a specific part of the overall research aim, they are deliberately ordered to move from describing current work design and coping practices, via testing underlying mechanisms, to exploring organizational design solutions and, finally, developing a methodological framework for studying human-centric interventions in dynamic production environments.

Paper 1 and Paper 2 focus primarily on individual experiences and outcomes of work design. Paper 1 explores how front-line managers manage functional misalignments between prescribed and perceived work characteristics through compensatory job crafting. Paper 2 examines operators, demonstrating how basic psychological need satisfaction serves as a primary mechanism linking work design to well-being in standardized settings.

Paper 3 shifts the lens to the meso and macro levels by introducing and evaluating the loop-model, an organizational design supporting multilevel organizational learning and multiskilled production teams. Finally, Paper 4 synthesizes methodological insights from the longitudinal intervention project into a six-step framework and eight design principles for human-centric operations management research.

Together, these papers provide complementary perspectives on how top-down structural conditions and bottom-up agency co-construct work design in practice, advancing both theory and methodology for sustainable and human-centric production.

Table III provides an overview of the appended papers, detailing their primary focus, methodological approach, main theoretical and practical contributions, and how they relate to the overarching research questions (RQs) of this thesis.

Table III. Overview of appended papers

Paper	Primary Focus	Research Approach / Context	Main Contribution	Addresses RQ(s)
1	Front-line managers' work design and job crafting.	Qualitative, exploratory multi-case study (interviews and observations).	Introduces the compensatory job crafting model; shows how reactive crafting sustains operations but masks misalignments.	RQ1, RQ2, RQ3
2	The impact of work design on operator well-being and motivation.	Quantitative, cross-sectional survey study (n=586).	Challenges the full self-determination theory double mediation model; highlights basic psychological need satisfaction as the primary mechanism.	RQ1
3	Organizational design for multilevel learning and multiskilled teams.	Design science research using CIMO logic.	Develops the loop-model for continuous improvement; highlights challenges related to the paradox of success and internal mobility.	RQ1, RQ2, RQ3
4	Methodology for designing human-centric interventions.	Longitudinal multidisciplinary intervention study.	Presents a six-step methodological framework and eight design principles for handling dynamic production environments.	RQ3

4.1 Paper 1

This study explores the work design of front-line managers in production and how they respond to and influence their work through job crafting. While operations management literature has traditionally viewed work design as a top-down endeavor, this research presents a nuanced understanding of work design as a co-constructed yet unequal process. The study employs an exploratory, inductive multi-case design involving four production plants in northern Europe, based on in-depth interviews with 15 front-line managers and 12 senior managers, as well as observations and a focus group.

The findings reveal a functional misalignment between the work characteristics prescribed by senior management and those perceived by front-line managers. Senior managers view the front-line role as demanding and flexible, requiring self-reliance and self-organizing behavior. They expect managers to prioritize and create structure for themselves. In contrast, front-line managers perceive these conditions as overwhelming scope and role conflict, combined with inadequate support. They face large spans of control and administrative workloads that limit their ability to be present on the shop floor, creating a situation where the work characteristics are insufficient to conduct the job.

To cope with this misalignment, front-line managers engage in compensatory job crafting practices. These practices are described as reactive compensatory mechanisms rather than proactive initiatives. The study identifies three main themes of job crafting practices: task organizing, attending to relationships, and altering perspectives. Task organizing involves prioritizing among mandatory tasks, delegating responsibilities, and working outside regular hours to manage the workload. Attending to relationships includes seeking peer support to handle isolation and using expedient interaction modes to maintain contact with employees despite time constraints. Altering perspectives involves reframing the work as people-centered to justify production goals and adjusting self-image to cope with feelings of inadequacy.

These job crafting practices result in redesigned work, characterized by a reconfigured task structure, expedient interaction modes, and an adjusted view of work and self-image. The compensatory job crafting model is presented (Figure 2), which conceptualizes job crafting as a counterbalance to misalignment between prescribed and perceived work characteristics, resulting in redesigned work. This model explains how misaligned work characteristics drive front-line managers to redesign their work to make an unsustainable work design manageable.

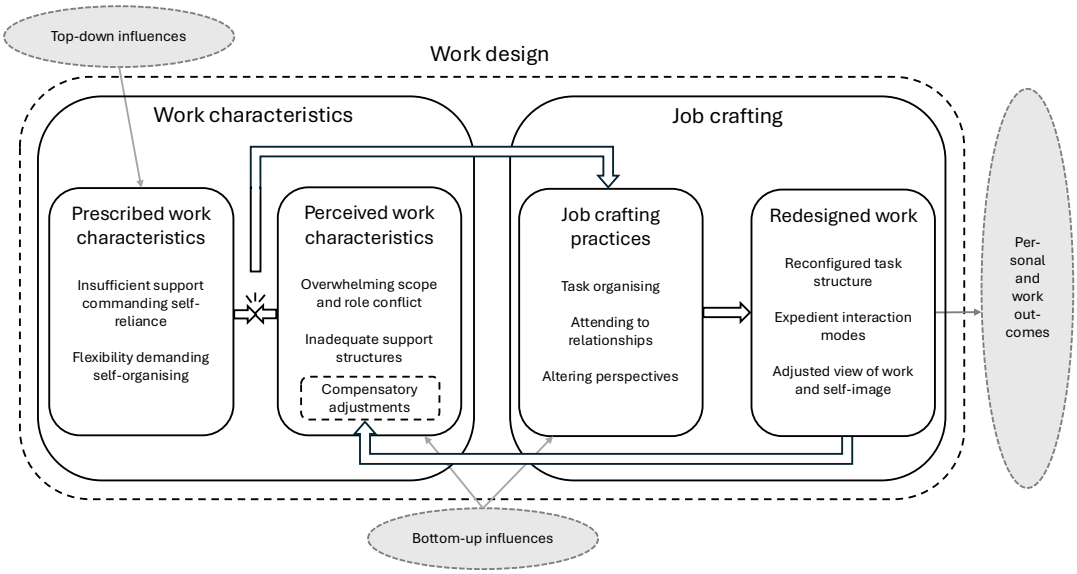

Figure 2. The compensatory job crafting model

The paper concludes that while compensatory job crafting allows managers to sustain operations and handle immediate disturbances, it creates unmanaged variation in front-line manager practices that challenges standardization principles. Furthermore, these bottom-up solutions risk masking systematic design problems from senior management, thereby making it harder to identify the need for structural redesign. For bottom-up work redesign to become

proactive and align with organizational strategies, it is essential to ensure a sustainable work design in production where job crafting can evolve from compensatory mechanisms to learning and future-oriented practices.

4.2 Paper 2

This study examines the impact of work design on stress and job satisfaction, focusing on the pathways through basic psychological need satisfaction and work motivation within the self-determination theory (SDT) framework. In the manufacturing industry, work is often characterized by short repetitive work tasks with a high degree of standardization. While lean production aims for efficiency, there is an increasing need for motivated and creative employees in the production industry due to the importance of learning and continuous improvement to stay competitive.

The research examined a theoretically hypothesized double mediation model using cross-sectional survey data from 586 production workers in three Swedish manufacturing companies. The model linked six work design characteristics (WDQ autonomy, WDQ task variety, WDQ problem solving, WDQ skill variety, WDQ job complexity, and WDQ interdependence) to health and well-being outcomes through the satisfaction of three basic psychological needs (autonomy, competence, and relatedness) and three motivation indices (intrinsic motivation, the merged identified and introjected regulation factor representing the autonomous-controlled boundary, and external social regulation). Within a path-analytic framework, all possible sequential paths were examined, including those corresponding to the theorized “double-step” process from work design via need satisfaction and motivation to stress and job satisfaction (Figure 3). Of the 108 possible full two-step pathways, only 7 were statistically significant, all of which operated through intrinsic motivation and culminated in job satisfaction, whereas no such full pathways were significant for stress.

Rather than supporting a broad pattern of full double-step pathways, the results showed that most significant indirect effects bypassed the motivation variables entirely and occurred solely through basic psychological need satisfaction. Among the specific work characteristics, WDQ task variety and WDQ problem solving emerged as particularly potent predictors.

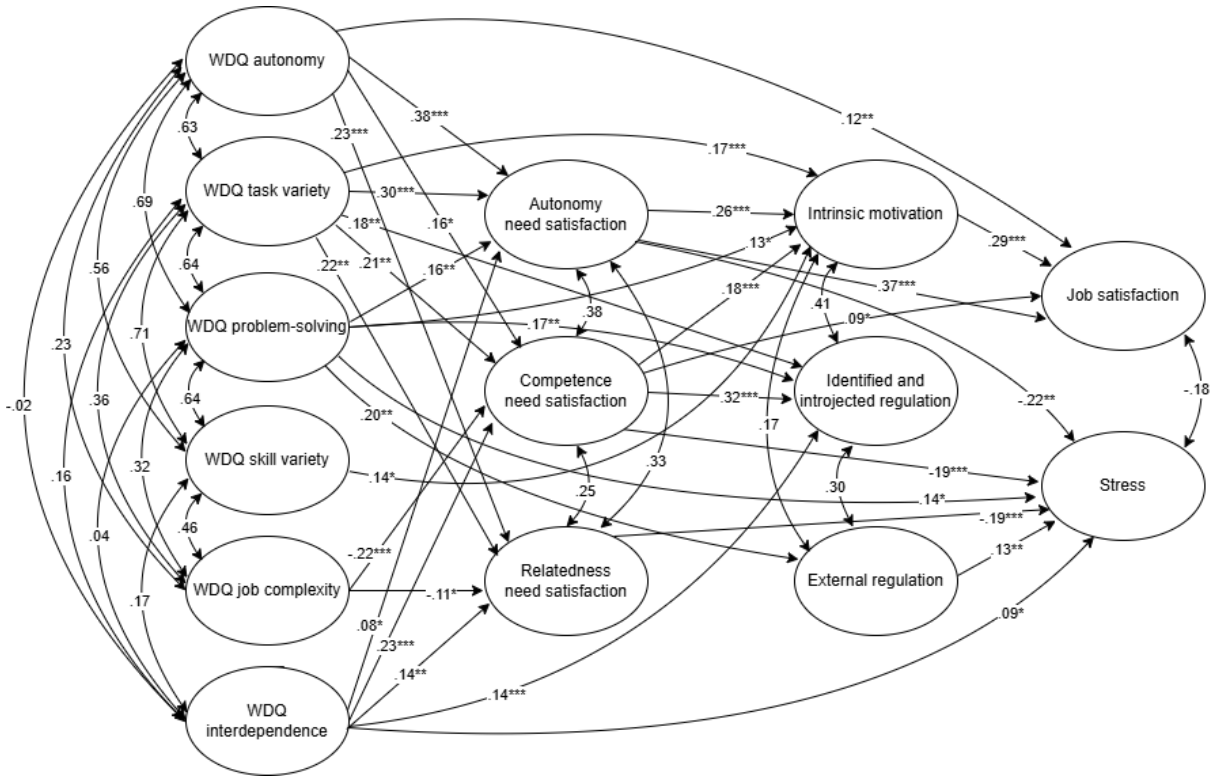

Figure 3. The resulting model including all effects and correlations between variables

Regarding the relationships between variables, autonomy need satisfaction and competence need satisfaction were positively related to intrinsic motivation. Competence need satisfaction was also positively related to the merged identified and introjected regulation factor, while none of the basic psychological need satisfaction variables significantly predicted external social regulation. In terms of outcomes, intrinsic motivation was positively related to job satisfaction whereas it was not significantly related to stress. External social regulation was positively related to stress but not to job satisfaction, while the merged identified and introjected regulation factor was not related to either outcome.

The findings challenge assumptions about the universality of the full self-determination theory model in industrial settings, demonstrating that basic psychological need satisfaction is often a sufficient mechanism for predicting health and well-being, frequently bypassing the subsequent motivational step. Practical implications highlight that managers should prioritize redesigning tasks to support autonomy, task variety, and problem solving, even within standardized processes.

4.3 Paper 3

This paper designs and evaluates an artifact – the loop-model – that facilitates multilevel organizational learning processes in lean manufacturing organizations. As the transition toward Industry 4.0 introduces high technological and process complexity, there is a growing need for multiskilled and specialized workers capable of decentralized decision-making and problem-solving. However, traditional structural ambidexterity approaches, where responsibility for continuous improvements lies with technical specialists in support functions rather than at the shop floor level, often fail to provide long-lasting behavior change and continuous learning opportunities for all employees. Addressing this gap, the study employs a design science research approach, implementing and evaluating the model in two case companies using CIMO logic (Context, Intervention, Mechanism, Outcome), as illustrated in Figure 4.

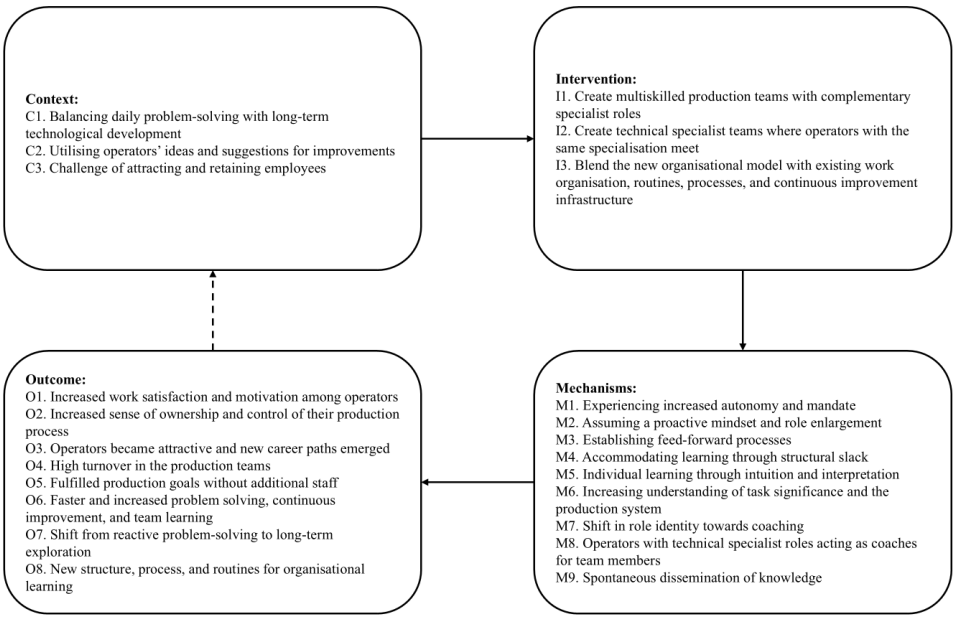

Figure 4. Overview of context, intervention, mechanisms, and outcome

The loop-model is built on dual team membership, dedicated time for technical specialist roles, technicians acting as coaches, and formal meeting structures in the form of learning loops. The intervention involved reorganizing work by building on dual team membership, where operators participate in both multiskilled production teams (breadth) and technical specialist teams (depth). To foster deep learning, operators were assigned to specific technical specialist roles – such as quality, maintenance, or safety – and integrated into technical specialist teams led by technical experts acting as coaches. This design establishes a formalized structure for organizational learning processes that bridges individual and organizational levels through

team-based integration (Figure 5). The model facilitates feed-forward processes, in which individual insights are assimilated into collective team practices, and feedback processes, where institutionalized learning enables teams and individuals to exploit what has already been learned.

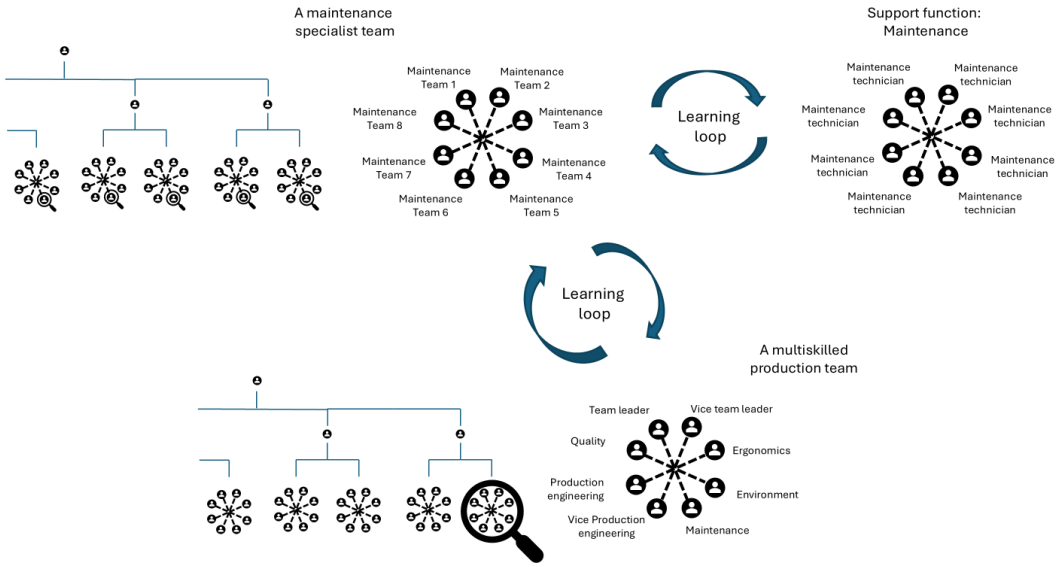

Figure 5. Loop-model with learning loops between production teams and technical specialist teams

The findings demonstrate (Figure 4) that the intervention triggered several mechanisms facilitating multilevel organizational learning processes. Primarily, the new roles increased job autonomy and individual competence among operators. By assuming duties traditionally held by support functions to drive continuous improvement, operators gained a deeper sense of task significance and a broader understanding of the production system. This shift required a change in role dynamics; team leaders moved from being the operational hub to becoming coaches, while support functions transformed from reactive firefighting into proactive coaches focused on long-term exploration and technological development.

Regarding outcomes, the study identified the establishment of a new structure, process, and routines for organizational learning and increased work satisfaction and motivation among operators. The model increased problem solving, continuous improvement, and team learning, and successfully allowed support functions to shift from reactive problem-solving to long-term exploration.

However, the study also revealed challenges associated with this transformation. The upskilling of operators created a paradox of success: operators became highly attractive for

internal recruitment, which led to higher internal mobility and challenged the stability of the multiskilled production teams. Additionally, shift-based production designs presented barriers for feed-forward and feedback processes, making inter-team learning difficult.

The conclusion is that the loop-model provides a foundation for multiskilled production teams and operationalizes an organizational design for continuous improvement. It advances human-centric operations research by validating an organizational design that operationalizes multilevel organizational learning, enabling decentralized decision-making and continuous upskilling. However, successful implementation requires management to actively allocate protected time for specialist work and to align recruitment strategies to manage the dynamics of increased internal mobility.

4.4 Paper 4

This paper develops a methodological framework for integrating human-centric aspects into operations management research, emphasizing the need for multidisciplinary and interdisciplinary approaches. Human-centric operations are increasingly recognized as essential for the effective functioning of operational systems, particularly within the transition toward Industry 5.0, which highlights the need for sustainable, human-centric, and resilient industry. To achieve this, research must go beyond technocentric approaches and place human needs and interests at the center of the production process.

The paper distinguishes between multidisciplinary and interdisciplinary research. Multidisciplinary research involves cooperation among researchers from different disciplines with low integration, offering diverse perspectives but potentially resulting in a fragmented understanding. In contrast, interdisciplinary research entails high integration where insights and methods are combined to solve complex problems. Although interdisciplinary approaches have the potential for more innovative solutions and a more comprehensive understanding, they require more resources and face epistemic difficulties regarding how knowledge is constructed.

Drawing on a longitudinal multidisciplinary intervention study conducted in four manufacturing companies, the paper examines how to design and evaluate human-centric intervention studies in operations management. The research project faced several challenges that illustrate the difficulties of designing human-centric interventions in dynamic production environments. First, contextual instability caused by external disturbances and a high turnover rate among operators made planned statistical analyses impossible. Second, epistemic difficulties emerged within the multidisciplinary project group, leading to a fragmented understanding of the research problem and to tensions around appropriate methodological choices. Third, the intervention created unintended consequences, such as when training

interventions made operators more attractive for internal recruitment to other positions, effectively draining the project of its key participants.

To address these challenges, the primary contribution of the paper is a six-step methodological framework and eight actionable design principles tailored to dynamic production contexts. The six-step methodological framework structures the overall research process through epistemic alignment, contextual scoping, intervention design and adaptation rules, measurement strategy, handling unintended consequences, and integration and reflection (Figure 6).

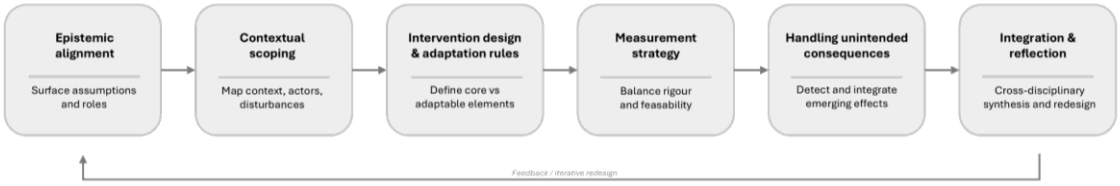

Figure 6. Six-step methodological framework for human-centric OM research

This framework is supported by eight actionable design principles (D1–D8) that guide researchers to foster epistemic awareness, define interdisciplinary integration points, conduct multi-level contextual scoping, define core versus adaptable elements, establish context-adaptive measurement strategies, systematize the detection of unintended consequences, enable iterative synthesis, and utilize contextual volatility as an empirical asset. The framework and principles address critical challenges identified in the study, such as epistemic difficulties within diverse teams and the “paradox of success”, where successful upskilling unintentionally leads to higher internal mobility that drains production teams of competence. By providing this structured model, the paper moves beyond reflecting on methodological challenges to offering a proactive guide for integrating human-centric, multi- and interdisciplinary perspectives in operations management.

5. SUMMARY OF FINDINGS – ANSWERS TO RESEARCH QUESTIONS

The aim of this thesis was to explore the dynamics of work design and redesign across individual, team, and organizational levels in the manufacturing industry, in order to understand how human-centric operations can be realized in an Industry 5.0 context. Drawing on the four appended papers, this chapter responds directly to the three research questions by providing an integrated summary of the empirical findings. The subsequent chapter (Chapter 6) then deepens the discussion through a synthesis of how these findings illustrate co-constructed work design and human-centricity in practice.

5.1 Research question 1

RQ1. In what ways do work design characteristics influence individual outcomes such as motivation, well-being, and learning in standardized production contexts?

Taken together, the findings across the papers indicate that the influence of work design on individual outcomes is both more direct and more context-dependent in standardized production settings than much of the existing theory assumes. Paper 2 challenges the assumption that the full double mediation model of self-determination theory is universally applicable in standardized settings, as the hypothesized full model received limited support. Instead, the results suggest that basic psychological need satisfaction operates as a primary mechanism for predicting stress and job satisfaction, frequently bypassing the subsequent motivational step. Task characteristics – particularly task variety and problem solving – show strong direct effects on stress and job satisfaction, whereas the indirect effects via autonomous motivation are weaker and less consistent. This suggests that in standardized lean production contexts, the structural design of tasks and roles can exert a relatively immediate influence on well-being, with motivation playing a less central, more bounded role than SDT would predict in more flexible work environments.

Paper 3 further illustrates how changes in work design at the team level can reshape these mechanisms. The loop-model and the associated multiskilled production teams enrich work design by increasing job autonomy, task significance, and individual competence. Through the combination of specialist roles, dual team membership, and structured learning loops, operators report greater overview, responsibility, and involvement in problem solving. This design appears to support basic psychological need satisfaction and create better conditions for learning and capability building over time.

However, Paper 1 shows that when prescribed work characteristics for front-line managers are misaligned, work design can undermine well-being even when managers work hard to make

their roles sustainable. Senior managers describe the role as demanding and flexible, expecting front-line managers to be self-reliant and to create their own structure. In contrast, front-line managers experience these conditions as overwhelming scope, role conflict, and inadequate support, with large spans of control and administrative workloads limiting their presence on the shop floor. To cope with this misalignment, front-line managers engage in compensatory job crafting – a set of reactive practices in which they reorganize tasks, rely on peer support, and reframe their work and self-image in order to keep operations running. While these practices result in a redesigned version of the role that is more manageable in the short term, they require continuous compensatory labor that risks becoming an additional burden on the individual over time. In this way, Paper 1 highlights that the experienced impact of work design on well-being is shaped not only by formal job descriptions, but also by how front-line managers continuously reorganize and reframe their work to make an unsustainable role manageable in practice.

Collectively, these findings suggest that in standardized production contexts, the structural design of work plays an important role in shaping individual outcomes. While basic psychological needs remain important, the satisfaction of these needs can be constrained by the realities of lean production. In systems with short cycle times and tight controls, individual well-being and learning are at risk of being compromised if tasks lack variety, problem-solving opportunities, or adequate support. Furthermore, relying on individual coping strategies, such as compensatory job crafting, to manage a misaligned work design is unlikely to be a sustainable solution on its own, as it tends to mask structural deficits rather than resolve them. Therefore, these results nuance existing SDT and work design research by highlighting that sustainable improvements in individual outcomes depend less on treating motivation as a standalone objective, and more on redesigning concrete tasks and team structures to reliably support autonomy, competence, and relatedness in daily operations.

5.2 Research question 2

RQ2. How do top-down structural conditions and bottom-up agency interact to shape work design at individual and team levels in manufacturing environments?

The findings from Papers 1 and 3 indicate that the interaction between top-down structural conditions and bottom-up agency manifests differently depending on the level of analysis and how well the prescribed work design fits the functional demands of the role or team.

At the individual (micro) level, Paper 1 reveals a functional misalignment between the top-down prescribed work characteristics and the front-line managers' perceived work characteristics. When senior management's expectations of a flexible, self-reliant role diverge from a reality of overwhelming scope, role conflict, and inadequate support, the organizational

structure places significant constraints on how the role can be enacted. This structural deficit leads managers to rely on compensatory job crafting to keep operations running. Through the continuous co-construction of a redesigned version of the role, this bottom-up agency makes the situation more manageable in the short term, but introduces unmanaged variation in practice and risks masking underlying structural design problems from senior management. In other words, misaligned top-down work design is associated with bottom-up agency that is primarily compensatory, oriented toward preserving day-to-day functioning rather than enabling strategic development or systematic learning.

At the team (meso) level, Paper 3 illustrates a more constructive pattern, where a deliberate top-down intervention is used to scaffold bottom-up agency and multilevel organizational learning. The loop-model reorganizes work around dual team membership, dedicated time for technical specialist roles, and formal learning loops linking multiskilled production teams with technical specialist teams coached by experts. This design shifts responsibility for continuous improvement from support functions to operators, increasing job autonomy, task significance, and perceived competence as operators take on duties previously held by technical specialists and develop a deeper understanding of the production system. Bottom-up agency in the form of problem solving, continuous improvement, and team learning can be channeled through structured feed-forward and feedback processes that connect individual insights to collective routines and organizational capabilities over time. While this intervention also generates new challenges – such as a paradox of success where upskilling inadvertently destabilizes the teams – the overall pattern differs markedly from Paper 1: here, top-down structures are explicitly designed to create time, roles, and routines for proactive learning and decentralized decision-making rather than leaving individuals to compensate for deficits in the work design. These findings illustrate that changes to team

level work design are not neutral for individual experiences; they reconfigure how operators can satisfy basic psychological needs and exercise agency.

Taken together, these papers suggest that the interaction between top-down structural conditions and bottom-up agency is not uniform but contingent on the quality and intent of the work design. When structures are misaligned and under-resourced, bottom-up agency tends to take a compensatory form that makes unsustainable roles workable, at the cost of variation and reduced transparency about structural problems. When structures are deliberately designed to support multilevel learning, bottom-up agency can instead become a productive force that strengthens both human capabilities and organizational performance. In this way, the thesis contributes a more nuanced view of work design in manufacturing as a co-constructed yet unequal process, where top-down and bottom-up forces jointly shape how work is actually done in practice.

5.3 Research question 3

RQ3. What are the organizational and methodological implications and emergent challenges of implementing human-centric work design?

The findings across Papers 1, 3, and 4 indicate that moving toward more human-centric work design in manufacturing is not a linear implementation task, but a dynamic process that surfaces organizational tensions and methodological challenges. On the organizational side, Papers 3 and 4 point to a "paradox of success": human-centric initiatives that successfully upskill operators and broaden their roles can, under certain conditions, destabilize the very teams they aim to strengthen. As operators become more competent and visible, they also become attractive candidates for internal recruitment to other positions, increasing internal mobility and gradually draining multiskilled production teams of critical capabilities. Similarly, Paper 1 shows that while compensatory job crafting allows front-line managers to sustain operations and handle immediate disturbances, it creates unmanaged variation in how the role is enacted and risks masking underlying structural design problems from senior management. Taken together, these results suggest that human-centric work design interventions can generate unintended organizational effects – such as team instability and structural masking – that need to be anticipated and managed if the long-term aim is sustainable improvements in both human outcomes and operational performance.

Methodologically, Paper 4 shows that evaluating human-centric interventions in dynamic production environments raises substantial challenges related to contextual instability, epistemic alignment, and measurement. External disturbances and high operator turnover made planned statistical analyses unfeasible in the longitudinal project, while epistemic differences within the multidisciplinary research group led to fragmented problem definitions and tensions around appropriate methods. The intervention also generated unintended consequences, including the paradox of success mentioned above, which complicated both implementation and evaluation. Rather than treating such volatility and emergent outcomes only as barriers, Paper 4 develops a six-step methodological framework and eight actionable design principles that encourage researchers and practitioners to use these conditions as empirical resources. The framework structures human-centric OM research around epistemic alignment, contextual scoping, intervention design and adaptation rules, context-sensitive measurement strategies, systematic detection of unintended consequences, and iterative integration and reflection, thereby offering a more robust basis for conducting intervention studies in unstable production settings.

Overall, the organizational and methodological implications highlighted by RQ3 suggest that human-centric work design in lean production is better understood as an ongoing alignment

process than as a target end state. Human-centric interventions can improve autonomy, competence, and learning opportunities, but they also interact with existing structures, HR practices, and production logics in ways that may create new vulnerabilities, such as team instability, role strain, and masked design problems. Addressing these implications requires not only redesigning work and organizational structures, but also adopting methodological approaches that are sensitive to contextual volatility, interdisciplinary tensions, and emergent effects. In this sense, the thesis contributes both to theory on human-centric production systems and to practical guidance on how such systems can be studied and developed under real-world conditions in contemporary manufacturing.

6. CO-CONSTRUCTED WORK DESIGN AND HUMAN-CENTRICITY

Taken together, the findings show that work design in manufacturing is not merely a structural framework imposed from above. As posited in the introduction, work design in production must be understood as a dynamic co-construction process driven by the interplay between top-down structural conditions and bottom-up employee agency across different organizational levels. Moving beyond the traditional view of work design as a static managerial assignment, the empirical findings highlight how this interplay continuously shapes work in practice. However, it is an unequal process in which overarching top-down structures set the terms of co-construction, ultimately determining whether bottom-up initiatives become reactive survival mechanisms or proactive drivers of organizational learning. Building on this insight, the following subsections elaborate how, first, work design exerts direct effects on employee well-being beyond motivational processes, second, how the distinction between more reactive and more constructive modes of this co-construction emerges depending on how top-down structural conditions and bottom-up agency interact, and third, how human-centric interventions can generate paradoxical outcomes when success in capability development undermines the stability of the very work systems they seek to improve.

6.1 Beyond motivation: direct effects of work design

A central debate in work design literature concerns the balance between mechanistic (efficiency-oriented) and motivational (human-oriented) perspectives in production (Campion & Thayer, 1985; Morgeson & Campion, 2002). The findings of this thesis suggest that in the highly constrained context of lean production, the structural design of work stands out as a robust predictor of individual outcomes. In contrast, the specific effects of different motivational regulations are weaker and more variable, particularly when basic psychological need satisfaction and work characteristics are included in the model.

6.1.1 Revisiting motivation pathways

Current applications of self-determination theory (SDT) in the workplace often assume that work characteristics influence well-being mainly through autonomous motivation, typically via a sequence where work design affects basic psychological need satisfaction, which in turn affects different forms of motivation, which then predict outcomes (Deci et al., 2017; Van den Broeck et al., 2016; Olafsen et al., 2018). However, a more complex pattern emerges when these relationships are examined at the path level in standardized manufacturing (Paper 2). The

hypothesized full double-mediation structure received limited empirical support: only 7 out of 108 possible paths from work design characteristics to outcomes followed the full sequence via both need satisfaction and motivation, and all of these involved intrinsic motivation predicting job satisfaction, while no such full paths were found for stress.

Instead, three types of relationships stand out. First, many of the significant indirect paths from work design to stress and job satisfaction run through basic psychological need satisfaction only, bypassing the motivation variables entirely. Second, several work characteristics – particularly task variety and problem solving – also show substantial direct paths to stress and job satisfaction, over and above their indirect effects via need satisfaction. This indicates that, in the studied standardized production contexts, work design characteristics can influence health and well-being both by supporting basic psychological needs and by exerting relatively immediate effects that are not fully captured by motivational variables. Third, the different forms of motivation themselves do not behave symmetrically: intrinsic motivation is positively related to job satisfaction but unrelated to stress, external social regulation is positively related to stress but not to job satisfaction, and the merged identified/introjected regulation factor is not significantly related to either outcome.

The merged factor for identified and introjected regulation is particularly noteworthy. In SDT, identified regulation is typically considered a more internalized and self-endorsed form of motivation than introjected regulation, which reflects more controlled, pressure-driven motives (Ryan & Deci, 2000; Deci et al., 2017). In this study, however, these forms of regulation could not be empirically distinguished and were combined into a single factor that showed no significant paths to either stress or job satisfaction. One plausible interpretation is that, in the context of short-cycle, standardized production work, the experiential difference between "doing the job because one personally values it" and "doing it to avoid guilt or social disapproval" becomes blurred in practice. When work is tightly prescribed and offers limited room for self-determined choice – as lean production systems often do (Parker, 2003; Conti et al., 2006; Cullinane et al., 2013; de Treville & Antonakis, 2006) – intermediate forms of internalization may have little incremental impact on daily well-being compared to more basic questions of whether tasks support or frustrate the needs for autonomy, competence, and relatedness.

Taken together, these patterns suggest that in standardized lean production settings, basic psychological need satisfaction and direct task effects play a more prominent role in linking work design to stress and job satisfaction than the full SDT sequence would predict in more flexible work environments. The findings do not invalidate motivational processes, but they indicate that interventions aiming to improve well-being in such contexts may be more effective when they prioritize redesigning concrete task characteristics – especially autonomy, task

variety, and opportunities for problem solving – to support need satisfaction and reduce strain, rather than focusing primarily on generic efforts to foster internalized motivation without addressing the underlying work design.

6.1.2 Work design deficits and compensatory behavior

The front-line manager findings demonstrate how a misalignment between prescribed and perceived work characteristics transforms job crafting from a source of development into a survival mechanism. Combining wide spans of control, heavy administrative workloads, and limited support results in work design deficits that make the role difficult to enact as intended. In this highly constrained situation, job crafting is not driven by a proactive search for meaning or self-actualization, as often portrayed in the literature (Wrzesniewski & Dutton, 2001). Instead, compensatory job crafting emerges as a reactive mode of bottom-up agency. To keep operations running, managers are pushed into continuous compensatory efforts, reprioritizing tasks, relying on informal delegation, and seeking peer support to handle demands that exceed the resources and boundaries defined by the formal work design.

When these qualitative insights are viewed alongside the path-level findings from Paper 2, a consistent picture emerges: in standardized production environments, deficits in work design cannot be offset simply by appealing to motivation. While operators experience diminished well-being due to frustrated psychological needs when foundational task characteristics – such as autonomy, task variety, and problem solving – are restricted, front-line managers are driven to compensatory behaviors to cope with overwhelming scope and inadequate support. In both instances, the potential benefits of autonomous motivation are constrained by the basic structural conditions. To move toward the human-centric vision of Industry 5.0 in such contexts, the thesis therefore suggests that organizations need to treat robust work design – including realistic role scopes, adequate support, and task characteristics that support basic psychological needs – as a necessary foundation (European Commission, 2021, 2024). Motivational initiatives may still play an important role, but they are unlikely to be effective or sustainable unless the underlying structural scaffold is sound.

6.2 From reactive coping to responsible autonomy

As established, work design in production is a dynamic co-construction process rather than a static top-down assignment. The empirical findings demonstrate how this actually unfolds on the shop floor. A key contribution of this research is the distinction between more reactive and

more constructive modes of this co-construction in production, which emerge depending on how top-down structural conditions and bottom-up agency interact.

6.2.1 Job crafting as a compensatory mechanism

While job crafting is traditionally viewed as a proactive behavior to enhance meaning, control, and person-job fit (Wrzesniewski & Dutton, 2001; Tims & Bakker, 2010; Bruning & Campion, 2018), compensatory job crafting emerges as a distinct pattern in the front-line manager role in production (Paper 1). Front-line managers engaged in reactive compensatory crafting – such as working overtime and informally delegating tasks – primarily to mitigate the functional misalignment between prescribed and perceived work characteristics, establishing local routines to keep operations running, which together form what Paper 1 conceptualizes as a compensatory job crafting model. Furthermore, this reactivity was not merely individual. The findings suggest that through relational crafting, managers collectively reasoned about how to bypass constraints, resulting in a form of collective coping.

While this bottom-up agency allowed the system to function in the short term, it also risked masking underlying structural design problems from senior management, thereby creating a layer of invisible compensatory routines that left the root causes unaddressed. In this sense, work design appeared as a co-construction process with an undesirable dependency on individual adaptation under constrained structural conditions, where individual agency and collaborative efforts were largely consumed by reactive problem-solving rather than directed toward proactive role redesign or creating space for development and learning.

6.2.2 Scaffolding for learning

In contrast, the implementation of formal learning structures demonstrates how top-down design can actively facilitate constructive bottom-up agency (Paper 3). The loop-model functioned as a structural intervention that formally sanctioned and organized operator participation in continuous improvement and learning. By reorganizing work around dual team membership, dedicated time for technical specialist roles, and structured learning loops linking multiskilled production teams with technical specialist teams, the organization provided a legitimate and resourced space for operator agency. In this configuration, individual insights were not handled through ad hoc workarounds but were intentionally captured, shared, and integrated into team practices and cross-team routines. Over time, this integration at the meso level helped to bridge the individual (micro) and organizational (macro) levels in a way that

resonates with multi-level models of organizational learning, which emphasize feed-forward and feedback processes between levels (Crossan et al., 1999; Saabye et al., 2022).

This comparison suggests that empowerment in production is not about removing constraints, but about providing the right constraints. This aligns with de Treville and Antonakis's (2006) concept of responsible autonomy. In the studied cases, constructive bottom-up agency emerged when clear structures, roles, and routines provided both boundaries and resources for participation, rather than leaving employees to improvise alone under misaligned conditions. Under such scaffolding, bottom-up initiatives have the potential to shift from reactive coping toward more systematic organizational learning.

6.3 The paradox of success in human-centric operations

While the transition to Industry 4.0 has been heavily techno-centric, the emerging Industry 5.0 paradigm introduces normative models that explicitly emphasize human-centricity, resilience, and continuous learning (European Commission, 2021; Neumann et al., 2021; Grosse et al., 2023; Ivanov, 2023). Implementing these ideals in contemporary manufacturing, however, surfaces deep-seated tensions between standardized operational efficiency and human development. This tension is particularly pronounced in the Swedish industrial context, which is characterized by a historical legacy of sociotechnical work design and autonomous work groups that has increasingly been overlaid with the strict standardization of lean production (Oudhuis & Tengblad, 2020; Medbo & Wänström, 2025). Within this constrained environment, the loop-model evaluated in Paper 3 represents an attempt to reintroduce constructive autonomy and multiskilling by designing multiskilled, autonomous teams. This aligns with recent work in operations and production management that stresses the need to integrate work organization concerns and multiskilled operators into Industry 4.0 and Industry 5.0 transitions (Cagliano et al., 2019; Marcon et al., 2022; Frank et al., 2024). Yet, synthesizing the longitudinal findings with the methodological insights from Paper 4 reveals that successfully reviving such human-centric ideals generates a fundamental systemic tension, conceptualized in this thesis as the paradox of success.

6.3.1 The tension between operational stability and human mobility

Rather than a simple implementation failure, the paradox of success represents a structural tension between two competing organizational logics. On the one hand, the traditional operations management logic in lean production relies on standardization and the reduction of variation, which inherently assumes and requires stable, static team structures to function

optimally. On the other hand, the human-centric logic draws on self-determination theory, which emphasizes the satisfaction of basic psychological needs for autonomy and competence (Deci et al., 2017), and on sociotechnical ideas about participative work design and the development of multiskilled operators in production systems.

When the organizational intervention successfully fulfilled this human-centric aim, it fundamentally altered the operators' value in the internal labor market. Upskilling made operators highly visible and attractive for internal recruitment, which inevitably increased their mobility. Consequently, the success of the human-centric intervention at the micro level (increased employability) directly undermined the macro level system requirement for predictability, gradually draining the multiskilled production teams at the meso level of the very capabilities the intervention had built. Similar to other OM studies that have shown how change programs and performance measurement systems can generate paradoxes and unintended consequences rather than straightforward improvements (Hasle & Vang, 2021; Norrman & Näslund, 2026), this finding illustrates how interventions aimed at individual and team-level empowerment can destabilize the broader operational structure if the macro level system relies on static components.

6.3.2 Designing for continuous competence flow

This paradox challenges the idea that enriched work design will naturally translate into retention and stability within specific teams. While work design research has long linked enriched work to positive outcomes such as engagement and reduced turnover intentions (e.g., Parker et al., 2017), the findings of this thesis suggest that, in dynamic internal labor markets, effective human-centric design may instead accelerate internal movement. If organizations wish to sustain multiskilled, autonomous teams within standardized production environments, they cannot treat team membership as a static boundary condition.

Instead, organizations must design for continuous competence flow and team fluidity. This requires a structural integration of human resources and operations management strategies (Boudreau et al., 2003), where career paths, recruitment practices, and production systems are jointly calibrated. In this synthesized view, a successful human-centric production unit acts not as a closed, stable system, but as an organizational "career engine" that continuously develops and exports competence. To realize the human-centric vision of Industry 5.0, operational systems must be engineered for a level of resilience that allows them to thrive despite, or even because of, constant internal mobility. This thesis contributes to ongoing Industry 5.0 discussions on human-centricity, resilience, and sustainability (European Commission, 2021; Neumann et al., 2021; Grosse et al., 2023; Ivanov, 2023) by positioning work design not as a

static implementation, but as a dynamic co-construction process. By demonstrating how the interplay between individual upskilling and organizational stability creates systemic tensions, the research highlights that human-centric production cannot be achieved through structural design alone; rather, it requires continuously managing and calibrating the co-construction of work across the micro, meso, and macro levels.

7. CONTRIBUTIONS AND IMPLICATIONS

Drawing on the empirical findings and the synthesis of co-constructed work design presented in the previous chapters, this chapter outlines the primary contributions of the thesis. The chapter is divided into two main sections. First, it details the theoretical contributions to the literature on operations management, work design, and motivation, highlighting how this research reframes work design as a dynamic, multilevel process in highly constrained environments. Second, it translates these insights into actionable managerial implications, offering guidance for practitioners navigating the transition toward human-centric operations and the ideals of Industry 5.0.

7.1 Theoretical contributions

This thesis makes three primary contributions to the literature on operations management, work design, and motivation. It is important to note that while the empirical research was situated within lean production environments, this thesis does not aim to contribute to the lean literature per se. Instead, it treats this specific production context as a boundary condition to explore how work design dynamics unfold in highly standardized settings. That said, the loop-model intervention in Paper 3 naturally connects to the stream that views lean as a learning system, by illustrating how formal multilevel learning structures can support continuous improvement while also creating new tensions around internal mobility and team stability.

7.1.1 Reframing work design as a dynamic co-construction process in OM

First, this research contributes to the field of operations management by challenging the traditional view of work design as a static, top-down structural assignment. Through the synthesis of the findings from the appended papers, this thesis reframes work design as a dynamic, co-construction process that emerges from the interplay between top-down structural constraints and bottom-up agency. This perspective becomes particularly critical when evaluating normative models for production, such as the human-centric frameworks of Industry 5.0, which explicitly call for integrating human, technical, and organizational dimensions (European Commission, 2021; Cagliano et al., 2019; Neumann and Dul, 2010). While OM literature has historically focused on mechanistic efficiency, this research highlights that achieving the vision of Industry 5.0 – specifically human-centricity – requires recognizing that employees actively shape their work environments. Recent work on human-centric operations

similarly argues that a narrow techno-centric focus risks undermining system performance and that Industry 5.0 requires a stronger integration of human factors into operations design (Grosse et al., 2023; Ivanov, 2023).

The findings demonstrate that without deliberate structural support (scaffolding) to manage this co-construction, implementing these normative models risks generating unmanaged variation, organizational instability, and the paradox of success, rather than sustainable capability building. In doing so, the thesis adds to operations management research by showing how normative, human-centric interventions can produce unintended consequences when the ongoing co-construction of work is not explicitly managed, a pattern that echoes earlier observations of paradoxes and side effects in change programs (Hasle and Vang, 2021). In Paper 3, these insights are positioned within the stream that views lean as a learning system, showing that continuous improvement capabilities depend on formal learning structures and on how internal mobility is handled over time.

7.1.2 Expanding the multilevel understanding of work redesign

Second, this thesis contributes to work design theory by offering a multilevel perspective on how work is redesigned in standardized production contexts. Research on bottom-up work redesign has often focused on job crafting, typically defined as self-initiated changes that employees make to their tasks, relationships, or perceptions to improve their work design (Wrzesniewski and Dutton, 2001). At the same time, recent work has emphasized the need to consider bottom-up job crafting and top-down work design within a shared framework, rather than studying them as separate phenomena (Parker et al., 2025). Building on this discussion, this thesis identifies and conceptualizes compensatory job crafting as a specific type of behavior that is prevalent in high-constraint environments: instead of primarily seeking greater meaning or personal growth, employees adjust and stretch their roles to cope with functional misalignments and work design deficits (Paper 1).

In parallel, the intervention study in Paper 3 illustrates how formal learning structures and specialist roles can be used as a top-down way to reshape the organizational and team context within which bottom-up agency operates, creating more constructive channels for employees' initiatives and adjustments. Together, these findings show that work redesign in standardized manufacturing is not only an individual-level phenomenon but a multilevel process in which individual crafting efforts and organizational structures jointly shape whether bottom-up agency remains reactive and compensatory or becomes a source of collective competence.

7.1.3 Refining the application of SDT in standardized contexts

Third, this research contributes to self-determination theory (SDT) by refining its application within standardized manufacturing environments. The empirical findings (Paper 2) nuance the traditional SDT assumption in workplace research that work characteristics primarily influence well-being through a sequential pathway where job design affects basic psychological need satisfaction, which in turn shapes motivation, and ultimately drives well-being outcomes (Ryan & Deci, 2000; Trepanier et al., 2015). In the studied lean production settings, the analyses instead show that work characteristics are strongly linked both directly to stress and job satisfaction and indirectly via basic psychological need satisfaction, whereas pathways that run through autonomous motivation are noticeably weaker than anticipated. This indicates that robust task design and satisfying these basic needs play the most crucial roles in driving job satisfaction and reducing stress, in line with the central role of autonomy, competence, and relatedness in SDT (Deci et al., 2017). This adds an important nuance to the SDT literature: in highly standardized work, the structural design of tasks and the resulting need satisfaction seem to be the main ways through which job design affects employee well-being, whereas internalized motivation may be more critical in knowledge-intensive or highly autonomous work contexts.

7.2 Managerial implications

For practitioners, particularly in the manufacturing sector, this thesis offers actionable insights for navigating the transition toward human-centric operations.

7.2.1 Establish a structure for organizational learning

Managers need to recognize that motivation, well-being, and learning require a robust structural foundation. The findings imply that expecting self-reliance without adequate resources or clear boundaries leads to stress and compensatory behaviors. Therefore, organizations should prioritize designing supportive structures, such as the specialist roles and technical teams in the loop-model, that provide real opportunities for task variety and competence development. By ensuring that the work design is sound and that roles are clearly defined, managers can prevent the emergence of reactive compensatory mechanisms and instead foster more systematic organizational learning processes. For example, instead of relying on informal problem-solving by a few experienced operators, managers can formalize technical specialist roles and regular team learning meetings so that improvements are shared and followed up, rather than handled as isolated adjustments.

7.2.2 Integrate HR and OM strategies to manage mobility

Organizations must be prepared for the paradox of success identified in this research. When implementing top-down work design interventions that successfully upskill operators, managers should anticipate increased internal mobility. Rather than being viewed as a failure, team membership instability should be recognized as a natural consequence of increasing the employability of the workforce. This implies that operations management strategies cannot exist in isolation from human resources strategies. In line with behavioral operations arguments that call for integrating OM and HRM to better understand how human behavior and workforce decisions affect operating systems (Boudreau et al., 2003), companies need to align these strategies to handle competence flows over time. Companies should design career paths and recruitment processes that accommodate this mobility, treating the production floor as a key source of internal recruitment and organizational competence, while at the same time securing continuity in critical teams through succession planning and role overlap.

7.2.3 Enable responsible autonomy

Finally, managers should adopt an open stance toward bottom-up work redesign. Since reactive compensatory job crafting often emerges to cope with demands, the goal should not be to suppress this agency but to channel it into constructive behaviors. By applying the principle of responsible autonomy, leaders can define clear boundaries within which employees are resourced and authorized to adapt and improve their work (de Treville & Antonakis, 2006). This shift allows the organization to systematically capture the insights of the shop floor, transforming reactive adaptations into organizational learning and resilience.

8. CONCLUSIONS AND FUTURE RESEARCH

This final chapter summarizes the main conclusions of the thesis and points to directions for future research. It brings together the key insights from the findings to clarify what they mean for how work is designed and redesigned in manufacturing, and how this can inform the development of more human-centric operations in an Industry 5.0 context.

8.1 Conclusions

This thesis set out to explore the dynamics of work design and redesign across individual, team, and organizational levels in the manufacturing industry, in order to understand how human-centric operations can be realized in an Industry 5.0 context. Through the examination of both the empirical realities of daily operations and the outcomes of a deliberate intervention, the research suggests that work design in this context is best understood not as a static assignment, but as a dynamic, multilevel system where top-down structural conditions and bottom-up agency continuously interact.

One of the primary conclusions drawn from this work is that the structural design of tasks appears to play a more direct and dominant role in employee well-being than is sometimes assumed in motivational literature. While psychological factors such as motivation are undoubtedly important, the findings from the quantitative study indicate that in highly standardized production environments, the tangible design of work tasks – specifically task variety, problem solving, and autonomy – has direct effects on stress and job satisfaction, and operates as a primary driver of basic psychological need satisfaction. This is further supported by the qualitative findings regarding front-line managers, which suggest that without a supportive structural foundation, individuals are often forced into compensatory behaviors to cope with overwhelming scope and inadequate support. This implies that psychological interventions aimed at increasing motivation may be insufficient on their own if the underlying work design remains misaligned or restrictive.

Furthermore, the thesis suggests that while employees inevitably exert agency to shape their work, the quality of this agency seems highly dependent on the organizational context. The comparison between the different sub-studies indicates that when top-down demands are not matched with adequate resources, agency often manifests as reactive coping – a way to uphold operational continuity rather than driving proactive development. Conversely, when the organization provides a clear structure or scaffold, such as the specialist roles implemented in the intervention study, this agency appears to be channeled into systematic learning and future-

oriented practices. This reinforces the conceptualization of work design as a co-construction process, where top-down structures shape whether bottom-up initiatives become compensatory or developmental.

A particularly important insight regarding the transition to Industry 5.0 concerns the systemic trade-offs involved in human-centric interventions. The findings indicate a paradox of success, where successful upskilling initiatives can lead to increased internal mobility, which in turn challenges the stability of production teams. This suggests that meso-level organizational instability should not always be viewed as a failure of work design, but rather as a natural consequence of a functioning internal labor market in a learning organization. It highlights a need to view human-centricity not merely as a win-win scenario, but as a complex transformation that requires managing the tension between individual development and team stability through integrated HR and OM strategies.

Taken together, the thesis shows that in standardized manufacturing, sustainable human-centric operations require a robust structural foundation, in which work design is co-constructed across levels so that concrete task characteristics, team structures, and managerial roles reliably support basic psychological needs and constructive forms of employee agency.

8.2 Future research

The conclusions derived in this thesis point toward several fruitful directions for future inquiry. A primary area of interest concerns the long-term effects and sustainability of the organizational interventions studied. Since the empirical work was bounded by the project's timeframe, the full implementation of the loop-model could not be observed. Future research should therefore aim to follow similar interventions over a more extended period to evaluate the full potential of the model. This would be particularly valuable for understanding the dynamics of the paradox of success. It remains to be seen whether the high rate of internal mobility observed is a permanent feature of this type of learning organization, or if it represents a transient phase that stabilizes once the organization's immediate demand for new competence is saturated.

Furthermore, while this thesis provides a structural foundation for human-centric operations, the technological dimension of Industry 5.0 warrants deeper exploration. The framework conceptualized here offers a scaffold for learning and autonomy, but future studies should strive to test this structure in contexts characterized by a higher degree of digitalization and automation. It would be highly relevant to investigate how the proposed work design models function when integrated with advanced digital technologies. This would allow researchers to

move beyond conceptualization and empirically test how human-centric work design interacts with the technological reality of Industry 5.0.

Additionally, the scope of job crafting research within production contexts could be expanded. While this thesis specifically explored the compensatory crafting of front-line managers, future research should examine the crafting behaviors of operators. Traditionally, standardized assembly work offers limited autonomy, making job crafting difficult. However, the introduction of specialist roles, as seen in the loop-model, potentially creates new spaces for agency. Investigating if and how operators utilize these specialist roles to craft their work would provide deeper insight into how bottom-up agency emerges when the strict constraints of the assembly line are loosened.

Finally, the dynamic interplay between top-down structures and bottom-up initiatives deserves further attention through a temporal lens. Work design is rarely static, and future research should strive to use longitudinal designs to capture the temporality of these processes. By following these dynamics over time, researchers could better understand how job crafting behaviors evolve and how top-down and bottom-up forces continuously shape and reshape the work environment.

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