Transforming Healthcare with Lean

Hospital-wide Change, Dynamic Capabilities, and Relational Coordination

J.C.A.M. van Beers

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Cover design: José Wentzel
Printed by: Gildeprint Enschede (www.gildeprint.nl)
Layout: Ilse Modder (www.ilsemodder.nl)
ISBN: 978-94-6496-314-4

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DISSERTATION

to obtain
the degree of doctor at the University of Twente,
on the authority of the rector magnificus,
prof. dr. ir. A. Veldkamp,
on account of the decision of the Doctorate Board
to be publicly defended
on Tuesday 28 January 2025 at 14.45 hours

by

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ACKNOWLEDGEMENT

Embarking on a Ph.D. is often described as a journey—and what a journey it has been! Equal parts rewarding and challenging, this experience has been marked by moments of insight, perseverance, and personal growth. It began with a simple desire: to deepen my knowledge as a management consultant. My curiosity first led me to pursue an MBA and later a Master's in Management Science. It was during this stage that I had the privilege of working with Professor Dr. Van de Ven, whose guidance was instrumental in shaping the early part of my academic journey.

This academic fascination brought me to a serendipitous meeting in 2019 with Professor Dr. Celeste Wilderom and Dr. Desirée van Dun. Little did I know that this initial conversation would set the stage for a transformative Ph.D. partnership. Celeste and Desirée, you have been more than supervisors—you have been mentors, guides, and relentless champions of my academic growth. Working with you elevated my understanding of research and sharpened my thinking. Your passion for excellence pushed me to take my work to levels I didn't think possible, and your encouragement gave me the confidence to present at conferences and connect with leading scholars. Desirée, our brainstorming sessions over lunches will always remain a highlight. Celeste, your ability to demystify the academic labyrinth was nothing short of inspiring. Thank you for not just guiding me through this process but also for showing me the joys and challenges of the academic world.

Balancing this Ph.D. journey with a full-time job and family life was an adventure in its own right—one that wouldn't have been possible without the unwavering support of my family. Laura, you were the one who encouraged me to take on this challenge—though I'm sure you didn't fully anticipate what that meant! Your patience, love, and belief in me never wavered, even when the hours were long and the laptop seemed permanently glued to my hands. Felice, Benjamin, and Florence, thank you for your understanding when I missed family moments. I promise to make up for all the lost "playtime"—and more! Laura, you are my rock, and this accomplishment is as much yours as it is mine.

Pursuing this Ph.D. taught me that academic work is as much about navigating trade-offs as it is about building knowledge. There were times I got lost down rabbit holes of peripheral topics (a generalist's curse!) or felt the weight of juggling personal and professional commitments. Yet through it all, my curiosity and optimism never faltered, even when the journey demanded its fair share of sweat, tears—and far too many early mornings and late nights.

A heartfelt thank you goes out to the many people who supported me along the way. To my parents and sister, thank you for always encouraging me to dream big and for providing the foundation that allowed me to chase those dreams.

To the University of Twente, I am grateful for the staff who offered guidance and ensured everything stayed on track. Many thanks to the hospital professionals who played a crucial role in this research. Your willingness to share your insights during interviews, support the data-gathering process, and provide constructive feedback on early drafts of my work made this dissertation possible. Your commitment to improving healthcare and your openness to engage with my research enriched both the study and my own learning.

To my business partners and friends at NextChange, Robert and Erwin, thank you for your understanding and flexibility as I juggled professional and academic commitments. Your support opened doors, including the hospital settings where I conducted two major case studies. You helped me strike a balance that often felt impossible, and I am grateful for your encouragement and belief in this endeavour.

A very special thank you goes to my mother-in-law, Karin, who became our family's ultimate problem-solver. Your quiet strength and unwavering support not only gave me the time to focus on my research but also ensured our family continued to thrive during this demanding journey.

Finally, to my wife Laura and our children, Florence, Benjamin, and Felice: this PhD may be complete, but our adventure continues. I am excited to embrace the next chapter together—with plenty of playtime to make up for the moments we missed.

Thank You
John van Beers

SUMMARY

This dissertation investigates how large hospitals can implement Lean as a hospital-wide system to promote continuous improvement (CI) and staff learning, thereby enhancing performance. Lean management, originally developed in manufacturing, has become one of the most influential management innovations of the past 70 years. Its core principles—delivering customer value by eliminating waste, optimizing processes, and fostering a culture of CI—have evolved into a comprehensive system applicable across diverse sectors, including healthcare. Embedding Lean in hospitals presents unique challenges due to hierarchical structures, siloed operations, and the inherent need for cross-disciplinary collaboration. These complexities often lead to Lean implementation falling short, hindered by resistance to change, entrenched silos, and the absence of a clear strategic roadmap for organization-wide adoption. Recent literature shifts the perspective, emphasizing Lean not just as a set of tools but as a learning system—one that integrates strategy deployment, engages leaders across all levels, and cultivates dynamic learning capabilities. By framing Lean as a holistic system for continuous learning and improvement, this dissertation explores its potential as a transformative enabler for sustainable organizational change in hospital settings.

Summary of the Presented Empirical Studies

This research examines Lean adoption in hospitals through three interconnected empirical studies, addressing its relation with organizational transformation, CI, and relational coordination (RC). The studies are based on a rich dataset, consisting of interviews, field observations, and document study, collected over four years from two Dutch university hospitals. By integrating perspectives from change management, Dynamic Capability (DC) theory, and RC theory, these studies provide both theoretical advancements and practical guidance for implementing Lean as a learning system. Our approach highlights Lean's dual technical and relational dimensions, demonstrating its potential to enhance not only operational efficiency but also hospital-wide collaboration, adaptability, and continuous learning.

The *first study* explores how Lean can be implemented effectively in a hospital-wide setting, comparing two contrasting approaches—top-down and bottom-up. By examining these contrasting starting points, the study provides unique insights into the advantages and limitations of each approach, offering valuable lessons for organizations seeking to navigate the complexities of Lean implementation. One hospital adopted a predominantly top-down strategy, driven by executive leadership and strategic oversight, while the other embraced a bottom-up approach, emphasizing grassroots initiatives and staff-driven improvements. The inductive qualitative longitudinal method revealed six key stages of Lean implementation: strategize, prepare, pilot, evaluate, scale-up, and structure. The analysis shows that neither a purely top-down nor a bottom-up approach is sufficient to achieve hospital wide lean adoption. Instead, a hybrid approach—characterized by leadership role modeling, co-

creation, and cross-hierarchical collaboration—is most effective in embedding Lean across all levels of the organization.

The study contributes to organizational change literature by introducing co-creation as a transformative process. This approach emphasizes the active engagement of leaders and staff at all levels to collaboratively embed Lean across the hospital. The findings underline the importance of visible leadership—where leaders are actively present on the floor, demonstrating commitment to Lean practices and engaging directly with staff. The study presents three key propositions to be explored in future research: First, to achieve hospital-wide performance gains, its top managers must role-model the co-creation of lean rather than delegating top-down or tolerating bottom-up lean implementation. Second, to implement lean hospital-wide, close cross-hierarchical collaboration must occur between top, middle, and frontline management throughout the lean implementation journey, including during goal setting. Third, combining both top-down and bottom-up approaches to implementing lean is likely to result in quicker, larger, and more sustainable hospital-wide performance improvement.

The *second study* builds on the premise that CI is central to Lean's success, serving as a mechanism for incrementally improving (service) processes, reducing waste, and enhancing both patient outcomes and organizational performance. However, scaling CI across an entire hospital remains poorly understood, often leading to its confinement within isolated projects or departments. This limitation diminishes CI's potential to drive sustainable, organization-wide impact. The second study thus explores how CI can be conceptualized as a DC by developing specific organizational routines that integrate Lean practices across all levels of a hospital. DC theory describes the ability of organizations to maintain a competitive edge by renewing resources and reconfiguring processes to address emerging challenges and opportunities. Through the lens of DC theory, CI is conceptualized as an evolving bundle of interdependent organizational routines that collectively streamline operations and drive continuous process improvement. While most DC research focuses on macro-level strategic management, few studies examine the micro-level processes through which organizational routines are aligned and sustained across various hierarchical levels. In particular, the literature lacks clarity on identifying the specific routines that contribute to CI and on how these routines are systematically bundled and sequenced to develop a hospital-wide dynamic capability.

Thus, we used process research methods to understand how Lean was implemented and how organizational routines evolved over four years in both hospitals. Data collection included reviewing hospital documents, conducting 48 one-hour semi-structured interviews with key staff (executives, managers, nurses, physicians, and support staff), and observing 13 stand-up meetings on-site to study real-time interactions between leaders and employees. These diverse data sources provided comprehensive case narratives of the Lean implementation process that were further examined using cross-case analysis.

Both hospital cases demonstrated significant (cross-departmental) performance improvements as a result of Lean implementation, for example related to patient throughput time, increased productivity, and higher surgical volumes. Additionally, in one of the cases, a hospital-wide reduction of patients' perceived pain after surgery was achieved. The results further revealed how Lean practices evolved into CI routines, which were systematically bundled into four distinct organizing capabilities: the improvement system, collaborative synergy, integrated accountability, and learning-to-learn. These capabilities collectively formed a hospital-wide CI dynamic capability, which was fully realized and demonstrated in one of the cases.

This study advances DC theory by presenting a comprehensive model that illustrates how CI routines evolve into a CI DC over time (see, Figure 1). It challenges the traditional view that DCs are primarily developed at the top management level by emphasizing the interdependence and dynamic interplay of routines across all organizational levels—frontline, middle, and top management.

Another key contribution lies in demonstrating how Lean practices aggregate into CI routines, which then form the foundation for an initial improvement system capability. This process aligns with emerging research on the clustering and sequencing of routines at a system-wide level, providing new insights into how these routine clusters enhance organizational performance. By bridging Lean and DC theory, the study deepens the understanding of how structured routines can drive sustained improvements and adaptability in complex, knowledge-intensive environments like hospitals.

The *third study* flows from the practical observation that, as hospitals advance through Lean maturity stages, their focus shifts from merely reducing waste to creating a flexible, strategic system that drives patient value. Achieving organization-wide coordination in such a system requires strong relational structures that support collaboration across hierarchical levels and departments. RC theory highlights that better organizational performance comes from seamless teamwork built on shared goals, shared knowledge, mutual respect, and effective communication. In hospitals, where (cross-disciplinary) teamwork is essential, RC may help to foster collaboration across departments, transforming traditional hierarchical setups into dynamic, patient-centred networks. Although Lean and RC seem like a natural pair, their joint evolution and interaction remain underexplored. This study fills that gap, exploring how the stages of Lean—knowing, understanding, thinking, and learning—interact with RC dimensions to improve hospital performance.

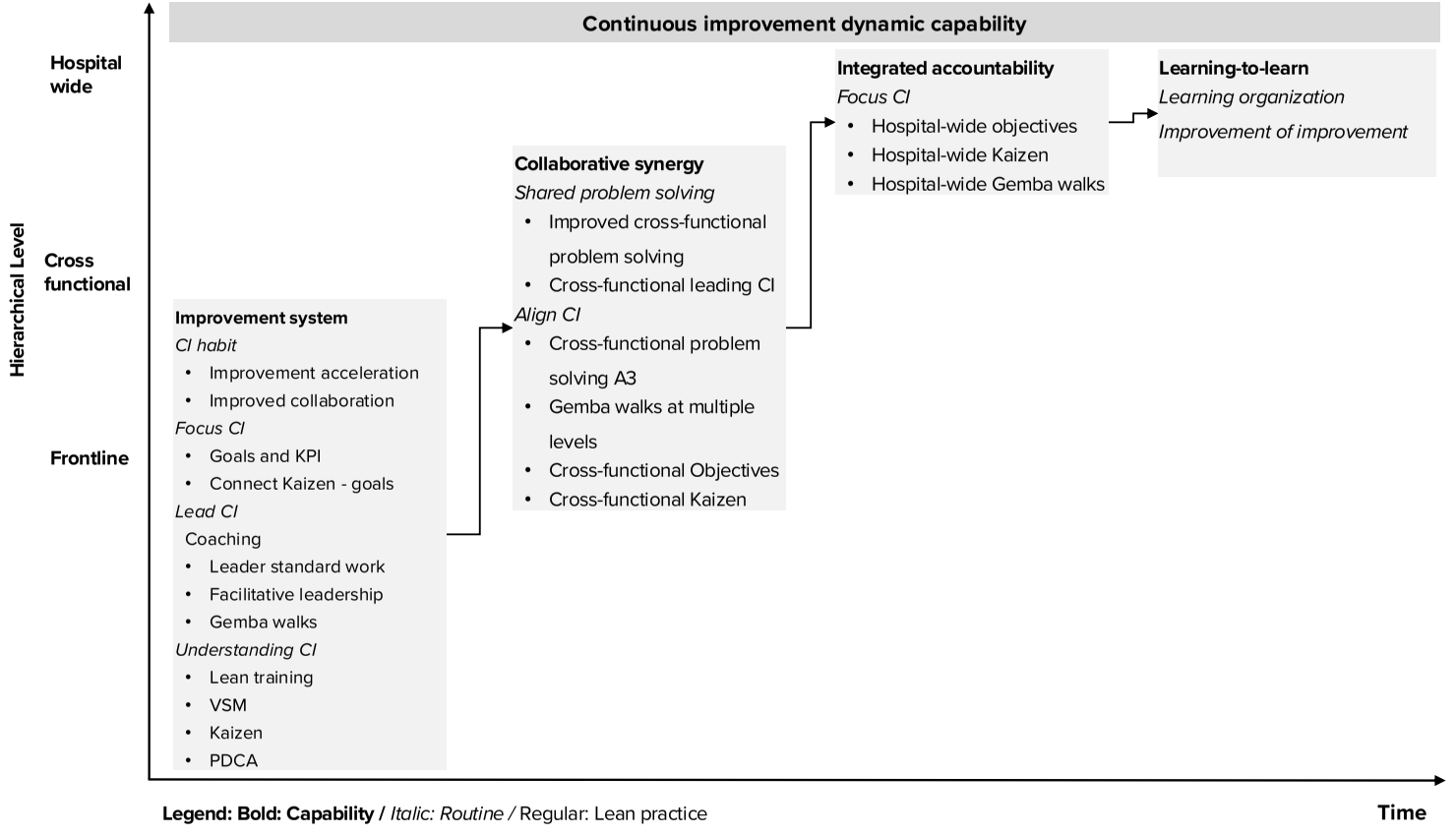


Figure 1.
Conceptual model of the development of a continuous improvement dynamic capability

We employed a retrospective longitudinal process design across eight hospital units in the two previously-mentioned Dutch hospitals. Data were collected over four years, including 62 semi-structured interviews with executives, managers, nurses, and physicians to capture diverse perspectives on Lean practices and RC dynamics. Performance metrics and hospital documents offered quantitative evidence of patient outcomes, operational efficiency, and other key indicators. This time, we adopted an abductive approach, iteratively refining the theoretical understanding of how Lean and RC evolve together, by systematically mapping Lean stages against RC dimensions.

The results reveal a clear connection in performance improvement as hospitals advance through the Lean maturity stages. In the early stages—knowing and understanding, where the focus is on applying explicit Lean practices—no significant performance improvements were observed. However, during the thinking stage, notable gains emerged, including increases in hospital revenues, productivity, cost efficiency, and bed utilization. The cases that were in the most advanced stage, learning, demonstrated the highest level of impact, whereby substantial results were achieved despite the complexity of involving multiple disciplines and divisions across the entire hospital.

The study thus underscores the pivotal role of RC in enabling performance improvements as hospitals progress through Lean stages. Enhanced RC dimensions—shared goals, shared knowledge, mutual respect, and effective communication—were shown to facilitate better collaboration and outcomes. Advancing Lean by progressing into the more mature stages—particularly the thinking and learning stages—was found to enhance RC dimensions. This development promoted more cohesive teamwork and streamlined processes across departments, aligning efforts toward improved collaboration and performance. Additionally, the research introduced the concept of shared infrastructure within the RC framework as a critical new RC dimension (see, Figure 2). Shared infrastructure refers to the organizational, relational, and technical coordination mechanisms that support Lean practices, such as Gemba walks, PDCA cycles, Kaizen events, and A3 problem-solving. This infrastructure facilitates cross-departmental collaboration, breaking down silos and creating a common language and tools for problem-solving. In complex hospital settings, shared infrastructure was identified as essential for overcoming structural barriers enabling consistent RC practices across all levels and departments within the organization.

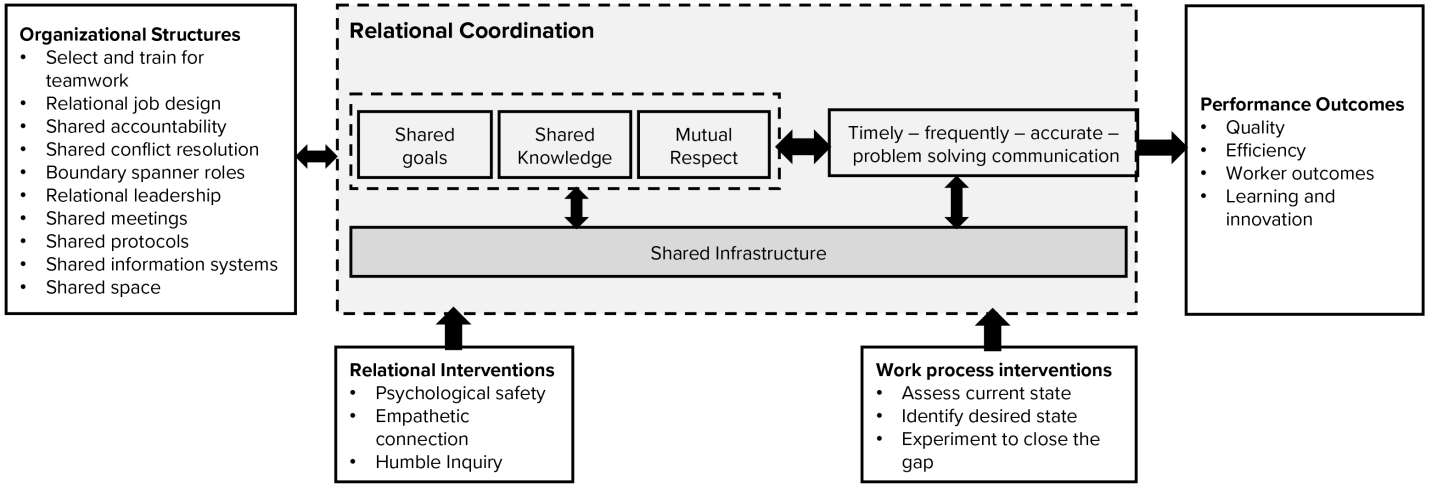


Figure 2.
Updated Relational Coordination Theory framework adapted from Bolton et al. (2021, p. 292)

Theoretical contribution and future research

This dissertation makes a significant contribution to the literature by integrating Lean, Dynamic Capability (DC) theory, and Relational Coordination (RC) theory, advancing the understanding of Lean as a comprehensive learning system. By focusing on its application in hospitals, the research demonstrates how Lean can drive organization-wide transformation in complex environments characterized by hierarchical structures, interdepartmental silos, and the need for multidisciplinary collaboration. The findings highlight Lean's dual nature, comprising both technical elements—such as process optimization and waste reduction—and relational aspects, including fostering shared goals, mutual respect, and effective communication. This dual perspective reveals that Lean's potential extends beyond operational improvements, acting as a strategic enabler of adaptability, collaboration, and continuous learning across all organizational levels. The empirical studies illustrate actionable pathways for hospital-wide Lean adoption. These include fostering leadership engagement across hierarchical levels, systematically developing DCs to adapt to changing environments, and embedding CI as a dynamic capability. The introduction of the concept of shared infrastructure as a new RC dimension—encompassing mechanisms like Gemba walks, Kaizen events, and PDCA cycles—underscores the importance of aligning technical and relational coordination frameworks. This shared infrastructure not only supports Lean practices but also facilitates cross-departmental collaboration by creating a common language and tools for problem-solving.

This dissertation opens new avenues for future research by extending its conceptual models to other knowledge-intensive sectors, such as technology firms, higher education, and public administration. Quantitative methods, like structural equation modelling, could deepen the understanding of the interdependencies between routines and capabilities within the DC framework. Similarly, the relationships between RC dimensions, including the newly introduced shared infrastructure, merit further exploration to refine the theoretical integration of Lean and RC. Furthermore, applying action research—through iterative cycles of planning, action, observation, and reflection—offers a practical methodological lens to evaluate the interplay between Lean and RC in dynamic and resource-constrained environments.

Ultimately, this research establishes a foundation for exploring the intersection of DC and RC theories, offering valuable insights into how structured routines and relational dynamics can jointly drive sustainable improvements. By bridging these theoretical domains, the dissertation not only contributes to academic knowledge but also provides a robust framework for practitioners seeking to navigate the complexities of Lean implementation in demanding, knowledge-intensive settings like hospitals.

Conclusion

This dissertation highlights the potential of Lean as a strategic enabler in hospitals, driving CI, fostering DCs, and enhancing RC. By integrating technical and relational approaches, Lean

can overcome the inherent complexities of healthcare, delivering sustained organizational improvements. The findings contribute to academic knowledge and provide actionable insights for practitioners navigating the challenges of Lean implementation in dynamic and resource-constrained environments.

NEDERLANDSE SAMENVATTING

In dit proefschrift onderzoeken we hoe Lean integraal kan worden geïmplementeerd in ziekenhuizen. We richten ons daarbij op hoe Lean als een samenhangend systeem continue verbetering (CV), organisatiebreed leren en het leren van medewerkers bevordert, en hoe dit bijdraagt aan verbeterde prestaties. Lean management, oorspronkelijk ontwikkeld in de maakindustrie, is in de afgelopen 70 jaar uitgegroeid tot een van de meest invloedrijke managementinnovaties. De kernprincipes van Lean zijn het leveren van klantwaarde door verspilling te elimineren, processen te optimaliseren en een cultuur van continue verbetering te stimuleren. Deze principes hebben zich ontwikkeld tot een integraal systeem dat toepasbaar is in diverse sectoren, waaronder de gezondheidszorg.

De implementatie van Lean in ziekenhuizen brengt echter unieke uitdagingen met zich mee. Hiërarchische structuren, gescheiden operaties en de noodzaak tot multidisciplinaire samenwerking maken de implementatie complex. Hierdoor blijven resultaten vaak uit, voornamelijk door weerstand tegen verandering, diepgeworteld silo-denken en -werken, en het ontbreken van een strategische en geïntegreerde aanpak voor organisatiebrede implementatie. Recente literatuur benadrukt een verschuiving in het perspectief op Lean. Waar Lean voorheen werd gezien als een verzameling tools, wordt het nu gepositioneerd als een leersysteem. Dit systeem vraagt om strategische implementatie op alle organisatie-niveaus, betrokkenheid van leiderschap en het ontwikkelen van dynamische leer- en aanpassingsvermogens.

In dit proefschrift positioneren we Lean als een integraal (ziekenhuis breed) systeem voor continu leren en verbeteren. We onderzoeken hoe Lean kan fungeren als een transformerende kracht voor duurzame organisatieverandering in ziekenhuizen. Daarnaast verkennen we hoe het kan bijdragen aan betere zorguitkomsten, efficiëntere processen en een veerkrachtige organisatiecultuur.

Samenvatting van de gepresenteerde empirische studies

Dit onderzoek richt zich op de adoptie van Lean in ziekenhuizen aan de hand van drie onderling verbonden empirische studies, waarbij de relatie met organisatieverandering, continue verbetering en relationele coördinatie (RC) centraal staat. De studies zijn gebaseerd op een omvangrijke dataset, bestaande uit interviews, veldobservaties en documentanalyse, verzameld over een periode van vier jaar in twee Nederlandse academische ziekenhuizen. Door perspectieven uit verandermanagement, Dynamic Capability (DC)-theorie en RC-theorie te integreren, bieden deze studies zowel theoretische inzichten als praktische richtlijnen voor de implementatie van Lean als een leersysteem. Onze aanpak benadrukt de technische en relationele dimensies van Lean en toont aan hoe het niet alleen operationele efficiëntie kan verbeteren, maar ook samenwerking ziekenhuisbreed, aanpassingsvermogen en continu leren kan versterken.

De eerste studie onderzoekt hoe Lean effectief kan worden geïmplementeerd in een ziekenhuisbrede context door twee implementatie strategieën te vergelijken: top-down en bottom-up. Door deze contrasterende uitgangspunten te analyseren, biedt de studie unieke inzichten in de voordelen en beperkingen van beide benaderingen, en waardevolle lessen voor organisaties die de complexiteit van Lean-implementatie willen doorgronden. Het ene ziekenhuis koos voor een overwegend top-down strategie, aangestuurd door het leiderschap en strategisch toezicht van het bestuur. Het andere ziekenhuis richtte zich op een bottom-up aanpak, waarbij Lean initiatieven op team niveau en door medewerkers geleide verbeteringen centraal stonden.

De inductieve kwalitatieve longitudinale methode bracht zes sleutelstadia van Lean-implementatie aan het licht: strategie, voorbereiden, pilot uitvoeren, evalueren, opschalen en structureren. Uit de analyse blijkt dat noch een zuivere top-down, noch een puur bottom-up aanpak voldoende is om Lean integraal te implementeren. Een hybride benadering, gekenmerkt door leiderschap als rolmodel, co-creatie en samenwerking over hiërarchische lagen heen, blijkt het meest effectief om Lean op alle niveaus van de organisatie te verankeren.

De studie draagt bij aan de literatuur over organisatieverandering door co-creatie te introduceren als basis voor een transformatie. Deze aanpak benadrukt de actieve betrokkenheid van leiders en medewerkers op alle niveaus om gezamenlijk Lean in een ziekenhuis te implementeren. De bevindingen onderstrepen het belang van zichtbaar leiderschap, waarbij leiders actief aanwezig zijn op de werkvloer, hun betrokkenheid bij Lean-praktijken tonen en direct in contact staan met medewerkers.

De studie formuleert drie proposities voor toekomstig onderzoek: ten eerste, om ziekenhuisbrede prestatieverbeteringen te realiseren, moeten topmanagers zelf rolmodel zijn voor co-creëren in plaats van te vertrouwen op top-down sturing of bottom-up initiatieven op afstand te tolereren. Ten tweede, voor een succesvolle ziekenhuisbrede Lean-implementatie is nauwe samenwerking tussen het top-, midden- en operationeel management noodzakelijk gedurende het hele Lean-traject, inclusief tijdens het vaststellen van doelen. Ten derde, het combineren van zowel top-down- als bottom-up-benaderingen bij de implementatie van Lean zal (waarschijnlijk) leiden tot snellere, grotere en duurzamere prestatieverbeteringen op ziekenhuisbrede schaal.

De tweede studie bouwt voort op de aanname dat continue verbetering (CV) essentieel is voor het succes van Lean. CV fungeert als een mechanisme om (zorg) processen stapsgewijs te verbeteren, verspilling te verminderen en zowel patiëntuitkomsten als organisatorische prestaties te optimaliseren. Het opschalen van CV naar een ziekenhuisbrede aanpak wordt echter nog onvoldoende begrepen, waardoor CV vaak beperkt blijft tot geïsoleerde projecten of afdelingen. Deze beperking vermindert het potentieel van CV om duurzame en

organisatiebrede impact te realiseren. Daarom onderzoekt deze studie hoe CV kan worden geconceptualiseerd als een “Dynamic Capability” (DC), ofwel een dynamisch vermogen, door het ontwikkelen van specifieke organisatorische routines die Lean-methodieken op alle niveaus van een ziekenhuis integreren.

DC-theorie beschrijft het vermogen van organisaties om concurrerend te blijven door continu bedrijfsmiddelen te vernieuwen en processen anders in te richten om in te spelen op uitdagingen en kansen in de externe omgeving. Vanuit de DC-theorie wordt CV gezien als een verzameling organisatorische routines die voortdurend evolueren en nauw met elkaar samenhangen. Deze routines werken samen om processen te stroomlijnen, verspilling te verminderen en CV in de operatie te waarborgen. Verreweg het meeste onderzoek naar DC richt zich op strategisch management op macroniveau. Tot op heden is er echter weinig literatuur die zich richt op het microniveau en beschrijft hoe routines ontstaan, op elkaar worden afgestemd en zich ontwikkelen tussen verschillende hiërarchische niveaus. De literatuur biedt bovendien weinig inzicht over welke specifieke routines bijdragen aan CV en hoe deze routines systematisch worden gebundeld en geordend om een ziekenhuisbrede DC te ontwikkelen.

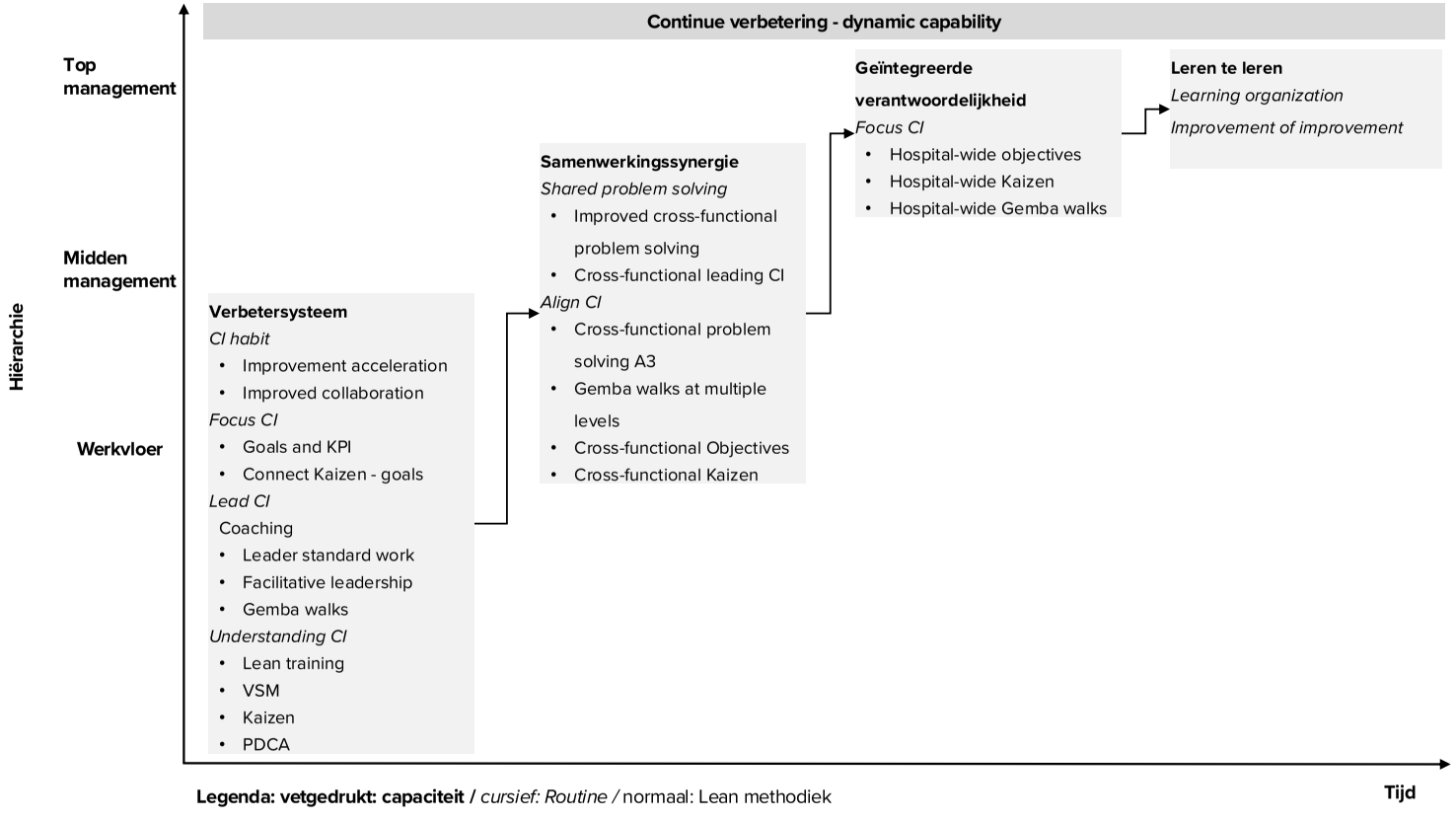
Voor deze studie hebben we procesonderzoek als methodiek toegepast om inzicht te verkrijgen in de implementatie van Lean en de ontwikkeling van organisatorische routines gedurende een periode van vier jaar in twee ziekenhuizen. De dataverzameling bestond uit een grondige analyse van ziekenhuisdocumenten, 48 semigestructureerde interviews van elk ongeveer een uur met sleutelfiguren binnen de organisatie (waaronder bestuurders, managers, verpleegkundigen, artsen en ondersteunend personeel), en observaties van 13 stand-up meetings om interacties tussen leiders en medewerkers te analyseren. De verschillende gegevensbronnen zijn gebruikt om gedetailleerde casusbeschrijvingen van het Lean-implementatieproces op te stellen. Deze beschrijvingen zijn vervolgens systematisch geanalyseerd en met elkaar vergeleken door middel van een cross-case analyse.

Beide ziekenhuizen lieten aanzienlijke prestatieverbeteringen zien in meerdere afdelingen, zoals kortere doorlooptijden voor patiënten, een hogere productiviteit en een toename in het aantal uitgevoerde chirurgische ingrepen. In één van de ziekenhuizen werd, door een organisatiebreed CV-traject, bovendien een aanzienlijke vermindering gerealiseerd in de pijn die patiënten na operaties ervoeren. De resultaten tonen aan hoe Lean-methodieken zich geleidelijk ontwikkelden tot continue verbetering routines. Deze routines werden systematisch gebundeld in vier specifieke organisatorische capaciteiten: een verbeteringssysteem, samenwerkingssynergie, geïntegreerde verantwoordelijkheid en leren-te-leren. Samen vormden deze capaciteiten een ziekenhuisbrede CV-DC. In één van de onderzochte ziekenhuizen werd deze volledig ontwikkeld en succesvol toegepast.

Deze studie draagt bij aan de DC-theorie door een uitgebreid model te presenteren dat laat zien hoe CV-routines zich in de loop van de tijd ontwikkelen tot een CI-DC (zie figuur 1). Het doorbreekt de traditionele opvatting dat DC's uitsluitend op topmanagementniveau worden ontwikkeld. De nadruk ligt op de onderlinge afhankelijkheid en dynamische samenwerking van routines op alle organisatieniveaus: de werkvloer, het middenmanagement en het topmanagement. De studie geeft verder een gedetailleerd inzicht in hoe Lean-methodieken zich ontwikkelen tot CV-routines, die de basis leggen voor een organisatiebreed verbeteringssysteem. Dit inzicht sluit aan bij hedendaags onderzoek naar het clusteren en structureren van routines en biedt inzicht in hoe deze clusters de prestaties van een organisatie versterken. Door Lean te verbinden met DC-theorie, laat de studie zien hoe vanuit routines duurzame verbeteringen en flexibiliteit kunnen worden gerealiseerd in complexe, kennisintensieve omgevingen zoals ziekenhuizen.

De derde studie vertrekt vanuit de observatie dat ziekenhuizen, naarmate zij vorderen in Lean-volwassenheidsstadia, hun focus verleggen van het reduceren van verspilling naar het ontwikkelen van een flexibel, strategisch systeem dat (patiënt) waarde stimuleert. Het realiseren van organisatiebrede coördinatie vereist sterke relationele structuren die samenwerking tussen hiërarchische niveaus en afdelingen ondersteunen. De theorie van Relationele Coördinatie (RC) benadrukt dat betere organisatieprestaties voortkomen uit naadloze samenwerking, gebaseerd op gedeelde doelen, gedeelde kennis, wederzijds respect en effectieve communicatie. In ziekenhuizen, waar (interdisciplinaire) samenwerking essentieel is, kan RC bijdragen aan het bevorderen van samenwerking tussen afdelingen, waardoor traditionele hiërarchische structuren transformeren in dynamische, patiëntgerichte netwerken. Hoewel Lean en RC elkaar logisch aanvullen, is de gezamenlijke evolutie en interactie tussen deze concepten tot nu toe onderbelicht gebleven. Deze studie vult die lacune door te onderzoeken hoe de Lean-stadia—kennen, begrijpen, denken en leren—interactie hebben met de dimensies van RC om de prestaties van ziekenhuizen te verbeteren.

Voor dit onderzoek gebruikten we een retrospectief longitudinaal procesontwerp in acht ziekenhuisafdelingen van de twee eerder genoemde Nederlandse ziekenhuizen. Over een periode van vier jaar verzamelden we data via 62 semigestructureerde interviews met bestuurders, managers, verpleegkundigen en artsen, om verschillende perspectieven op Lean-praktijken en RC-dynamieken vast te leggen. Daarnaast leverden prestatie-indicatoren en ziekenhuisdocumenten kwantitatieve gegevens over patiëntuitkomsten, operationele efficiëntie en andere belangrijke maatstaven. We volgden een abductieve benadering, waarbij we theoretische inzichten in de gezamenlijke evolutie van Lean en RC iteratief verfijnden door de Lean-stadia systematisch te koppelen aan de dimensies van RC.



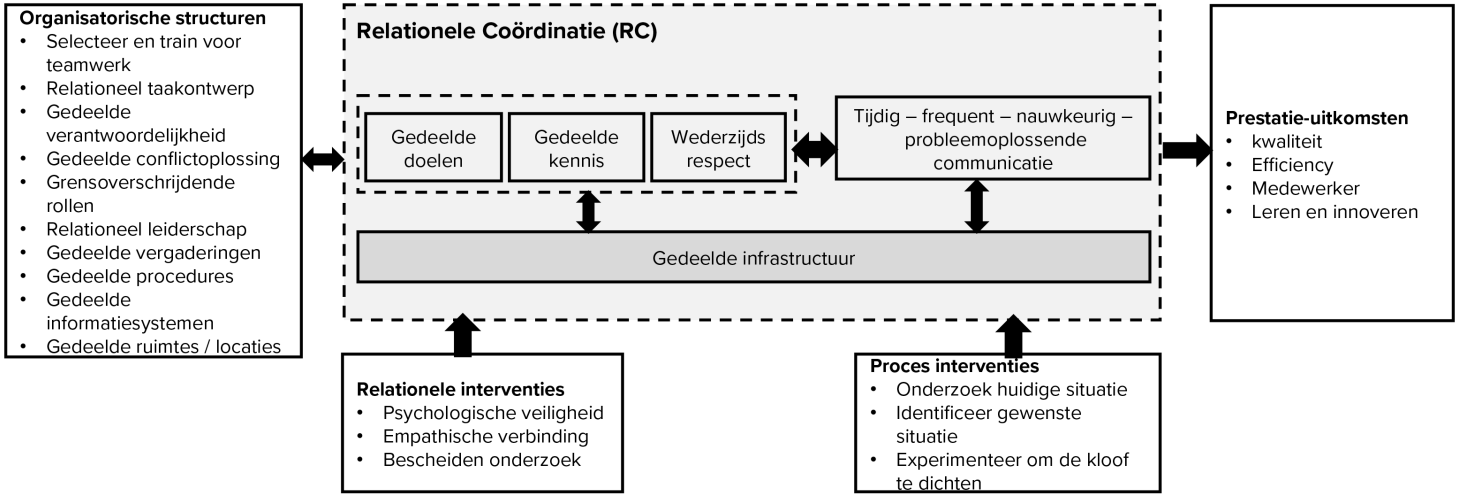
Figuur 1.
Conceptueel model voor de ontwikkeling van een DC voor continue verbetering

De resultaten tonen een duidelijke relatie tussen prestatieverbeteringen en het doorlopen van de Lean-volwassenheidsstadia door ziekenhuizen. In de vroege stadia—*kennen* en *begrijpen*, waar de nadruk ligt op het toepassen van expliciete Lean-methodieken—werden geen significante prestatieverbeteringen waargenomen. In het stadium van *denken* kwamen echter duidelijke verbeteringen naar voren, zoals efficiëntere behandelprocessen, hogere productiviteit, een stijging in omzet, verbeterde kostenefficiëntie en een optimalere benutting van bed capaciteit. Het *leren*-stadium, toonde de grootste impact, waarbij substantiële resultaten werden bereikt ondanks de complexiteit van het betrekken van meerdere disciplines en divisies binnen het hele ziekenhuis.

De studie benadrukt de sleutelrol van RC bij het realiseren van prestatieverbeteringen naarmate ziekenhuizen verder gevorderd zijn in de Lean-stadia. Verbeteringen in RC-dimensies—zoals gedeelde doelen, gedeelde kennis, wederzijds respect en effectieve communicatie—bevorderden direct samenwerking en resulteerden in betere uitkomsten. Het opschalen naar de meer volwassen Lean-stadia, met name *denken* en *leren*, versterkte deze RC-dimensies verder. Dit leidde tot betere samenwerking tussen teams wat uiteindelijk de prestaties aanzienlijk verbeterde. Daarnaast introduceren we een nieuwe dimensie, binnen het RC-kader: gedeelde infrastructuur (zie Figuur 2). Deze dimensie omvat organisatorische, relationele en technische coördinatiemechanismen die Lean-methodieken ondersteunen, zoals Gemba-walks, PDCA-cycli, Kaizen-events en A3-probleemoplossing. Gedeelde infrastructuur bevordert samenwerking tussen afdelingen, doorbreekt silo's en biedt een gemeenschappelijke taal en tools voor effectieve probleemoplossing. In complexe ziekenhuisomgevingen bleek deze infrastructuur onmisbaar voor het overwinnen van structurele barrières en het consistent toepassen van RC-praktijken tussen alle organisatie niveaus en binnen alle afdelingen.

Theoretische bijdrage en toekomstig onderzoek

Dit proefschrift levert een belangrijke bijdrage aan de literatuur door Lean, Dynamic Capability (DC)-theorie en Relationele coördinatie (RC)-theorie te integreren en het begrip van Lean als een allesomvattend leersysteem te verdiepen. Door te focussen op de toepassing ervan in ziekenhuizen laat het onderzoek zien hoe Lean kan bijdragen aan organisatiebrede transformatie in complexe omgevingen, gekenmerkt door hiërarchische structuren, interdepartementale silo's en de noodzaak van multidisciplinaire samenwerking. De bevindingen benadrukken de duale aard van Lean, bestaande uit zowel technische elementen—zoals procesoptimalisatie en het reduceren van verspilling—als relationele aspecten, waaronder het bevorderen van gedeelde doelen en kennis, wederzijds respect en effectieve communicatie. Deze combinatie laat zien dat Lean verder gaat dan operationele verbeteringen; het fungeert als een strategische katalysator voor aanpassingsvermogen, samenwerking en continu leren op alle organisatieniveaus.



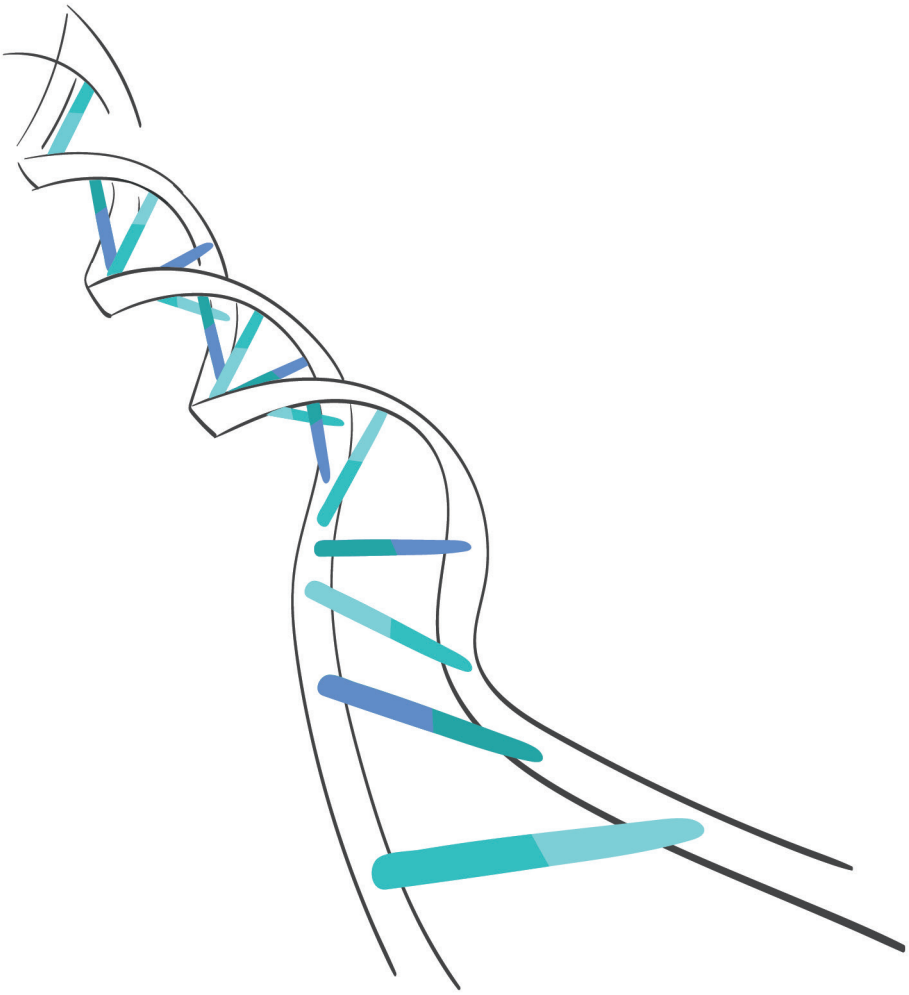
Figuur 2.
Geactualiseerd kader van de RC theorie, aangepast van Bolton et al. (2021, p. 292)

De empirische studies presenteren concrete strategieën voor ziekenhuisbrede Lean-adoptie. Deze strategieën omvatten het betrekken van leiderschap op alle hiërarchische niveaus en het systematisch ontwikkelen van DC's om flexibel in te spelen op veranderingen en het verankeren van CV als een dynamische capaciteit. Daarnaast introduceert het onderzoek het concept van gedeelde infrastructuur als een nieuwe RC-dimensie. Deze infrastructuur, ondersteund door mechanismen zoals Gemba-walks, Kaizen-events en PDCA-cycli, benadrukt het belang van het integreren van technische en relationele coördinatiekaders. Het creëert een gemeenschappelijke taal en tools die samenwerking tussen afdelingen versterken en silo's doorbreken.

Dit proefschrift biedt mogelijkheden voor toekomstig onderzoek, met name door de conceptuele modellen in dit proefschrift te vertalen naar andere kennisintensieve sectoren zoals technologiebedrijven, hoger onderwijs en de publieke sector. Daarnaast kunnen andere onderzoeksmethoden, zoals kwantitatieve modellen, het inzicht verder verdiepen in de afhankelijkheden tussen routines en capaciteiten binnen het DC-kader. Ook verdienen de relaties tussen RC-dimensies, inclusief de nieuw geïntroduceerde gedeelde infrastructuur, verder onderzoek om de integratie van Lean en RC-theorie te verfijnen. Actieonderzoek zou ook een waardevolle benadering kunnen zijn om de dynamiek tussen Lean en RC te onderzoeken, door theorie en praktijk te verbinden via iteratieve cycli van plannen, uitvoeren, observeren en reflecteren. Tot slot legt dit proefschrift een stevige basis voor verder onderzoek naar de interactie tussen DC- en RC-theorieën. Het verbinden van deze theoretische domeinen opent nieuwe perspectieven voor een geïntegreerde aanpak van organisatieverbetering en samenwerking.

Conclusie

Dit proefschrift benadrukt het potentieel van Lean als een strategische katalysator in ziekenhuizen. Lean stimuleert continue verbetering (CV), bevordert Dynamic capabilities (DC's) en versterkt relationele coördinatie (RC). Door technische en relationele benaderingen te integreren, kan Lean de inherente complexiteiten van de gezondheidszorg overwinnen en duurzame organisatieverbeteringen realiseren. De bevindingen dragen bij aan de academische kennis en bieden praktische inzichten voor professionals die de uitdagingen van Lean-implementatie in dynamische en middelenbeperkte omgevingen willen aanpakken.



Introduction

1. RESEARCH BACKGROUND

Lean stands as one of the most influential management innovations of the past 70 years (Åhlström et al., 2021; Womack et al., 1990). Its enduring relevance lies in its capacity for continuous reinvention as a management system, adapting to new challenges, such as the present discussion about the combination between Lean and green (Martinez & Jirsák, 2024). As argued in the commentary by Cusumano in Cusumano et al. (2021), Lean is everywhere in organizations: from manufacturing and startups to healthcare, and more. Lean can help organizations navigate the complexities of a sometimes rapidly changing environment. By embedding parallel participation structures, such as cross-functional teams, Lean can facilitate (relatively) swift organizational adaptations (Anand et al., 2009). This is particularly relevant in hospital settings, where rapid changes in patient clinical conditions demand prompt and assertive decision-making processes from employees (Tortorella et al., 2020).

The healthcare sector, and particularly hospitals, faces growing demand driven by an ageing population, pandemics, and overcrowded emergency departments (Leite et al., 2022). This heightened demand puts immense pressure on hospital systems, often constrained by limited financial and workforce resources (Williams & Radnor, 2018). The complex and unpredictable nature of hospital environments, marked by growing but fluctuating demand and the need for a highly specialized workforce collaborating in a complex organizational structure complicates the adoption of Lean (Nembhard et al., 2009). Hospitals, providing professional services, involve co-creation and intensive knowledge work. This requires high levels of expertise, collaboration, and customization, making it challenging to standardize processes and reduce variability, as Lean typically demands (Staats et al., 2011). Its hierarchical professional structure led by doctors adds to this complexity (Leite et al., 2019), given that healthcare also requires personalized interactions among clinicians but also with nurses, other employees, and even with patients (Fournier & Jobin, 2018). A deep understanding of these interacting complexities is crucial for successfully implementing Lean in hospitals (Fournier & Jobin, 2018; Rich & Piercy, 2012).

Before diving deeper into the challenges of Lean adoption in hospitals, it is important to first clarify my understanding of the concept of Lean. Lean started in the manufacturing industry with the aim to increase customer value by reducing operational waste through continuous process improvement (Shah & Ward, 2003). Womack et al. (1990) labelled this value-driven approach as a pattern of thinking, acting, and performing and referred to five Lean principles to ultimately create customer value: specify the value, identify the value stream, flow, pull, strive for perfection. Over time, Lean evolved from its origins in manufacturing into a strategic enabler in various contexts, including healthcare institutions and knowledge-intensive organizations (D'Andreamatteo et al., 2015; Stone, 2012). This resonates with Hopp and Spearman (2021) who offer four lenses through which Lean can be viewed:

process, flow, network, and organizational. The process lens focuses on reducing waste in individual activities, while the flow lens emphasizes the continuous movement of products through production systems. The network lens looks at the relationships between various units, ensuring coordination across multiple entities, and the organizational lens focuses on the structural and cultural changes required to implement Lean effectively. Together, these lenses provide a comprehensive framework for Lean systems, addressing both technical and social aspects. Their approach highlights the importance of integrating these lenses to achieve sustained Lean transformations across different industries. The overarching aim of Lean, as they argue, is to create a more efficient, waste-free, and integrated system that enhances performance across multiple levels. My dissertation aligns with Hopp and Spearman's four lenses, however, the core of my research is on the organizational lens, emphasizing hospital-wide Lean transformation, embedding CI, and developing DCs. Indeed, Lean brings more to an organization than merely eliminating waste and an efficiency focus as argued by Cusumano et al. (2021). This point highlights the distinction between hard and soft Lean practices. Hard practices focus on technical and analytical tools, often through an industrial engineering approach (Bortolotti et al., 2015). Soft Lean practices emphasize staff, relationships, empowerment, CI, and leadership: seen as critical for successful implementation (Bortolotti et al., 2018; Ljungblom & Lennerfors, 2021). From the perspective of hard Lean practices, the primary goal is to enhance efficiency. Instead, the soft Lean practices view, sees the concrete Lean tools and methods as a way to identify learning opportunities while uncovering operational problems to solve, which can lead to improved performance (Ballé et al., 2019).

The recent literature advocates for a broader construct, a Lean system, that includes a set of practices beyond operations (Marodin et al., 2018): an organization-wide, non-siloed, cross-functional approach to lean adoption and creating CI (Camuffo & Poletto, 2023), including the critical factors to successfully implement practices like strategy deployment and leadership engagement (Netland et al., 2019). Along with this idea of a Lean system, Lean is increasingly seen, in essence, as a learning system (Hines et al., 2004; Kristensen et al., 2022; Saabye et al., 2022). According to this learning lens, Hines et al. (2004) defined the foundation of Lean as the ability to learn an organization to evolve. Holweg (2007) added to this lens that successful Lean implementations entail the development of dynamic learning capabilities. Thus, learning-to-learn should be the core of Lean, as it is what supposedly makes Lean sustainable (Ballé et al., 2019; Furlan et al., 2019; Powell & Coughlan, 2020; Saabye et al., 2022). A Lean enterprise is nowadays therefore described as a learning organization, continuously improving through learning (Tortorella et al., 2020). Central to this is the capability to identify, confront, frame, and solve problems using the scientific method, which is fundamental to the Lean learning organization (Kristensen et al., 2022). Adopting the perspective from Ballé et al. (2019, p. 3), "Lean is a system to continuously develop people and create a culture of problem-solving; a strategy to face challenges by engaging

and involving all problem solvers into exploring issues and forming unknown solutions by learning experientially from practical countermeasures. Lean tools are techniques to create the conditions for such experiential learning, and the lean approach turns management upside down by turning the chain of command into a chain of help: challenge and support, rather than command and control". In conclusion, embracing Lean as a learning system presents both a profound opportunity and a significant challenge, especially in complex hospital environments.

Despite Lean's widespread adoption, many organizations do struggle to fully leverage its potential as an organization-wide learning system for driving sustainable change (Holweg, 2007). This challenge is particularly acute in large, complex, and knowledge-driven organizations, like hospitals, where entrenched hierarchies, deeply embedded routines, and fragmented structures often obstruct Lean's (full and) effective implementation (Fournier & Jobin, 2018). While the literature has extensively examined Lean's contribution to operational efficiency (Dahlgaard et al., 2011; Negrão et al., 2016), there remains a lack of understanding regarding its broader role as a strategic enabler (Secchi et al., 2019; Van Zyl-Cillié et al., 2024). Traditional Lean implementations in hospitals have often focused narrowly on problem-solving tools without embedding these practices into the organization's culture (Tortorella et al., 2020). A merely tool-based approach fails to instill a deeper, learning-oriented mindset in organizations, essential for cultivating long-term dynamic capabilities (Powell et al., 2024). For Lean to be truly effective, especially in a hospital setting, it needs to be understood as a comprehensive system that emphasizes process improvement through continuous experimentation, reflection, and the empowerment of both employees and leaders (Camuffo & Poletto, 2023; Secchi & Camuffo, 2016).

When viewing Lean from this 'holistic' perspective, a few challenges become apparent in the literature: first, there is a lack of strategic insight into how Lean can be best implemented on a hospital-wide scale (Kim et al., 2014; Van Zyl-Cillié et al., 2024) and in this perspective: how to best conduct the transformational change? Second, as CI plays a vital role in Lean's success, there is limited knowledge on how to develop hospital-wide CI (Burgess et al., 2022; Gutierrez-Gutierrez & Antony, 2020). This lack of knowledge hinders to scale CI beyond isolated projects or departments, limiting Lean's long-term potential performance impact in hospitals (Furnival et al., 2019). Third, although Lean is well-suited to stimulate learning, as it fosters CI, problem-solving, and adaptability which are all critical elements in complex healthcare environments, it is rarely examined in hospital settings (Van Zyl-Cillié et al., 2024). Lean promises better care coordination, resource management, and patient outcomes, aligning with hospitals' goals of quality care, reducing waste, and improving performance. Yet, how Lean stimulates such learning throughout hospitals is still underexplored.

When it comes to the first challenge, there is an unresolved debate regarding whether hospital-wide Lean adoption is best approached top-down or bottom-up (Dannaphel et al., 2014; Van Elp et al., 2021). While Lean has traditionally been implemented through top-down strategies increasing evidence suggests that bottom-up or hybrid approaches may be equally or more effective (Kim et al., 2014; Van Elp et al., 2021). Resistance to (top-down imposed) change (or lack of readiness) further complicates Lean adoption (Narayanamurthy et al., 2018), with many hospitals struggling to embed Lean practices into their organizational culture and overcome entrenched behaviors (Edelman et al., 2017). Leadership commitment and guiding coalitions across various levels is critical for success, yet there is only limited understanding of how leaders should act throughout different stages of Lean implementation in hospitals (Tortorella et al., 2020). More research is needed on how leaders can simultaneously support top-down directives and foster bottom-up learning to overcome these barriers and ensure effective, sustained Lean adoption (Stouten et al., 2018).

Secondly, CI, a cornerstone of Lean, drives the development of an organization's Lean system by refining products/services and processes in incremental steps, which in turn can reduce waste and significantly enrich customer/patient satisfaction and performance (Galeazzo et al., 2021). CI incorporates various Lean practices such as the Plan-Do-Check-Act cycle and Kaizen, which foster ongoing refinement and enhancement of processes (Gutierrez-Gutierrez & Antony, 2020). Beyond operational efficiency, CI plays a critical role in Lean thinking, enabling hospitals to adapt, innovate, and respond to changing environments, positioning CI as a dynamic capability (Gutierrez-Gutierrez & Antony, 2020). However, the literature has yet to fully explore how CI evolves as a dynamic capability across various hierarchical levels (Anand et al., 2009; Burgess et al., 2022). Dynamic capabilities refer to "the capacity of an organization to purposefully create, extend, or modify its resource base" in response to changing environmental conditions (Helfat et al., 2007, p. 4). These capabilities, which evolve over time, enable organizations to maintain a competitive edge by renewing their resources and reconfiguring their processes to adapt to new challenges and opportunities (Schilke et al., 2018). Using the lens of dynamic capabilities, CI can be conceptualized as a bundle of organizational routines that collectively streamline operations and drive CI (Gutierrez-Gutierrez & Antony, 2020). These routines are repeating, recognizable patterns of interdependent action, carried out by multiple actors and represent a stable set of practices that guide day-to-day operations and decision-making (Feldman et al., 2016). As routines evolve through continuous practice and refinement, they can be bundled into higher-order capabilities that contribute to the organization's overall strategic goals. This process, known as capability bundling, involves recognizing complementarities between routines and optimizing their interactions to generate synergies (Peng et al., 2008). Dynamic capabilities are formed when these bundled routines allow the organization to adapt, renew, and reconfigure its processes in response to environmental shifts (Schilke et al., 2018; Zollo & Winter, 2002). The dynamic capability theory adopts a

holistic view given that all elements of an organization need to be in alignment, recognizing the importance of learning for the purpose of adaptation (Teece, 2018). While much of the dynamic capabilities research has focused on the strategic management macro level (Teece, 2018), less attention has been given to how to develop (and keep) organizational routines aligned internally, across all organizational levels. There is growing recognition of the need to explore the micro-level processes through which dynamic capabilities emerge, develop, and are sustained over time (Felin et al., 2012; Salvato & Rerup, 2011; Schilke et al., 2018; Sousa-Zomer et al., 2020). Despite the advances, academic challenges persist in fully deciphering the aggregation mechanisms that enable routines at the micro level to evolve into dynamic capabilities at the organizational level (Chen et al., 2023). Specifically, the literature provides limited insight into which organizational routines contribute to CI and how these routines are bundled and sequenced to develop a hospital-wide, macro-type dynamic capability (Furnival et al., 2017; Furnival et al., 2019; Wenzel et al., 2020).

Thirdly, a key challenge is developing Lean until the most advanced 'Lean learning' stage in hospital settings, which is hindered by the inherent complexity and siloed nature of healthcare organizations. I started out this research to better understand how the four Lean stages of Hines et al. (2004) actually contribute to sustainable hospital-wide learning and increased performance. In the first stage, knowing, people in organizations become aware of Lean practices. In the second stage, understanding, organizations do grasp how Lean practices are to be applied within their context. In the third stage, thinking, hospitals start to develop their own strategies for implementing Lean as a tailored system. Finally, in the learning stage hospitals continuously experiment, adapt, and refine their Lean practices, thereby embedding—ideally—a culture of CI. In all these stages, staff members are learning. Saabye et al. (2023) distinguished individual learning, group learning, leading change through questioning, systems thinking, and respect for people. Clearly, good relations between employees are fundamental to organize and coordinate effectively in a hospital (Gittell, 2002). However, how Saabye et al.'s (2023) components influence the relational aspects of coordinating work in hospital settings remains underexplored. For example, problem solving at the frontline without referring issues upward for resolution is essential for realizing CI at speed; however, the relational aspects of Lean implementation remain underexplored (Bolton et al., 2021; Gittell et al., 2010). Understanding how these social dimensions of Lean learning contribute to efficient work coordination could provide valuable insights for enhancing both collaboration and performance in complex healthcare environments (Saabye et al., 2022; Van Dun & Kumar, 2023).

2. OVERVIEW OF THIS DISSERTATION'S RESEARCH

Adopting Lean as a system in existing hospitals is the connecting thread that bundles my three empirical studies. The first study explores how to adopt Lean effectively as a system in a hospital setting. In the second study, I explain how CI can be established across a hospital, as grounded in organizational routines that evolve into a dynamic capability. The third study explores how Lean learning embeds in a hospital setting through the four Lean stages outlined by Hines et al. (2004); it examines intra-hospital relational coordination quality, i.e., its impact on organizational performance. Together, these studies illustrate how to transform a hospital into a sustainable and adaptive Lean system by developing CI and fostering a culture of learning. Overall, this dissertation addresses the question: *How can large hospitals implement Lean as a hospital-wide system to foster continuous improvement and staff learning, thereby enhancing performance?* The dissertation is structured around independent, published (or publishable) reports of three interconnected empirical studies, each focusing on a different theoretical angle as depicted in Figure 1.

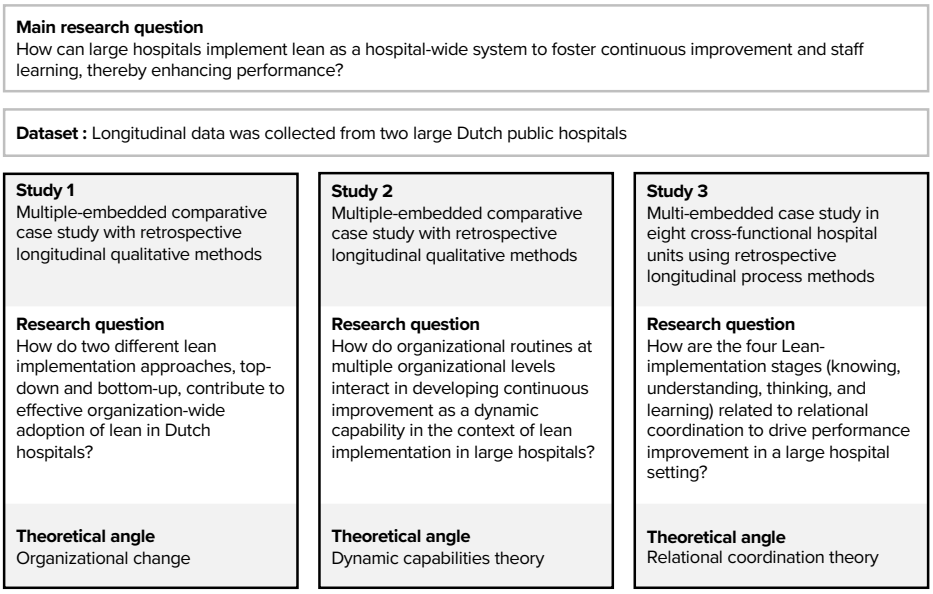


Figure 1.
Overview of the Three Specific Empirical Research Questions

The data for the three studies presented in my dissertation were collected from two hospitals. The first two studies utilized the same dataset, ensuring a consistent analytical foundation, though the focus of each study differs. The first study examines Lean implementation

strategies and organizational change, while the second concentrates on the development of CI and the creation of organizational routines and dynamic capabilities. In the third study, although it also centered in the same hospitals, the dataset was further enriched with more detailed information, incorporating eight embedded case studies to provide deeper insights and enhance the analytical rigor of the research.

Study 1, presented in Chapter 2, examines Lean implementation strategies in two Dutch university hospitals by comparing top-down and bottom-up implementation approaches. This study employs an inductive qualitative research method, analyzing data collected over a four-year period (Caniato et al., 2018). The data includes 49 interviews, documents, field notes, observations, and performance metrics. By tracing the sequential events of Lean transformations in these hospitals, the study reveals the critical roles played by leadership, middle management, and frontline employees during the transformation. This study contributes to answering the central research question by providing insights into how different Lean implementation strategies affect the organization-wide integration of Lean practices, setting the foundation for understanding Lean as a system-wide enabler in complex, knowledge-intensive environments of which hospitals are a prime example.

Building on these insights, the second study, presented in Chapter 3, explores how Lean contributes to the development of CI as a dynamic capability. Using a multiple-embedded longitudinal case study approach, this study applies retrospective qualitative methods to analyze sequences of CI episodes (Caniato et al., 2018; Langley et al., 2013). This study advances the central research question by demonstrating how Lean, when embedded in organizational routines, fosters hospital-wide CI thereby enhancing an organization's ability to respond to internal and environmental changes. The findings reveal a staged approach to building a CI dynamic capability.

The third study, presented in Chapter 4, inquires how Lean stages (Hines et al., 2004) influence relational coordination and their combined impact on organizational performance. This study adopts an abductive research approach and uses qualitative data from eight hospital units, including interviews, documents and observational data (Ketokivi & Choi, 2014). Connecting Lean stages with relational coordination dimensions (Bolton et al., 2021), the study explores how each Lean stage enhances learning through enhanced collaboration, breaking down silos, and improving cross-functional teamwork in large, complex organizations.

3. INTENDED CONTRIBUTION

Through this Ph.D. dissertation, I contribute to both academic knowledge and practical applications in the fields of Lean system adoption, change management, dynamic capabilities, and relational coordination. The three empirical studies presented herein advance the understanding of how Lean can be effectively integrated into large or complex knowledge-intensive organizations like hospitals, and how it interacts with theories to drive organizational transformation, CI, and organizational learning. By examining Lean through multiple theoretical lenses, this research addresses gaps in the prior literature and offers new perspectives for both scholars and practitioners. Lean is shown not just as an operational tool, but a dynamic management system that enables CI and learning.

The comparative analysis of top-down and bottom-up Lean adoption strategies in study 1 reveals the importance of leadership engagement adopting co-creation, creating value through interaction, between top management, middle management, frontline management, and employees in sustaining Lean transformations (Gummesson et al., 2014). This work extends the Lean adoption literature (Kim et al., 2014) by demonstrating that a hybrid approach, combining strategic oversight with grassroots involvement, fosters a more resilient and sustainable environment for change. The second study, introduces a conceptual model that demonstrates how CI can be developed as a hospital-wide dynamic capability through the bundling and sequencing of organizational routines across the organization. This work deepens the understanding of how Lean practices, when embedded in routines, support an organization's ability to adapt, improve, and respond to environmental changes. My third study explores how the various stages of Lean implementation (Hines et al., 2004) interact with the RC dimensions (shared goals, shared knowledge, mutual respect, and communication), to improve performance in large complex healthcare settings. The introduction of the concept of "shared infrastructure" as a new dimension of relational coordination theory highlights the importance of structural and relational elements in breaking down silos and enhancing cross-functional collaboration.

Holistically, the three empirical reports thus demonstrate that doing Lean well entails much more than merely making use of an operational toolkit. Lean acts as a strategic enabler, driving CI, fostering dynamic capabilities, and enhancing relational coordination across and within organizational levels. By examining Lean through various theoretical lenses, this dissertation shows how Lean can reach sustainable organizational effectiveness in complex, knowledge-intensive environments. This multifaceted approach to Lean not only deepens the theoretical understanding of Lean's potential but also offers practical insights for organizations aiming to navigate the challenges of today's dynamic organizational landscapes. By connecting Lean with essential organizational theories, my work thus contributes to the ongoing dialogue between academia and industry, supporting sustainable

organizational development and positive change that extend beyond academic discourse into real-world application.

4. PERSONAL MOTIVATION FOR THIS RESEARCH

My journey towards pursuing a Ph.D. began many years ago, fueled by a deep-seated interest and a curiosity about how to connect management theories to my daily practices as a consultant to support organizations to achieve sustainable effectiveness. Over 25 years of experience guiding global transformations in large companies exposed me to the complexity of driving change in deeply entrenched organizational cultures. This experience ignited a desire to delve deeper into the underlying theories of management practices, beyond their surface-level applications, and to understand their deeper theoretical foundations.

Throughout my career, I have witnessed firsthand the challenges organizations face in adopting new practices such as Lean (and Agile), which are often seen as essential for delivering value, fostering growth, and simultaneously achieving cost reduction. The reality is that organizations are in constant pursuit of what is often referred to as “the sheep with five legs”, a metaphor for the seemingly impossible balance of these objectives. My work in complex alliances within the telecommunications sector, where business units and external partners were required to collaborate on large-scale capital investment projects worth billions of euros, illustrated the difficulties inherent in breaking down silos and fostering cooperation.

In this setting, I recognized that starting with a focus on value creation was a critical step toward aligning disparate teams around a common goal. My experience with Lean practices confirmed that a shared understanding of value could bring us closer to achieving our objectives, even in the most challenging environments. This approach proved successful in various contexts, including in the healthcare sector, where I had the opportunity to go even deeper with Lean implementation. It was here that I learned the true fundamentals of CI and the importance of fostering a culture of learning to learn. These experiences laid the groundwork for the research presented in this dissertation. This journey, observed over the last 25 years, has only strengthened my belief in Lean as a powerful management innovation (Birkinshaw et al., 2008).

In sum, through this dissertation that lies here in front of you, I aim to contribute to (not only my own but also) the general understanding of how Lean and related organizational theories can help organizations (particularly in healthcare) overcome the challenges of increasing demand, complexity, and scarcity of resources, while achieving lasting improvement. By

exploring the theoretical intersections, my research seeks to provide actionable insights that can guide organizations in their pursuit of sustained effectiveness in an increasingly complex and fast-paced world.

5. REFERENCES

Åhlström, P., Danese, P., Hines, P., Netland, T. H., Powell, D., Shah, R., Thürer, M., & Van Dun, D. H. (2021). Is lean a theory? Viewpoints and outlook. *International Journal of Operations & Production Management*, *41*(12), 1852-1878. https://doi.org/10.1108/ijopm-06-2021-0408

Anand, G., Ward, P. T., Tatikonda, M. V., & Schilling, D. A. (2009). Dynamic capabilities through continuous improvement infrastructure. *Journal of Operations Management 27*(6), 444-461. https://doi.org/10.1016/j.jom.2009.02.002

Ballé, M., Chaize, J., & Jones, D. (2019). Lean as a learning system: what do organizations need to do to get the transformational benefits from Toyota's method? *Development and Learning in Organizations*, *33*(3), 1-4. https://doi.org/10.1108/dlo-11-2018-0147

Birkinshaw, J., Hamel, G., & Mol, M. J. (2008). Management innovation. *Academy of Management Review*, *33*(4), 825-845. https://doi.org/10.5465/amr.2008.34421969

Bolton, R., Logan, C., & Gittell, J. H. (2021). Revisiting relational coordination: a systematic review. *The Journal of Applied Behavioral Science*, *57*(3), 290-322. https://doi.org/10.1177/0021886321991597

Bortolotti, T., Boscari, S., & Danese, P. (2015). Successful lean implementation: organizational culture and soft lean practices. *International Journal of Production Economics*, *160*, 182-201. https://doi.org/10.1016/j.ijpe.2014.10.013

Bortolotti, T., Boscari, S., Danese, P., Medina Suni, H. A., Rich, N., & Romano, P. (2018). The social benefits of kaizen initiatives in healthcare: an empirical study. *International Journal of Operations & Production Management*, *38*(2), 554-578. https://doi.org/10.1108/ijopm-02-2017-0085

Burgess, N., Currie, G., Crump, B., & Dawson, A. (2022). *Leading change across a healthcare system: how to build improvement capability and foster a culture of continuous improvement: report of the evaluation of the NHS-VMI partnership*. Warwick Business School.

Camuffo, A., & Poletto, A. (2023). Enterprise-wide lean management systems: a test of the abnormal profitability hypothesis. *International Journal of Operations & Production Management*, *44*(2), 483-514. https://doi.org/10.1108/ijopm-10-2022-0646

Caniato, F., Doran, D., Sousa, R., & Boer, H. (2018). Designing and developing OM research: from concept to publication. *International Journal of Operations & Production Management*, *38*(9), 1836-1856. https://doi.org/10.1108/ijopm-01-2017-0038

Chen, Y., Liu, L., Li, W., Xie, Z., & Wei, C. (2023). Microfoundations of dynamic capabilities: a systematic review and a multilevel framework. *Management Decision*, *61*(6), 1717-1753. https://doi.org/10.1108/md-05-2022-0615

Cusumano, M. A., Holweg, M., Howell, J., Netland, T., Shah, R., Shook, J., Ward, P., & Womack, J. (2021). Commentaries on "The lenses of lean". *Journal of Operations Management*, *67*(5), 627-639. https://doi.org/10.1002/joom.1138

D'Andreamatteo, A., Lanni, L., Lega, F., & Sargiacomo, M. (2015). Lean in healthcare: a comprehensive review. *Health Policy*, *119*(9), 1197-1209. https://doi.org/https://doi.org/10.1016/j.healthpol.2015.02.002

Dahlgaard, J. J., Pettersen, J., & Dahlgaard-Park, S. M. (2011). Quality and lean health care: a system for assessing and improving the health of healthcare organisations. *Total Quality Management & Business Excellence*, *22*(6), 673-689. https://doi.org/10.1080/14783363.2011.580651

Dannaphel, P., Poksinska, B., & Thomas, K. (2014). Dissemination strategy for lean thinking in healthcare. *International Journal of Health Care Quality Assurance*, *27*(5), 391-404. https://doi.org/doi:10.1108/IJHCQA-01-2013-0001

Edelman, E. R., Hamaekers, A. E. W., Buhre, W. F., & van Merode, G. G. (2017). The use of operational excellence principles in a university hospital [Article]. *Frontiers in Medicine*, *4*(7), 1-8, Article 107. https://doi.org/10.3389/fmed.2017.00107

Feldman, M. S., Pentland, B. T., D'Adderio, L., & Lazaric, N. (2016). Beyond routines as things: Introduction to the Special Issue on Routine Dynamics. *Organization Science*, *27*(3), 505-513. https://doi.org/10.1287/orsc.2016.1070

Felin, T., Foss, N. J., Heimeriks, K. H., & Madsen, T. L. (2012). Microfoundations of routines and capabilities: individuals, processes, and structure. *Journal of Management Studies*, *49*(8), 1351-1374. https://doi.org/10.1111/j.1467-6486.2012.01052.x

Fournier, P., & Jobin, M. (2018). Understanding before implementing: the context of Lean in public healthcare organizations. *Public Money & Management*, *38*(1), 37-44. https://doi.org/10.1080/09540962.2018.1389505

Furlan, A., Galeazzo, A., & Paggiaro, A. (2019). Organizational and perceived learning in the workplace: a multilevel perspective on employees' problem solving. *Organization Science*, *30*(2), 280-297. https://doi.org/10.1287/orsc.2018.1274

Furnival, J., Boaden, R., & Walshe, K. (2017). Conceptualizing and assessing improvement capability: a review. *International Journal for Quality in Health Care*, *29*(5), 604-611. https://doi.org/10.1093/intqhc/mzx088

Furnival, J., Boaden, R., & Walshe, K. (2019). A dynamic capabilities view of improvement capability. *Journal of Health Organization and Management*, *33*(8), 821-834. https://doi.org/10.1108/JHOM-11-2018-0342

Galeazzo, A., Furlan, A., & Vinelli, A. (2021). The role of employees' participation and managers' authority on continuous improvement and performance. *International Journal of Operations & Production Management*, *41*(13), 34-64. https://doi.org/10.1108/ijopm-07-2020-0482

Gittell, J. H. (2002). Coordinating mechanisms in care provider groups: relational coordination as a mediator and input uncertainty as a moderator of performance effects. *Management Science*, *48*(11), 1408-1426. https://doi.org/10.1287/mnsc.48.11.1408.268

Gittell, J. H., Seidner, R., & Wimbush, J. (2010). A relational model of how high-performance work systems work. *Organization Science*, *21*(2), 490-506. https://doi.org/10.1287/orsc.1090.0446

Gummesson, E., Mele, C., Polese, F., Galvagno, M., & Dalli, D. (2014). Theory of value co-creation: a systematic literature review. *Managing service quality*, *24*(6), 643-683. https://doi.org/10.1108/MSQ-09-2013-0187

Gutierrez-Gutierrez, L., & Antony, J. (2020). Continuous improvement initiatives for dynamic capabilities development. *International Journal of Lean Six Sigma*, *11*(1), 125-149. https://doi.org/10.1108/IJLSS-07-2018-0071

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, S. (2007). *Dynamic capabilities: understanding strategic change in organizations*. Blackwell publishing.

Hines, P., Holweg, M., & Rich, N. (2004). Learning to evolve: a review of contemporary lean thinking. *International Journal of Operations & Production Management*, *24*(10), 994-1011. https://doi.org/10.1108/01443570410558049

Holweg, M. (2007). The genealogy of lean production. *Journal of Operations Management*, *25*(2), 420-437. https://doi.org/10.1016/j.jom.2006.04.001

Hopp, W. J., & Spearman, M. S. (2021). The lenses of lean: visioning the science and practice of efficiency. *Journal of Operations Management*, *67*(5), 610-626. https://doi.org/10.1002/joom.1115

Ketokivi, M., & Choi, T. (2014). Renaissance of case research as a scientific method. *Journal of Operations Management*, *32*(5), 232-240. https://doi.org/10.1016/j.jom.2014.03.004

Kim, Y. H., Sting, F. J., & Loch, C. H. (2014). Top-down, bottom-up, or both? Toward an integrative perspective on operations strategy formation. *Journal of Operations Management 32*(7-8), 462-474. https://doi.org/10.1016/j.jom.2014.09.005

Kristensen, T. B., Saabye, H., & Edmondson, A. (2022). Becoming a learning organization while enhancing performance: the case of LEGO. *International Journal of Operations & Production Management*, *42*(13), 438-481. https://doi.org/10.1108/ijopm-10-2021-0676

Langley, A., Smallman, C., Tsoukas, H., & Van De Ven, A. H. (2013). Process studies of change in organization and management: unveiling temporality, activity, and flow. *Academy of Management Journal*, *56*(1), 1-13. https://doi.org/10.5465/amj.2013.4001

Leite, H., Bateman, N., & Radnor, Z. (2019). Beyond the ostensible: an exploration of barriers to lean implementation and sustainability in healthcare. *Production, Planning & Control*, *31*(1), 1-18. https://doi.org/10.1080/09537287.2019.1623426

Leite, H., Williams, S., Radnor, Z., & Bateman, N. (2022). Emergent barriers to the lean healthcare journey: baronies, tribalism and scepticism. *Production Planning & Control*, *35*(2), 115-132. https://doi.org/10.1080/09537287.2022.2054386

Ljungblom, M., & Lennerfors, T. T. (2021). The Lean principle respect for people as respect for craftsmanship. *International Journal of Lean Six Sigma*, *12*(6), 1209-1230. https://doi.org/10.1108/ijlss-06-2020-0085

Marodin, G., Frank, A. G., Tortorella, G. L., & Netland, T. (2018). Lean product development and lean manufacturing: testing moderation effects. *International Journal of Production Economics*, *203*, 301-310. https://doi.org/10.1016/j.ijpe.2018.07.009

Martinez, F., & Jirsák, P. (2024). Exploring the relationship between Lean and Green for further research. *Journal of Manufacturing Technology Management*, *35*(9), 73-93. https://doi.org/10.1108/jmtm-05-2023-0165

Narayanamurthy, G., Gurumurthy, A., Subramanian, N., & Moser, R. (2018). Assessing the readiness to implement lean in healthcare institutions: A case study. *International Journal of Production Economics*, *197*, 123-142. https://doi.org/10.1016/j.ijpe.2017.12.028

Negrão, L. L. L., Godinho Filho, M., & Marodin, G. (2016). Lean practices and their effect on performance: a literature review. *Production Planning & Control*, *28*(1), 33-56. https://doi.org/10.1080/09537287.2016.1231853

Nembhard, I. M., Alexander, J. A., Hoff, T. J., & Ramanujam, R. (2009). Why does the quality of health care continue to lag? Insights from management research. *The Academy of Management Perspectives*, *23*(1), 24-42. https://doi.org/jstor.org/stable/27747492

Netland, T. H., Powell, D. J., & Hines, P. (2019). Demystifying lean leadership. *International Journal of Lean Six Sigma*, *11*(3), 543-554. https://doi.org/10.1108/ijlss-07-2019-0076

Peng, D. X., Schroeder, R. G., & Shah, N. T. (2008). Linking routines to operations capabilities: a new perspective. *Journal of Operations Management*, *26*(6), 730-748. https://doi.org/10.1016/j.jom.2007.11.001

Powell, D. J., & Coughlan, P. (2020). Rethinking lean supplier development as a learning system. *International Journal of Operations & Production Management*, *40*(7/8), 921-943. https://doi.org/10.1108/IJOPM-06-2019-0486

Powell, D. J., Laubengaier, D. A., Tortorella, G. L., Saabye, H., Antony, J., & Cagliano, R. (2024). Digitalization in lean manufacturing firms: a cumulative capability development perspective. *International Journal of Operations & Production Management*, *44*(6), 1249-1278. https://doi.org/10.1108/ijopm-05-2023-0414

Rich, N., & Piercy, N. (2012). Losing patients: a systems view on healthcare improvement. *Production Planning & Control*, *24*(10-11), 962-975. https://doi.org/10.1080/09537287.2012.666911

Saabye, H., Kristensen, T. B., & Wæhrens, B. V. (2022). Developing a learning-to-learn capability: insights on conditions for Industry 4.0 adoption. *International Journal of Operations & Production Management*, *42*(13), 25-53. https://doi.org/10.1108/ijopm-07-2021-0428

Saabye, H., Powell, D. J., & Coughlan, P. (2023). Lean and action learning: towards an integrated theory? *International Journal of Operations & Production Management*, *43*(13), 128-151. https://doi.org/10.1108/ijopm-06-2022-0371

Salvato, C., & Rerup, C. (2011). Beyond collective entities: multilevel research on organizational routines and capabilities. *Journal of Management*, *37*(2), 468-490. https://doi.org/10.1177/0149206310371691

Schilke, O., Hu, S., & Helfat, C. E. (2018). Quo vadis, dynamic capabilities? a content-analytic review of the current state of knowledge and recommendations for future research. *Academy of Management Annals*, *12*(1), 390-439. https://doi.org/10.5465/annals.2016.0014

Secchi, E., Roth, A., & Verma, R. (2019). The Impact of Service Improvisation Competence on Customer Satisfaction: evidence from the Hospitality Industry. *Production and Operations Management*, *28*(6), 1329-1346. https://doi.org/10.1111/poms.12969

Secchi, R., & Camuffo, A. (2016). Rolling out lean production systems: a knowledge-based perspective. *International Journal of Operations & Production Management*, *36*(1), 61-85. https://doi.org/10.1108/ijopm-04-2014-0194

Shah, R., & Ward, P. T. (2003). Lean manufacturing: context, practice bundles, and performance. *Journal of Operations Management*, *21*(2), 129-149. https://doi.org/https://doi.org/10.1016/S0272-6963(02)00108-0

Sousa-Zomer, T. T., Neely, A., & Martinez, V. (2020). Digital transforming capability and performance: a microfoundational perspective. *International Journal of Operations & Production Management*, *40*(7/8), 1095-1128. https://doi.org/10.1108/ijopm-06-2019-0444

Staats, B. R., Brunner, D. J., & Upton, D. M. (2011). Lean principles, learning, and knowledge work: evidence from a software services provider. *Journal of Operations Management*, *29*(5), 376-390. https://doi.org/10.1016/j.jom.2010.11.005

Stone, K. B. (2012). Four decades of lean: a systematic literature review. *International Journal of Lean Six Sigma*, *3*(2), 112-132. https://doi.org/10.1108/20401461211243702

Stouten, J., Rousseau, D. M., & De Cremer, D. (2018). Successful organizational change: integrating the management practice and scholarly literatures. *Academy of Management Annals*, *12*(2), 752-788. https://doi.org/10.5465/annals.2016.0095

Teece, D. J. (2018). Dynamic capabilities as (workable) management systems theory. *Journal of Management & Organization*, *24*(3), 359-368. https://doi.org/10.1017/jmo.2017.75

Tortorella, G., Van Dun, D. H., & De Almeida, A. G. (2020). Leadership behaviors during lean healthcare implementation: a review and longitudinal study. *Journal of Manufacturing Technology Management*, *31*(1), 193-215. https://doi.org/10.1108/JMTM-02-2019-0070

Van Dun, D. H., & Kumar, M. (2023). Social enablers of Industry 4.0 technology adoption: transformational leadership and emotional intelligence. *International Journal of Operations & Production Management*, *43*(13), 152-182. https://doi.org/10.1108/ijopm-06-2022-0370

Van Elp, B., Roemeling, O., & Aij, K. H. (2021). Lean leadership: towards continuous improvement capability in healthcare. *Health Services Management Research*, *0*(0), 1-9. https://doi.org/10.1177/09514848211001688

Van Zyl-Cillié, M. M., Van Dun, D. H., & Meijer, H. (2024). Toward a roadmap for sustainable lean adoption in hospitals: a Delphi study. *BMC Health Services Research*, *24*(1), 1-17. https://doi.org/10.1186/s12913-024-11529-4

Wenzel, M., Danner-Schröder, A., & Spee, A. P. (2020). Dynamic capabilities? unleashing their dynamics through a practice perspective on organizational routines. *Journal of Management Inquiry*, *30*(4), 395-406. https://doi.org/10.1177/1056492620916549

Williams, S., & Radnor, Z. (2018). An integrative approach to improving patient care pathways. *International Journal of Health Care Quality Assurance*, *31*(7), 810-821. https://doi.org/10.1108/IJHCQA-07-2017-0132

Womack, J. P., Jones, D. T., & Roos, D. (1990). *The machine that changed the world* (Vol. null). Simon and Schuster.

Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, *13*(3), 339-351. https://doi.org/10.1287/orsc.13.3.339.2780

Effective Hospital-wide Lean Implementation: Top-down, Bottom-up or Through Co-creative Role Modeling?

This chapter has been published: Van Beers, J. C. A. M., Van Dun, D. H. and Wilderom, C. P. M. (2022). Effective hospital-wide lean implementation: top-down, bottom-up or through co-creative role modeling? *International Journal of Lean Six Sigma*, *13*(1), 46-66. https://doi.org/10.1108/IJLSS-02-2021-0024

A previous version of this chapter has been presented at the *27th EurOMA Conference*: Van Beers, J. C. A. M., Van Dun, D. H., & Wilderom, C. P. M. (2020). Lean strategy implementation in two Dutch university hospitals: top-down vs. bottom-up. *27th EurOMA Conference: Managing Operations for Impact*, 17-19 June, Warwick.

ABSTRACT

Purpose

Lean implementations in hospitals tend to be lengthy or lack the desired results. In addressing the question, how can lean be implemented effectively in a hospital-wide setting, we examined two opposing approaches.

Design/methodology/approach

We studied two Dutch university hospitals which engaged in different lean implementation approaches during the same four-year period: top-down vs. bottom-up. Inductive qualitative analyses were made of 49 interviews; numerous documents; field notes; 13 frontline meeting observations; and objective hospital performance data. Longitudinally, we depict how the sequential events unfolded in both hospitals.

Findings

During the six implementation stages, the roles played by top, middle, and frontline managers stood out. While the top managers of one hospital initiated the organization-wide implementation, and then delegated it to others, the top managers of the other similar hospital merely tolerated the bottom-up lean activities. Eventually, only the hospital with the top-down approach achieved high organization-wide performance gains, but only in its fourth year after the top managers embraced lean in their own daily work practices and had started to co-create lean themselves. Then, the earlier developed lean infrastructure at the middle- and frontline ranks led to the desired hospital-wide lean-implementation results.

Originality

Change-management insights, including basic tenets of social learning and goal-setting theory, are shown to advance our knowledge of effective lean implementation in hospitals. We found lean implementation 'best-oiled' through role-modeling by top managers who use a phased-based process and engage in close cross-hierarchical or co-creative collaboration with middle as well as frontline managerial members.

Keywords

Lean management, hospitals, top-down vs. bottom-up implementation approaches, change management, lean leadership.

1. INTRODUCTION

Lean healthcare (Graban, 2008) concerns a hospital's operations strategy to improve the quality of patient care through understanding what is valuable for the patient while involving staff in a process of continuous improvement. Implementing lean in healthcare organizations has led to increased performance gains (Dobrzykowski et al., 2016), including a significantly higher level of patient care; service quality; and efficiency (D'Andreamatteo et al., 2015; Lima et al., 2021). In their literature review, Costa and Godinho Filho (2016) identified 18 studies on hospital-wide lean implementation, two of which had been carried out in the Netherlands (Schoonhoven et al., 2013; Vegting et al., 2012). Other Dutch lean implementations were reported by Van den Heuvel et al. (2004) and Niemeijer et al. (2012). These studies did not report precisely *how* the lean implementation *process* evolved over time nor did they stipulate what is needed for an effective hospital-wide lean implementation. Also, outside of the Netherlands, very few studies have addressed what is needed to effectively implement lean in large healthcare organizations (Hallam & Contreras, 2018).

An exception constitutes Edelman et al. (2017) who described a bottom-up implementation process in a Dutch university hospital which over time integrated top-down elements. Indeed, implementation of any change requires considering top-down direction and bottom-up engagement in a simultaneous manner (Beer & Nohria, 2000). Recently the dominant top-down implementation approach was challenged by Kim et al. (2014) who proposed an integrated process model encompassing both top-down planning and bottom-up learning, thereby raising the question how leaders in the several hospital layers are involved (Netland et al., 2019). Instead of focusing on hospital-wide transformations (Costa & Godinho Filho, 2016), most of the past lean healthcare studies report technical tool-based applications, focusing on local improvements, e.g. in the operating theatre (Lima et al., 2021; Souza et al., 2020). Making only piecemeal use of lean tools and practices limits the possible organizational-wide performance effects. Thus the incrementally reached lean effects might eventually be nullified if lean is not adopted by the rest of the organization (Netland et al., 2019). Yet, implementing lean successfully in a large knowledge-intensive organization, that consists of many different stakeholders, knows many challenges (Lima et al., 2021), particularly for the managers involved who often failed to overcome those challenges (Leggat et al., 2018).

In our comparative field study, one Dutch hospital started lean healthcare in a top-down fashion, i.e., where the change was led from the top; the other took more of a bottom-up approach; in that hospital lean was started among middle managers who were in pursuit of improving work-floor operations. These definitions of top-down and bottom-up are in line with Beer and Nohria (2000). Both lean implementations occurred in the same four-year time frame and offered rich insights to answer our study's key question:

How do two different lean implementation approaches, top-down and bottom-up, contribute to effective organization-wide adoption of lean in Dutch hospitals?

First, a brief topical literature review is offered after which we depict the lean implementation efforts within the two focal Dutch hospitals. Based on an inductive analysis of our mixed-methods longitudinal field data, we conclude that neither of the two approaches is optimal. Instead, a well-timed mixture of both approaches appears most effective: one in which the top managers do not merely delegate or tolerate lean but apply lean themselves while co-creating lean in close continuous cross-hierarchical cooperation. In the discussion section, we explain through the lens of change-management theorizing how lean implementations in Dutch hospitals and similar large knowledge-intensive organizations can be achieved. Besides three propositions for future research, we also explicate the implications for practice.

2. RESEARCH BACKGROUND

2.1. Lean healthcare

Many hospitals are under pressure to deliver improved quality care to more people, but with fewer resources (Waring & Bishop, 2010). Whilst lean has been shown to contribute to substantial healthcare improvement (Danese et al., 2018), many managers are still questioning lean's added value (McCann et al., 2015). We address this conundrum, not by discrediting lean, but by focusing on the conditions under which managers can implement lean well in large healthcare organizations, such as hospitals. Despite the huge differences between the manufacturing and healthcare sector, Womack et al. (2005) translated the five known lean principles to a healthcare context by integrating a patient pathway perspective to optimize value from the minute patients enter the hospital to when they leave. Lean thereby caters for better collaboration between different departments and other key actors (Graban, 2008) while abandoning the often authoritarian ways of working in hospitals (Collar et al., 2012). Thus, as to how lean can be implemented well in such complex organizational change contexts is not a trivial, but urgent, quest.

2.2. Lean implementation in hospitals

Lean implementation entails organizational change processes that affect all job facets (Kaplan et al., 2014); it involves, typically, changes in an organization's technical, physical, and socio-cultural domains (Hines, 2022; Scherrer-Rathje et al., 2009). Operations strategies, such as lean, are typically implemented top-down; however, increasingly, such a traditional approach is being challenged and bottom-up approaches have gained more attention. Kim et al. (2014), for instance, posed that an operations strategy is realized through iterative processes of top-down planning and emerging bottom-up learning whereby both angles serve complementary roles. Secchi and Camuffo (2016) argued for a more bottom-up

approach with lean being implemented as a set of principles, using the right conditions for a self-directed learning process. Furthermore, Bamford et al. (2015) argued that lean is best implemented step-by-step, through so-called 'partial implementation', instead of choosing the once-for-all organization-wide lean adoption; they provided empirical evidence that piecemeal adoption fosters more effective implementation. This aligns well with Netland and Ferdows (2016) depiction of lean implementation as an "S-curve shape" where operational performance improves slowly at first, then grows rapidly, and finally stabilizes throughout the various lean stages. As shown in a recent literature review by Rafique (2019) and the manufacturing case studies by Mostafa et al. (2013), most lean implementations combine a top-down implementation approach (i.e., the stages of initiating, preparing, planning, and directing) with bottom-up lean-practice activities at the frontline. The specific organizational conditions under which any lean implementation approach would need to be in place to yield the promising performance gains remains an often unaddressed question. Most lean healthcare studies mainly describe top-down implementation approaches (David Ollier, 2006; Kaplan & Patterson, 2008) without analyzing the specific implementation processes involved. The exceptions are Dannaphel et al. (2014), who elaborated on how lean was implemented in a large Swedish hospital using a five-step model, and Daaleman et al. (2018) and Mazur et al. (2012), but their studies only studied the top-down approach.

In the Netherlands, both Van den Heuvel et al. (2004) and Niemeijer et al. (2012) described a project-based approach to implement Lean Six Sigma in two different hospitals. Both implementations started top-down with an extensive internal Green and Black Belts training program for middle management and other staff, supported by external consultants. Niemeijer et al. (2012) reported that at the University Medical Center Groningen a total of 163 projects were completed scattered throughout the hospital emphasizing the primary patient treatment and care processes. Initially these projects were selected by employees themselves, thus bottom-up. In a second phase the lean philosophy and continuous improvement efforts gained more attention and senior management regained control to establish hospital-wide efficiency. Edelman et al.'s (2017) narrative of a single Dutch university hospital's lean implementation effort, on the other hand, depicted *how* both top-down and bottom-up initiatives were eventually combined; lean was initiated bottom-up by two departments which formed multidisciplinary teams to introduce new patient-centered processes. Thanks to their positive results, top management then installed a strategic lean program, led by physicians but, as their priorities changed, this approach failed. Upon noticing the lack of a customer-centered organizational culture, top management integrated lean as a strategic pillar and invested in training and a master Lean Black Belt office. However, two years later, there was still resistance to change. Only after intensifying top-down monitoring and directive top-managerial involvement, as well as a more permanent kaizen structure, the targeted hospital-wide and local improvements were met. Edelman *et al.'s* (2017) case illustrates well the complexity and challenges related to the conditions under which lean

can be embedded effectively in (Dutch) hospitals. Our study aims to offer not only in-depth descriptions of two comparable implementation processes; it also focusses on the actors involved, and especially how leaders at several levels act during each stage of a typical organization-wide lean implementation process.

2.3. Change in a complex hospital setting

One of the reasons why hospital-wide lean adoptions rarely succeed effectively lies in the underestimation of a hospital's high level of complexity (Fournier & Jobin, 2018). Many hospitals operate via autonomous divisions with own profit and loss responsibilities and the employees are not used to working outside their division, let alone develop objectives and matching routines that span functional hospital silos (De Souza & Pidd, 2011). Hence, the fragmented hospital structure and its many fairly autonomously operating knowledge-intensive functional units (Fournier & Jobin, 2018) encumber the introduction and the implementation of lean. Clearly, lean requires a hospital's entire staff to add a new daily focus: on top of carrying out and improving their own individual tasks, they have to continuously make substantial inter-task, cross-boundary process improvements (De Souza & Pidd, 2011). Implementing lean in a hospital also requires change management: As explained by Beer and Nohria (2000) effective change management should balance creating economic value (Theory E) with softer objectives such as developing leaders' and employees' behaviors and mindsets as part of a continuous improvement culture (Theory O). Combining both theories E and O, Beer and Nohria (2000) stated that leaders should manage change from both the top downwards as well as encourage bottom-up participation.

The literature that combines lean implementation and change management stresses the importance of leadership commitment to lean (Balushi et al., 2014; Losonci et al., 2011; Stouten et al., 2018; Van Dun et al., 2017). A lack of lean leadership commitment is known to lead to issues like: limited access to lean resources; lack of employee awareness of lean's value; and a lack of potential synergy between lean and other hospital initiatives (Scherrer-Rathje et al., 2009). Change can be initiated by top, middle, or lower management but active top management involvement in lean is known to be critical for lean implementation success (Scherrer-Rathje et al., 2009). Although most lean studies point to leadership commitment as the major vital factor, the literature rarely describes *how* the leaders at various levels should act during the various stages of a hospital implementation process. Leadership in hospital settings differs to some extent from most other work settings (Aij & Teunissen, 2017; Tortorella et al., 2020; Van Elp et al., 2021). As noted by Lima et al. (2021), leaders of different hospital disciplines tend to have different stakes and in some cases even strongly disagree with each other. In addition to this, Netland et al. (2019) stress that the necessary lean leadership actions of top managers, middle managers, and frontline managers vary, given their own different places and roles in a hospital's hierarchy. Recently, Alnadi and McLaughlin (2021) accentuated the interdependencies between these actors.

Below, we will explore how these different kinds of leaders acted during the various stages of two entirely different hospital lean implementation initiatives, including the degree to which they collaborated with each other.

3. RESEARCH METHODOLOGY

3.1. Research design

Our in-depth comparison of lean implementation in two similar Dutch university hospitals—one initiated lean in a top-down fashion, and the other bottom-up—entailed a process research design with two extreme cases. Process research aims to analyze complex data dealing with temporally evolving processes that might be persuasive and theoretically insightful (Langley et al., 2013). We used a multiple embedded comparative case study approach (Yin, 2015) with retrospective longitudinal methods to collect qualitative data spanning, in both cases, a period of four years.

3.2. Case selection and characteristics

Using purposive snowball sampling, we selected two contrasting lean implementation trajectories in two hospital settings (Yin, 2015). The selection criteria were: First, the hospital had to have visibly started adopting a lean program: i.e., the initiative had to be already in the 'transition' stage or beyond, as defined by Netland and Ferdows (2016). Second, the lean implementation approaches within both hospitals had to contrast: One selected hospital had started implementing lean top-down, while the other had started in a bottom-up fashion. Table 1 lists the key features of both hospitals; in terms of their non-lean characteristics, they were quite similar.

3.3. Data collection

In each longitudinal case, the same multiple methods were employed. We started with open-ended intake *interviews* with the most knowledgeable internal lean expert: to get an overview of the lean process thus far. Then, through snowball sampling, other lean-involved key employees were interviewed. These 49 interviewees included top managers, middle managers, frontline managers, nurses, physicians, HR members, quality assurance personnel, and hospital-finance specialists. The interviewees were selected through snowball sampling (Yin, 2015) which was aided by departmental lists of the employees most actively engaged in lean. The aim of these open-ended, semi-structured interviews was to get a deep understanding of their views about the state of the lean events in each hospital at the time (Yin, 2015). Our interview guide covered an entire lean program: from the implementation steps and practices to organizational changes, conditions, barriers, and results. Example questions are: How is lean dispersed throughout the hospital? And: What needed to be changed inside the hospital before the actual lean implementation could

start? All the interviews were audiotaped and transcribed.

Table 1.
Case and data collection characteristics

	Top-down case	Bottom-up case
Case characteristics		
No. of employees (in FTEs)	6,800	5,285
No. of departments	57	55
Annual patient admissions	27,000	22,000
Adopted lean practices	Hoshin kanri, VSM, kaizen (events), gemba walks, visual management, stand-ups, PDCA	VSM, kaizen (events), gemba walks, visual management, stand-ups, PDCA
Data collection characteristics		
No. of employees interviewed	27	21
Executives (top manager)	4	2
Staff[a] (middle manager)	4	3
Department heads (middle manager)	4	4
Medical department heads (middle manager	3	2
Team leaders (Frontline leader	5	5
Nursing / employees	5	4
Lean consultant	2	2
No. of transcribed pages	298	364
No. of (archival) documents	58 (1,842 pages)	47 (1,505 pages)
No. of 60-minute on-site field visits	6	7

[a] Staff included finance, human resources, strategy, quality, and supply chain personnel.

The interviewees also shared *documents* that described the stages and rationales of the lean implementation activities and processes. They also included the training materials, lean practices used, presentations, implementation progress data, monitoring methods, and descriptions of the organizational structure. Both hospitals' annual reports from the four-year study period were retrieved as well.

Over the four years, we also gathered the (in part archival*) key performance indicators data* at the frontline, cross-functional, and strategic levels. These related to productivity, (patient) quality, efficiency, employee satisfaction, and cost reductions.

Moreover, during 15 random site visits, *field notes* were taken by the first author about the lean practices observed, and how engaged the attending leaders and non-managerial staff members appeared.

At the end of the four-year research period, we engaged in *participant observation* (Czarniawska, 2008) of 13 daily stand-up meetings on-site: Five frontline stand-ups at each hospital, plus three cross-departmental stand-ups within the top-down case (the bottom-up case did not have an equivalent yet at the time). Every meeting happened to be chaired by one of the earlier interviewed frontline leaders.

3.4. Data analysis

During the data analysis, four steps were followed. First, we developed comprehensive single-case narratives (Langley et al., 2013) after inductively coding the interviews and documents using ATLAS.ti (see, the resulting coding structure in Appendix A) and then depicted the case events chronologically as temporal process stages (Langley et al., 2013). Then, we reconstructed, per hospital, the lean implementation processes and results that developed over time. For example, at the start of the lean implementation process in each hospital, we captured aspects such as vision, hoshin, and policy deployment: those aspects were found to cover the first lean implementation stage as will be explained further below. To check for any observer biases, we shared and discussed each case description with the key informants in each case, such as the internal lean expert and middle managers involved (Voss et al., 2002). Their feedback resulted in minor revisions of each case narrative.

Next, we analyzed what had happened during the sequence of events and the changes they brought, by focusing on conditions under which the identified changes took place during the lean implementation process, including the interconnections (or lack thereof) between, and the performance outcomes of, the top-, middle-, and frontline-management levels. Finally, cross-case analyses (Yin, 2015) were done to compare the patterns of the changes within both hospitals, with a focus on the hierarchical levels and other organizational fault lines associated with the hospital-wide outcomes.

4. CASE RESULTS

Below we first depict both case chronologies, see Figure 1, followed by a cross-case comparison.

4.1. Top-down case

4.1.1. Early lean stage

The hospital's executive board decided to adopt lean as their operations strategy (see event #1 in Figure 1). Supported by an external consulting firm, a business case was made for a four-year strategy that entailed a long-term vision and a balanced set of annual financial and production targets regarding patients, efficiency, employees, and quality (#2). All the top managers had acquired lean knowledge and attempted to develop their

commitment to lean by: visiting other Dutch lean organizations; learning about two best practice lean hospitals in the USA (ThedaCare and Virginia Mason); and attending in-house training sessions. A group of middle managers, selected from all the hospital's disciplines, engaged in an end-to-end process mapping of one patient group. An internal lean director was appointed who formed a multidisciplinary implementation team consisting of middle managers, headed by one of the five top managers. Their first act was to develop the lean program charter, signed by all the top and division managers.

In preparation for the lean implementation (#3), the lean director also established a central lean office. This hospital's lean implementation approach was modeled on the external consulting firm's standard script, aimed at departmental-level lean practice pilot interventions. Three departments volunteered to participate in the lean pilots.

4.1.2. Lean pilot stage

Within each pilot (#4), both an internal and external lean consultant first trained three departmental frontline leaders (medical and nursing) during four half days. Then, information sessions introduced all the employees in each pilot to the lean practices that had to be adopted. The lean consultants also engaged in on-site observations and interviewed the frontline leaders about the existing ways of working and their context. Finally, a value stream map (VSM) of the departmental main processes was developed by each frontline team to spot process waste.

The aim of the pilots (#5) was to engage the frontline employees, develop their problem-solving skills, and establish continuous improvement ('kaizen') across the teams. The lean consultants helped to establish daily learning and improvement cycles according to Plan–Do–Check–Act (PDCA). The employees tracked the progress of their VSM-inspired problem-solving initiatives through daily stand-ups around improvement boards. A lean consultant noted: "*The employees have taken a big step by highlighting problems and taking responsibility to solve them.*"

Nine months into the pilot, top management called for an evaluation (#6). Although tangible results were lacking, they ordered hospital-wide lean implementation with clearer frontline targets. The lean director and his consultants developed *goal sessions* to improve front leaders' goal orientations and the setting of priorities at the start of each departmental intervention (#7). Also, six external and six internal lean consultants were recruited to facilitate the next round of lean implementation within ten other volunteering departments (#8).

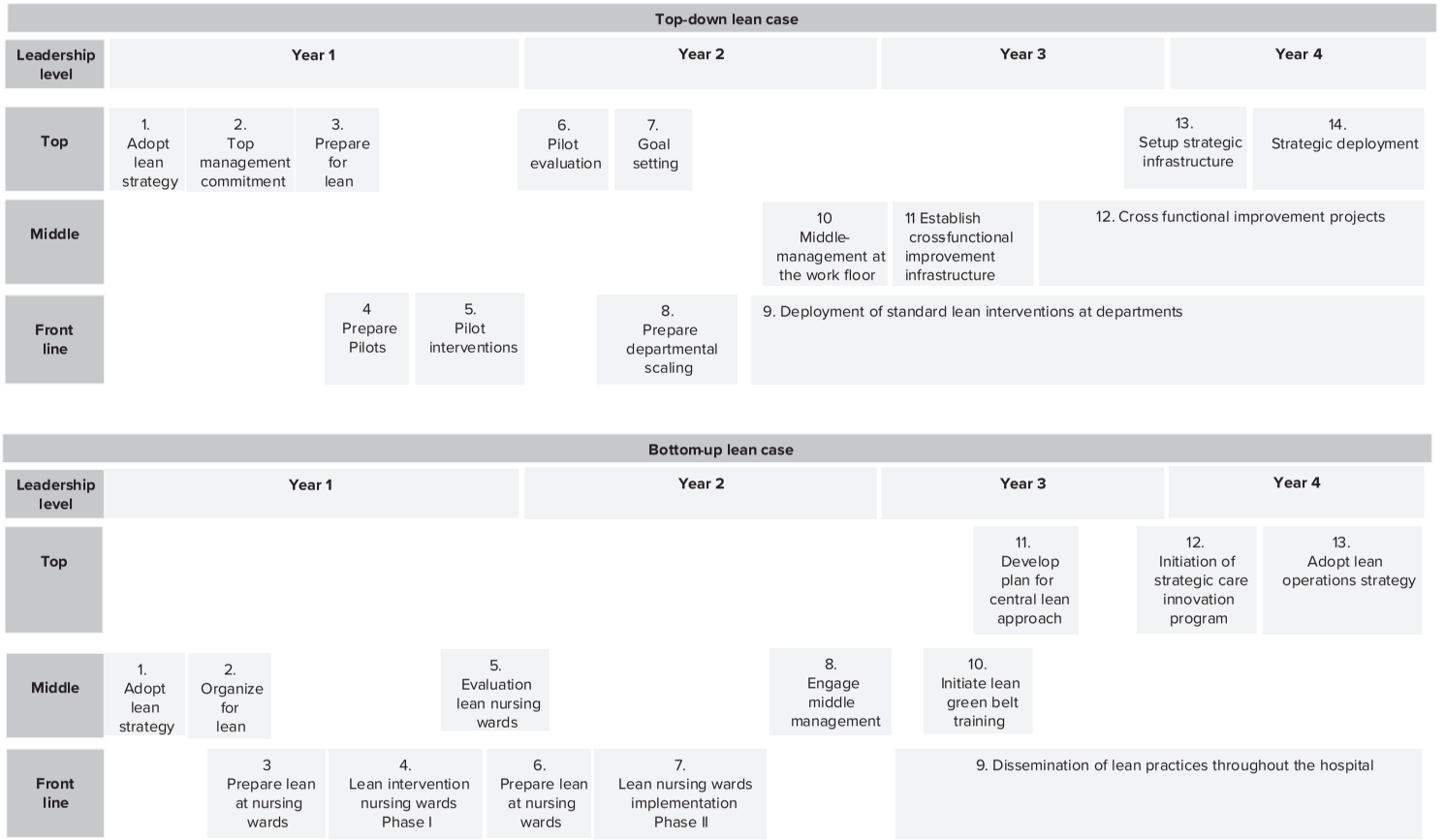


Figure 1.
Timeline of key events in the top-down and bottom-up lean hospital cases

4.1.3. Hospital-wide lean rollout

The ten departments engaged in six-to-nine month standardized lean interventions (#9). The lean consultant supported the employees and their frontline supervisors daily to become more comfortable with the new lean practices. During four sessions, facilitated by lean consultants, the middle and frontline managers *"set three to four goals and KPIs for the frontline teams to focus on."* The employees voiced and solved daily problems: more and faster than before. A team leader noted: *"Before, problems were discussed everywhere, but nothing really happened."* The frontline leaders became more visibly involved in the daily work, acted as lean coaches, and established closer communications within their teams, helped by the clear team objectives. Consequently, the team leaders gained a much better understanding of the complicated problems the staff were trying to solve. The frontline leader's skills and support for lean led to (non-) managerial employees responding mainly positively, although few of them remained defensive. Once the interventions matured, resistance to doing lean faded away. Apart from the departmental-level VSM sessions, complex multidisciplinary bottlenecks within each department were solved through separate kaizen events with nurses, physicians, and other staff: leading to clearly visible operational performance improvements, such as a maximum 2% failure rate to meet the operating theatre schedules and a 15-minute waiting time reduction for patients transitioning from nursing wards to operating rooms.

Across departments it appeared difficult to start with kaizen events. This lack of alignment between departments was also picked up by the middle management upon starting gemba walks during and engaging in conversations with the frontline staff (#10). A middle manager described: *"Before, we did not really know how our processes ran. We thought we could learn about them while sitting in our offices and by providing solutions for all kinds of frontline issues."* The middle managers and frontline leaders realized that functional silos and existing hierarchies within each specialty prevented cross-departmental alignment. Consequently, the middle managers started organizing weekly stand-ups to align the objectives, cross-functional KPIs, decisions, and improvements across all the 13 departments involved in lean (#11). Issues that had not been solved within the frontline teams were highlighted by the frontline leaders, and then discussed, prioritized, and monitored during these middle management stand-ups. As a middle manager explained: "*The cooperation between departments has improved tremendously and we are now managing to realize our KPIs.*"

Complex cross-departmental problems were solved through kaizen events (#12). Examples of cross-departmental improvements are: Reduction in medical costs (€ 128,000 per year) through a joint effort by the intensive care, pharmacology, and nursing wards; reduction in unnecessary patient relocations (3,200 hours per year) through improved collaborations between oncology and cardio surgery; reduction in patient waiting time (from six weeks to two days) by the polyclinic and cardiology departments. Finally, kaizen events led to

an optimized heart catheterization process: A complex value chain, that also required collaboration with other hospitals, led to reducing the failure rate from 15 medical errors a week to zero errors within six months.

4.1.4. Lean acceleration stage

During the third year, after 23 of the total 57 departments had transitioned to lean, top management decided to adopt the PDCA infrastructure at their own strategic level, including weekly stand-ups and visual performance boards (#13). A middle manager explained: "*We have now created strategic alignment across several hierarchical levels. The supervisors have stand-up sessions with the frontline employees. I have stand-ups twice a week with my peers. (...) I also have weekly 'report out' stand-ups with the board to discuss the strategic indicators in a similar way.*" Patient safety indicators were added to the set of strategic objectives, i.e., they were integrated into the top management PDCA cycle. Then, using the established lean infrastructure, patient safety objectives were deployed throughout the entire hospital upon which top management started to have weekly strategic KPI discussions, including middle managers and frontline leaders. A division leader led the kaizen event on patient safety: *"I go to the wards to discuss matters with them* [nurses]*; I am not just sitting behind my desk anymore, sending emails on what we should improve... I dive into it together with them* [involved employees at all levels]*."* As a result, the pain perceived by their patients after surgery reduced immensely; hospital-wide pain reduction after surgery improved by 72%.

4.2 Bottom-up case

4.2.1. Early lean stage

Lean was introduced by a middle manager who had followed an external lean training session and saw the potential of applying lean practices in his three nursing wards (event #1 in Figure 1, bottom-up lean case). One external consultant was hired to prepare the intervention that aimed to improve ward efficiency by 10%. A project plan was developed and a steering group, consisting of middle managers, was installed (#2). This lean consultant also gathered information about waste and inefficiencies through interviewing team leaders and other key personnel (#3). Moreover, to learn about lean's basics, yellow belt training was made available for the volunteering nurses and their leaders. On arranging lean practices, such as VSM related to end-to-end processes at the nursing wards, kaizen events, and a continuous improvement infrastructure, the employees' shared understanding arose of value versus waste and their own improvement potential (#4). Nevertheless, a clinical manager noted: *"To realize improvements we need engagement by all departments. It is rough to improve if not all players are on board."*

Problems were discussed during weekly stand-up meetings, chaired by the frontline leaders. Once the physicians joined the meetings, this, according to a frontline leader, resulted

in better cross-functional coordination. A nurse agreed: *"Issues are solved, and we get feedback from physicians."* Then, two months after the lean consultant had started, weekly kaizen events were introduced to all three hospital nursing wards, aimed at realizing quick wins and a nursing culture of continuous improvement. The kaizen events dealt with patient discharge, medication safety, and bed utilization issues. Initially, all the kaizen events were led by the consultant, but the projects did not flourish; the consultant explained: *"Later, I heard from some nurses that they had not been a part of developing the solution, but that* [they perceived] *it was a tool to be implemented by a consultant."*

After the first year, the lean project was evaluated by the division and nursing departmental leaders together with the consultant (#5). They saw that the nursing wards were working according to the lean principles, for instance during patient visit rounds, plus the nurses had started with autonomous problem solving and taking responsibility for day-to-day improvement tasks, but performance gains were lacking. The evaluation team decided to start with the prioritizing of objectives to achieve a 10% cost reduction.

4.2.2 Lean scale-up stage

After the evaluation, the lean consultant shifted his role, from steering to supporting the nursing wards (#6). The middle management and frontline leaders started making Gemba walks. Moreover, the existing lean practices, such as kaizen and VSM, had to be tied to concrete lean goals. Kaizen events were executed by the autonomous nursing teams and monitored, using visual performance dashboards, resulting in the targeted 10% cost reduction. The frontline leaders were coached by the lean consultant to enrich their work, e.g., by encouraging them to adopt 'go and see' practices. Together, the nursing wards did not only attain the desired 10% cost reductions, but also faster patient discharge, leading to a 13% increase in bed availability and a reduction in sterilized equipment errors (12% during surgery through standardization of transport trolleys). Informal measurements showed a parallel increase in overall nurse satisfaction.

4.2.3. Hospital-wide lean adoption stage

The nursing wards' successes caught other departments' eyes. The lean consultant and the nursing leadership team were invited to share their story with the other departments (#8). Lean was then introduced to some of the other departments, resulting in a wide array of disconnected lean practices (#9). A clinical department head explained: *"Each of the 34 projects started full of enthusiasm, but later it appeared to be hard to complete the full kaizen cycle, because we were not trained and did not have the right knowledge on how to proceed. That is fatal."* The HR department then initiated lean green belt training to facilitate awareness and joint learning among the frontline and middle managers. This training was their first attempt towards hospital-wide access to lean knowledge. (#10).

In the third year, top management requested the two bottom-up instigators of lean in the nursing wards to develop a hospital-wide lean implementation plan (#11). This plan was presented to the top-management team, but nothing happened for 8 months until they announced a hospital-wide strategic innovation initiative (#12) aimed at patient-focused care and continuous improvement. This strategic plan was further developed by an interdisciplinary team of middle managers, including the nurse middle manager who had started the bottom-up lean process, and the executives of the five hospital divisions approved the program. The 100 delegates at the top committed to this program and stated that clear, top-down objectives needed to be added when implementing the program. Lean was designated merely as the means for this 'innovation' program (#13). An internal program manager was appointed to centrally lead the program and, after having an evaluation session, the pioneering lean consultant left the organization. A lean office was installed to support the lean efforts in all the departments, four lean consultants were recruited, and a hospital-wide lean implementation roadmap was developed. Four years after starting the bottom-up lean initiative, the hospital had set up its central lean program; but its execution still had to begin.

4.3. Cross-case comparison

The top-down and the bottom-up cases differed mostly at the beginning of their lean initiatives but had a similar outcome: After four years, both hospitals were still struggling with their differing lean implementation processes. Both hospitals' struggles were due to insufficient top-managerial involvement in role-modeling lean from the start. While the top-down lean journey was prepared centrally, its execution was delegated to the middle managerial level in conjunction with external and internal lean consultants. The top managers in the bottom-up case lay lean dormant for four years; they merely tolerated lean efforts in the nursing wards. Only in the fourth year, after piecemeal successes of the bottom-up lean efforts became undeniable, the top of this hospital finally instated a hospital-wide strategy. In Table 2 a stage-based case comparison is listed.

Within the four-year period, the top-down case spent triple the amount on resources than the bottom-up case but reached many more performance gains at all the various organizational levels. Although both cases showed increased operational performance on multiple dimensions (quality, safety, efficiency, patient, and financial), only the top-down case resulted in cross-functional and hospital-wide performance improvements. The top-down case also eventually engaged more managers at all hierarchical levels to co-create process improvements, after a long period of removing the barriers to change. Below, we explain the process differences between both hospitals, based on the similar six lean implementation stages as well as the degree of leadership involvement during each stage.

Table 2.
Cross-case comparison: Top-down vs. bottom-up academic hospital case

Category	Top-down case	Bottom-up case
Lean implementation stage		
Strategize	Lean as part of strategic agenda from the start and commitment top management	
Prepare	Top management freed up resources to centrally organize lean, supported by a consulting firm, and established an aligned roadmap for hospital-wide lean roll-out	Middle management agreed to start lean in the nursing wards and hired an external consultant who developed an implementation plan
Pilot	Testing the intervention roadmap and lean practices	Value stream mapping, kaizen events, and problem-solving skills were developed at the nursing wards of one division
Evaluate	Evaluation of pilots by top management and a central decision to proceed to scale up	Organic decision-making at middle management to proceed with lean
Scale-up	Scale up through centralized standard lean intervention plan in ten departments	Implementing lean practices in various departments that volunteered: without a dissemination plan
Structure	Aligned infrastructure of bottom-up, cross-functional, and hospital-wide lean practices, integrated into daily routines developed by frontline, middle, and top management	Initiation of a centrally controlled lean delivery process, as part of a hospital-wide strategic pillar
Operational performance improvements	Yes	Yes
Cross-functional improvements	Yes	
Hospital-wide improvements	Yes	
Resource usage	Top-down case used triple the number of resources compared to the bottom-up case	

4.3.1. Strategize

The top-down case, see Table 3, started with top managers including lean in their operations strategy as part of the hospital's strategic agenda and becoming formally committed to it. Both top and middle managers gained generic lean knowledge through the external consulting firm's training. The bottom-up case started more ad hoc, after one pioneering middle manager from a nursing ward was trained externally in lean.

4.3.2. Prepare

In the top-down lean implementation case, top management freed up resources, especially for an internal lean director and his support office, including an external (hospital-specialized) consultancy firm that developed a roadmap for an aligned, hospital-wide lean implementation. The bottom-up case created a division-level steering committee and hired one external consultant who developed the nursing wards' lean implementation plan.

4.3.3. Pilot

Both cases set up front-line pilot interventions, helped by one or more consultants. The top-down case used pilot departments to test their intervention and lean practices in their daily work, while the bottom-up case started to experiment more loosely with kaizen events to develop problem-solving skills at the individual and team level.

4.3.4. Evaluate

In the top-down case, top management was involved in the pilot evaluation. In the bottom-up case, middle and frontline managers' decision to proceed was made more organically while setting locally developed frontline objectives. To ensure more visible results, the top managers in the top-down case enforced goal-setting sessions in each department.

4.3.5. Scale up

While the top-down case used a standardized intervention plan to roll-out parallel lean practices in ten department groups, the bottom-up case implemented lean practices in various disconnected willing departments without a clear dissemination plan. Moreover, the goal-setting exercise and lean training in the top-down case, involving multiple hierarchical layers and horizontal silos, enhanced people's lean knowledge and learning about process metrics. In the top-down as well as the bottom-up case, the employees' motivation for lean increased when frontline employees were coached more-and-more on lean through, e.g., individual, and team-based problem solving, which led to a team-oriented culture of continuous operational improvements. Hospital peer respect grew because of a better understanding of each other's work, further diminishing employee resistance to adopt lean. Through a dispersion of lean practices and methods throughout the hospital in the fourth year, the top-down case managed to scale its lean frontline interventions. This was accelerated because middle management also became highly involved in lean, e.g., through their Gemba walks that facilitated their own learning about operational results and the complexity experienced by the frontline to realize the targets. Then, middle management started to adopt the same lean infrastructure to improve and manage their own decision-making and to solve important cross-departmental problems.

Table 3.

Lean implementation activities and leadership involvement during each stage: Top-down case vs. bottom-up case

	Involvement of leadership levels per lean implementation stage																	
	1. Strategize			2. Prepare			3. Pilot			4. Evaluate			5. Scale up			6. Structure		
Implementation activities	TM	MM	FM	TM	MM	FM	TM	MM	FM	TM	MM	FM	TM	MM	FM	TM	MM	FM
Top-down case																		
Policy deployment	■									■			■	■	■	■	■	■
Develop themselves	■	■		■	■				■	■				■	■	■	■	■
Develop employees									■					■	■	■	■	■
Integrate in daily work									■					■	■	■	■	■
Build alignment				■					■	■				■	■	■	■	■
Improvement culture									■					■	■	■	■	■
Organize resources and structure				■			■		■	■			■	■	■	■	■	■
Bottom-up case																		
Policy deployment		■									■					■	■	
Develop themselves		■			■	■			■		■			■	■	■	■	
Develop employees									■						■			
Integrate in daily work									■					■	■			
Build alignment											■							
Improvement culture									■					■	■			
Organize resources and structure					■			■			■			■	■			

Note. TM = Top management, MM = middle management, and FM = frontline management. The activities listed in the left column are based on Aij and Teunissen (2017) and Netland et al. (2019). The lean implementation stages in the second row correspond with those in Table II.

4.3.6. Structure

The moment the top managers in the top-down case aligned their own work routines with the lean infrastructure that had been built up mainly by the lean consultants and middle managers, much more sustainable lean implementation was achieved throughout the entire hospital. Then, these top managers even started to prioritize and discuss frontline issues that required hospital-level solutions, and co-created lean with managers from various units and layers. In comparison, in year four the top managers of the other (originally bottom-up) hospital initiated a structured, centrally controlled, lean strategy, and then as if no lean efforts had been made before in its system; their initiative did not even acknowledge the bottom-up lean efforts so many front-line employees had made before.

5. DISCUSSION AND CONTRIBUTIONS

This paper depicts how lean was implemented over a period of four years in two university hospitals with opposing initial approaches (top-down vs. bottom-up) and vastly different performance gains. The top-down approach led, eventually after four years, to a wider range of larger performance gains. In year four, the hospital's top managers did no longer just *delegate lean* to lean consultants, middle managers, and the work floor. Instead, they had started to *co-create lean* by integrating the earlier built lean infrastructure with their own daily practices. Only then did they begin to collaborate closely with the middle and frontline managers on cross-departmental and hospital-wide issues. For four years, the top managers in the bottom-up hospital case just *tolerated* the 'organic' lean adoption efforts by lower hierarchical employees, thereby withholding support for and recognition of the obtained operational performance gains. Only four years later, after learning about the then accumulated benefits reached with lean, did they start a hospital-wide lean program without an interest in retaining the lean knowledge accumulation built up at the frontline thus far. These different top-managerial actions (delegating, tolerating, or co-creating), and the close cross-hierarchical collaboration (top, middle, and frontline management) in the top-down case, call for an integration of basic tenets of change management insights into what we know about effective hospital-wide lean implementation, as will be elaborated below.

The high failure rate of hospital-wide lean implementation is often attributed to non-managerial employee resistance due to a lack of lean understanding or willingness at the lowest hierarchical levels (Drotz & Poksinska, 2014). In contrast, others argue that a lack of top managerial support is the most pressing barrier to hospital-wide lean adoption (Balushi et al., 2014; Vaishnavi & Suresh, 2020). Our study adds that it mainly depends on the *type* of support provided by the top managers. Implementing lean hospital-wide can reap large performance results when top and middle managers actively co-create and infuse the lean infrastructure, for instance by carrying out lean activities themselves like gemba

walks; daily and weekly performance monitoring meetings; and structured problem solving (Netland et al., 2019). Co-creation is the process where more than one organizational actor systematically joins forces to interact, learn, and share information to create value (Prahalad & Ramaswamy, 2004; Vargo & Lusch, 2015). Effective lean co-creation cannot be delegated to others but, instead, requires managers at all hierarchical layers to engage people "to create valuable experiences together" (Ramaswamy, 2011, p. 195). In the hospital context, this co-creation process requires top managers to add value by connecting functional silos and overruling their medical professionals who tend to push away (seemingly) complex managerial doctrines like lean (Leite et al., 2019). The two current case studies illustrate how, in the absence of such a strong co-creative top-managerial effort, lean's eventual gains may take much longer to arise. When top managers only delegate or tolerate lean, thereby bypassing any personal lean effort, they disregard a vital change-management mechanism stemming from the *social learning theory* which postulates that people adapt their behavior based on their superiors' role-modeling (Wang et al., 2018). In fact, although the importance of lean role-modeling has, so far, been mainly attributed to frontline managers (Netland et al., 2019), the absence of top managers' role modeling is antithetical to lean's basic tenets as well (Dombrowski & Mielke, 2013). Future studies could thus examine the proposition:

> *To achieve hospital-wide performance gains, its top managers must role-model the co-creation of lean rather than delegating top-down or tolerating bottom-up lean implementation.*

Apart from the crucial active role of top managers, middle managers have also been noted as key change actors of effective lean implementation (Van Dun et al., 2017), an often overlooked lean adoption stakeholder group (Heyden et al., 2017; Narayanamurthy et al., 2018). By taking the lead in the scale-up stage, and initiating organization-wide change, middle managers can really capitalize on improving the synergies across hospital units (Taylor & Helfat, 2009). On installing a cross-departmental lean infrastructure, middle managers can connect important knowledge flows (Mom et al., 2007) between top managers and the work floors (Hutzschenreuter & Kleindienst, 2006); provide ideas that can lead to rethinking the strategic priorities; and shape a continuous improvement orientation by engaging the wider workforce (Reynders et al., 2020). Given the complex, siloed structure of hospitals, this middle-managerial 'broker' role (Burgess & Currie, 2013) is suggested to be essential as well for effective hospital-wide lean implementation. We propose that if both cases' top management had co-created their lean efforts sooner and more actively with the middle managers, larger hospital-wide performance improvements could have been achieved faster. Moreover, in the top-down case, the frontline leaders were not really involved during the early stages of the implementation. In line with the *goal-setting theory* (Locke & Latham, 2019; Locke et al., 1981), once the middle managers had involved the frontline managers in specifying lean goals, much more work floor motivation for lean, and less resistance, ensued

(Balushi et al., 2014; Narayanamurthy et al., 2018). In highly-professionalized contexts such as hospitals, people must perceive the goals as relevant for their patients/clients, before they embrace the change (Oreg et al., 2018). Hence, as mentioned by Beer and Nohria (2000), not only must lean change goals be of economic value to the patients involved, but also hospital leaders at all organizational layers must be part of the developmental process, to craft a culture of continuous improvement. Thus, by building on Netland *et al.*'s (2019) reasoning that both top, middle, and frontline managers must join forces to implement lean effectively, our second proposition is:

> *To implement lean hospital-wide, close cross-hierarchical collaboration must occur between top, middle, and frontline management throughout the lean implementation journey, including during goal setting.*

The lean journeys studied here followed six implementation stages: strategize, prepare, pilot, evaluate, scale up, and structure. These stages largely overlap with other existing models in manufacturing (Mostafa et al., 2013; Rafique, 2019) and healthcare (Daaleman et al., 2018; Dannaphel et al., 2014). During the first lean implementation stages, the top managers in the top-down case focused on developing an operational strategy, developing themselves, and enabling ample financial resources and implementation structure. They only developed an organization-wide infrastructure in the scale-up stage, especially in the structure stage, to align the entire hospital (Vaishnavi & Suresh, 2020) and only then started to co-create a system-wide culture of continuous improvement (Narayanamurthy et al., 2018). Indeed, organization-wide lean adoption often starts top-down, and only after having it piloted at lower levels than the top level, it is then 'rolled out' across the organization (Secchi & Camuffo, 2016). Although one may conclude from our analyses that the most profitable application of lean requires a once-for-all orchestration from the top, a more fruitful approach would be integrative strategy adoption (Kim et al., 2014): the top managers themselves must steer a co-creating leaning process already from the start and certainly not at the end of the implementation process by those working in lower hierarchical units. Our study adds to the knowledge that a centrally planned participatory or co-created lean implementation approach, throughout all the stages, can induce more-effective frontline learning, which, in turn, could help the managers to adjust and improve their lean implementation plans. We therefore propose that:

> *Combining both top-down and bottom-up approaches to implementing lean is likely to result in quicker, larger, and more sustainable hospital-wide performance improvement.*

5.1. Practical contributions

Our practical contributions are fourfold and pertain to the possibility of achieving large

patient and hospital performance gains (Radnor et al., 2012). Since few top managers have hospital-wide lean implementation experience, they may not know how to do it effectively and achieve the desired large performance gains. First, hospital managers should notice that by delegating lean to the lower levels, the top managers of the top-down hospital did not establish any desirable role-modeling effects from the start. Organization-wide lean adoption can then become a long journey. Instead, regarding the second point, top managers must actively join forces with middle managers and frontline managers at the outset of any effective lean implementation process and remain engaged throughout the various lean implementation stages depicted here. Thirdly, this co-creative effort requires, among other things, a carefully designed infrastructure for continuous process improvement that is constantly finetuned and fueled with bottom-up input from frontline hospital workers. Moreover, from a change management perspective it is expected that lean is more likely to succeed when process improvements are grounded in concrete patient-oriented objectives, and when managers show a genuine interest in the medical staff's daily struggles as well. This is a relevant insight when considering the major shift occurring in many hospitals across the world, whereby professionals are increasingly being asked to adopt "managerialism" logic together with "professionalism" logic (Keijser, 2019; Waring & Bishop, 2010). Thus, a fourth implication is that in professional bureaucracies like hospitals, lean implementation must not be delegated to internal and external lean consultants who lack power-based (but not expert-based) authority to motivate physicians and other hospital professionals to give lean a serious try. Instead of merely delegating or tolerating lean initiatives, hospital top managers must role-model the adoption of lean practices including the accompanying co-creative operational improvement-oriented behaviors.

6. STRENGTHS, LIMITATIONS, AND FUTURE RESEARCH

The process research strategy applied is the strength of this study. Process studies focus on the why of how things develop over time, enabling analyses of the interplay between leaders of several hierarchical layers, or lack thereof, thereby illuminating some of the tensions involved in hospital-wide change (Langley et al., 2013). At the same time, our inductive analyses leaned on the interpretations of the diverse data in a research team that elaborately discussed the observations collected in the past to sharpen them. Hence, this study builds on rich longitudinal field data of two contrasting lean implementation approaches in two similar Dutch hospitals, some limitations must be noted. Apart from the differing approaches, other factors should possibly be considered. For example, the cost-cutting objective of the bottom-up case's approach and the top-down case's investment in (expensive) external consultants. Follow-up studies could select and compare more hospitals that vary in terms of their lean objectives (cost-cutting or value-adding) and

available resources (scarcity or abundance) and examine the relative impact of these variables on the adoption of lean in the longer term.

Although this comparative study was conducted in a Dutch context, following Danese *et al.*'s (2018) call for studies of lean adoption outside the USA and UK healthcare systems, cross-cultural differences must be considered. The Netherlands has a low power-distance culture, with a longstanding tradition of cooperation and consensus building (Grit & Dolfsma, 2002). This may possibly explain why the top-down case started to bloom only after all the members of all the involved hierarchical layers truly engaged in the lean implementation process. Hence, outside of the Netherlands, larger and/or faster lean performance effects could result, especially in countries where lower-level employees are more inclined to follow and comply with the orders of top managers. Studying the impact of national cultural differences in adopting lean practices in healthcare organizations, as called for also by Erthal and Marques (2018), may thus be worthwhile.

Beyond the healthcare sector, the findings could be generalizable to other knowledge-intensive and/or professional organizations. Future studies should also examine our resulting propositions in similar large-scale organizational contexts, such as universities and R&D labs. A recent work by Seidel and Saurin (2021) pointed to the potential contextual impacts on how lean leadership might unfold in practice. Such future studies must especially consider the roles of the leading professionals and how they relate to the leading managers. After all, organization-wide lean implementation requires actors throughout the hospital to actively team up, especially during the early stages of lean adoption. Vigilance and co-creativity are needed throughout the entire lean journey as each phase has distinctive challenges for everyone concerned.

7. REFERENCES

Aij, K. H., & Teunissen, M. (2017). Lean leadership attributes: A systematic review of the literature. *Journal of Health Organization and Management*, *31*(7-8), 713-729. https://doi.org/10.1108/JHOM-12-2016-0245

Alnadi, M., & McLaughlin, P. (2021). Critical success factors of Lean Six Sigma from leaders' perspective. *International Journal of Lean Six Sigma*, *12*(5), 1073-1088. https://doi.org/10.1108/ijlss-06-2020-0079

Balushi, S., Sohal, A. S., Singh, P. J., Al Hajri, A., Al-Farsi, Y., & Abri, R. (2014). Readiness factors for lean implementation in healthcare settings: A literature review. *Journal of Health*, *28*(2), 135-153. https://doi.org/10.1108/JHOM-04-2013-0083

Bamford, D., Forrester, P., Dehe, B., & Leese, R. G. (2015). Partial and iterative Lean implementation: Two case studies. *International Journal of Operations & Production Management*, *35*(5), 702-727. https://doi.org/10.1108/ijopm-07-2013-0329

Beer, M., & Nohria, N. (2000). Cracking the code of change. *HBR's 10 must reads on change*, *78*(3), 133-141.

Burgess, N., & Currie, G. (2013). The knowledge brokering role of the hybrid middle level manager: the case of healthcare. *British Journal of Management*, *24*(1), 132-S142. https://doi.org/10.1111/1467-8551.12028

Collar, R. M., Shuman, A. G., Feiner, S., McGonegal, A. K., Heidel, N., Duck, M., McLean, S. A., Billi, J. E., Healy, D. W., & Bradford, C. R. (2012). Lean management in academic surgery. *Journal of the American College of Surgeons*, *214*(6), 928-936. https://doi.org/http://dx.doi.org/10.1016/j.jamcollsurg.2012.03.002

Costa, L. B. M., & Godinho Filho, M. (2016). Lean healthcare: Review, classification and analysis of literature. *Production, Planning & Control*, *27*(10), 823-836. https://doi.org/10.1080/09537287.2016.1143131

Czarniawska, B. (2008). Organizing: how to study it and how to write about it. *Qualitative Research in Organizations and Management: an International Journal*, *3*(1), 4-20. https://doi.org/doi.org/10.1108/17465640810870364

D'Andreamatteo, A., Lanni, L., Lega, F., & Sargiacomo, M. (2015). Lean in healthcare: a comprehensive review. *Health Policy*, *119*(9), 1197-1209. https://doi.org/https://doi.org/10.1016/j.healthpol.2015.02.002

Daaleman, T. P., Brock, D., Gwynne, M., Weir, S., Dickinson, I., Willis, B., & Reid, A. (2018). Implementing lean in academic primary care. *Quality Management in Healthcare*, *27*(3), 111-116. https://doi.org/10.1097/QMH.0000000000000173

Danese, P., Manfè, V., & Romano, P. (2018). A systematic literature review on recent lean research: state-of-the-art and future directions. *International Journal of Management Reviews*, *20*(2), 579-605. https://doi.org/10.1111/ijmr.12156

Dannaphel, P., Poksinska, B., & Thomas, K. (2014). Dissemination strategy for lean thinking in healthcare. *International Journal of Health Care Quality Assurance*, *27*(5), 391-404. https://doi.org/doi:10.1108/IJHCQA-01-2013-0001

David Ollier, W. (2006). Toyota-style management drives Virginia Mason. *Physician Executive*, *32*(1), 12-17.

De Souza, B. L., & Pidd, M. (2011). Exploring the barriers to lean health care implementation. *Public Money & Management*, *31*(1), 59 - 66. https://doi.org/10.1080/09540962.2011.545548

Dobrzykowski, D. D., McFadden, K. L., & Vonderembse, M. A. (2016). Examining pathways to safety and financial performance in hospitals: A study of lean in professional service operations. *Journal of Operations Management*, *42*, 39-51. https://doi.org/10.1016/j.jom.2016.03.001

Dombrowski, U., & Mielke, T. (2013). Lean leadership: Fundamental principles and their application. *Procedia CIRP*, *7*, 569-574. https://doi.org/10.1016/j.procir.2013.06.034

Drotz, E., & Poksinska, B. (2014). Lean in healthcare from employees perspectives. *Journal of Health Organization and Management*, *28*(2), 177-195. https://doi.org/10.1108/JHOM-03-2013-0066

Edelman, E. R., Hamaekers, A. E. W., Buhre, W. F., & van Merode, G. G. (2017). The use of operational excellence principles in a university hospital [Article]. *Frontiers in Medicine*, *4*(7), 1-8, Article 107. https://doi.org/10.3389/fmed.2017.00107

Erthal, A., & Marques, L. (2018). National culture and organisational culture in lean organisations: A systematic review. *Production Planning & Control*, *29*(8), 668-687. https://doi.org/10.1080/09537287.2018.1455233

Fournier, P., & Jobin, M. (2018). Understanding before implementing: the context of Lean in public healthcare organizations. *Public Money & Management*, *38*(1), 37-44. https://doi.org/10.1080/09540962.2018.1389505

Graban, M. (2008). *Lean Hospitals: improving quality, patient safety, and employee satisfaction*. Productivity Press.

Grit, K., & Dolfsma, W. (2002). The dynamics of the Dutch health care system: A discourse analysis. *Review of Social Economy*, *60*(3), 377-401.

Hallam, C. R. A., & Contreras, C. (2018). Lean healthcare: Scale, scope and sustainability. *International Journal of Health Care Quality Assurance*, *31*(7), 684-696. https://doi.org/www.jstor.org/

stable/29770168.

Heyden, M. L. M., Fourné, S. P. L., Koene, B. A. S., Werkman, R., & Ansari, S. (2017). Rethinking 'top-down' and 'bottom-up' roles of top and middle managers in organizational change: implications for employee support. *Journal of Management Studies*, *54*(7), 961-985. https://doi.org/10.1111/joms.12258

Hines, P. (2022). Human centred lean: introducing the people value stream. *International Journal of Lean Six Sigma*, *13*(5), 961-988. https://doi.org/10.1108/IJLSS-03-2021-0061

Hutzschenreuter, T., & Kleindienst, I. (2006). Strategy-process research: What have we learned and what is still to be explored. *Journal of Management*, *32*(5), 673-720. https://doi.org/10.1177/0149206306291485

Kaplan, G. S., & Patterson, S. H. (2008). Seeking perfection in healthcare: A case study in adopting Toyota Production System Methods [Case Study]. *Healthcare Executive*, *23*(3), 16-21.

Kaplan, G. S., Patterson, S. H., Ching, J. M., & Blackmore, C. C. (2014). Why lean doesn't work for everyone. *BMJ Quality & Safety*, *23*(12), 970-973. https://doi.org/10.1136/bmjqs-2014-003248

Keijser, W. (2019). *Opening up medicine: Physicians and leadership in times of transformation* University of Twente, the Netherlands]. Unpublished doctoral dissertation.

Kim, Y. H., Sting, F. J., & Loch, C. H. (2014). Top-down, bottom-up, or both? Toward an integrative perspective on operations strategy formation. *Journal of Operations Management 32*(7-8), 462-474. https://doi.org/10.1016/j.jom.2014.09.005

Langley, A., Smallman, C., Tsoukas, H., & Van De Ven, A. H. (2013). Process studies of change in organization and management: unveiling temporality, activity, and flow. *Academy of Management Journal*, *56*(1), 1-13. https://doi.org/10.5465/amj.2013.4001

Leggat, S. G., Stanton, P., Bamber, G. J., Bartram, T., Gough, R., Ballardie, R., Germann, K., & Sohal, A. (2018). New development: 4P recommendations for implementing change, from research in hospitals. *Public Money & Management*, *38*(1), 45-50. https://doi.org/10.1080/09540962.2017.1389534

Leite, H., Bateman, N., & Radnor, Z. (2019). Beyond the ostensible: an exploration of barriers to lean implementation and sustainability in healthcare. *Production, Planning & Control*, *31*(1), 1-18. https://doi.org/10.1080/09537287.2019.1623426

Lima, R. M., Dinis-Carvalho, J., Souza, T. A., Vieira, E., & Gonçalves, B. (2021). Implementation of lean in health care environments: an update of systematic reviews. *International Journal of Lean Six Sigma*, *12*(2), 399-431. https://doi.org/10.1108/ijlss-07-2019-0074

Locke, E. A., & Latham, G. P. (2019). The development of goal setting theory: A half century retrospective. *Motivation Science*, *5*(2), 93-105. https://doi.org/10.1037/mot0000127

Locke, E. A., Shaw, K. N., Saari, L. M., & Latham, G. P. (1981). Goal setting and task performance: 1969–1980. *Psychological Bulletin*, *90*(1), 125-152. https://doi.org/10.1037/0033-2909.90.1.125

Losonci, D., Demeter, K., & Jenei, I. (2011). Factors influencing employee perceptions in lean transformations. *International Journal of Production Economics*, *131*(1), 30-43. https://doi.org/10.1016/j.ijpe.2010.12.022

Mazur, L., McCreery, J., & Rothenberg, L. (2012). Facilitating lean learning and behaviors in hospitals during the early stages of lean implementation. *Engineering Management Journal*, *24*(1), 11-22. https://doi.org/10.1080/10429247.2012.11431925

McCann, L., Hassard, J. S., Granter, E., & Hyde, P. J. (2015). Casting the lean spell: The promotion, dilution and erosion of lean management in the NHS. *Human Relations*, *68*(10), 1557-1577. https://doi.org/10.1177/0018726714561697

Mom, T. J. M., Van Den Bosch, F. A. J., & Volberda, H. W. (2007). Investigating managers' exploration and exploitation activities: The influence of top-down, bottom-up, and horizontal knowledge inflows. *Journal of Management Studies*, *44*(6), 910-931. https://doi.org/10.1111/j.1467-6486.2007.00697.x

Mostafa, S., Dumrak, J., & Soltan, H. (2013). A framework for lean manufacturing implementation. *Production & Manufacturing Research: An Open Access Journal*, *1*(1), 44-64. https://doi.org/10.1080/21693277.2013.862159

Narayanamurthy, G., Gurumurthy, A., Subramanian, N., & Moser, R. (2018). Assessing the readiness to implement lean in healthcare institutions: A case study. *International Journal of Production Economics*, *197*, 123-142. https://doi.org/10.1016/j.ijpe.2017.12.028

Netland, T. H., & Ferdows, K. (2016). The S-curve effect of lean implementation. *Production and Operations Management*, *25*(6), 1106-1120. https://doi.org/10.1111/poms.12539

Netland, T. H., Powell, D. J., & Hines, P. (2019). Demystifying lean leadership. *International Journal of Lean Six Sigma*, *11*(3), 543-554. https://doi.org/10.1108/ijlss-07-2019-0076

Niemeijer, G. C., Trip, A., de Jong, L. J., Wendt, K. W., & Does, R. J. M. M. (2012). Impact of 5 years of Lean Six Sigma in a university medical center. *Quality Management in Health Care*, *21*(4), 262 - 268. https://doi.org/urn:nbn:nl:ui:29-428868

Oreg, S., Bartunek, J. M., Lee, G., & Do, B. (2018). An affect-based model of recipients' responses to organizational change events. *Academy of Management Review*, *43*(1), 65-86.

Prahalad, C. K., & Ramaswamy, V. (2004). Co-creation experiences: The next practice in value creation. *Journal of Interactive Marketing*, *18*(3), 5-14. https://doi.org/10.1002/dir.20015

Radnor, Z. J., Holweg, M., & Waring, J. (2012). Lean in healthcare: the unfilled promise? *Social Science & Medicine*, *74*(3), 364-371. https://doi.org/10.1016/j.socscimed.2011.02.011

Rafique, M. Z. (2019). A systematic review of lean implementation approaches: A proposed technology combined lean implementation framework. *Total Quality Management and Business Excellence*, *30*(3-4), 386-421.

Ramaswamy, V. (2011). It's about human experiences... and beyond, to co-creation. *Industrial Marketing Management*, *40*(2), 195-196. https://doi.org/10.1016/j.indmarman.2010.06.030

Reynders, P., Kumar, M., & Found, P. (2020). 'Lean on me': An integrative literature review on the middle management role in lean. *Total Quality Management & Business Excellence*, 1-37. https://doi.org/10.1080/14783363.2020.1842729

Scherrer-Rathje, M., Boyle, T., & Deflorin, P. (2009). Lean, take two! Reflections from the second attempt at lean implementation. *Business Horizons*, *52*(1), 79-88. https://doi.org/10.1016/j.bushor.2008.08.004

Schoonhoven, M., Lubbers, C., & Does, R. J. M. M. (2013). Quality quandaries: Shortening the throughput time of a hospital's billing process. *Quality Engineering*, *25*(2), 188-193. https://doi.org/10.1080/08982112.2012.758287

Secchi, R., & Camuffo, A. (2016). Rolling out lean production systems: a knowledge-based perspective. *International Journal of Operations & Production Management*, *36*(1), 61-85. https://doi.org/10.1108/ijopm-04-2014-0194

Seidel, A., & Saurin, T. A. (2021). A framework for analyzing how context influences lean leadership. *International Journal of Lean Six Sigma*, *12*(2), 149-174. https://doi.org/10.1108/ijlss-04-2019-0041

Souza, T. A., Roehe Vaccaro, G. L., & Lima, R. M. (2020). Operating room effectiveness: A lean health-care performance indicator. *International Journal of Lean Six Sigma*, *11*(5), 987-1002. https://doi.org/10.1108/ijlss-12-2017-0141

Stouten, J., Rousseau, D. M., & De Cremer, D. (2018). Successful organizational change: integrating the management practice and scholarly literatures. *Academy of Management Annals*, *12*(2), 752-788. https://doi.org/10.5465/annals.2016.0095

Taylor, A., & Helfat, C. E. (2009). Organizational linkages for surviving technological change: Complementary assets, middle management, and ambidexterity. *Organization Science*, *20*(4), 718-739. https://doi.org/10.1287/orsc.1090.0429

Tortorella, G., Van Dun, D. H., & De Almeida, A. G. (2020). Leadership behaviors during lean healthcare implementation: a review and longitudinal study. *Journal of Manufacturing Technology Management*, *31*(1), 193-215. https://doi.org/10.1108/JMTM-02-2019-0070

Vaishnavi, V., & Suresh, M. (2020). Modelling of readiness factors for the implementation of lean six sigma in healthcare organizations. *International Journal of Lean Six Sigma*, *11*(4), 597-633. https://doi.org/10.1108/ijlss-12-2017-0146

Van den Heuvel, J., Does, R., & Vermaat, T. (2004). Six Sigma in a Dutch hospital: does it work in the nursing department? *Quality and Reliability Engineering International*, *20*(5), 419. https://doi.org/10.1002/qre.656)

Van Dun, D. H., Hicks, J. N., & Wilderom, C. P. M. (2017). Values and behaviors of effective lean managers: Mixed-methods exploratory research. *European Management Journal*, *35*(2), 174-186. https://doi.org/10.1016/j.emj.2016.05.001

Van Elp, B., Roemeling, O., & Aij, K. H. (2021). Lean leadership: towards continuous improvement capability in healthcare. *Health Services Management Research*, *0*(0), 1-9. https://doi.org/10.1177/09514848211001688

Vargo, S. L., & Lusch, R. F. (2015). Institutions and axioms: an extension and update of service-dominant logic. *Journal of the Academy of Marketing Science*, *44*(1), 5-23. https://doi.org/10.1007/s11747-015-0456-3

Vegting, I. L., Van Beneden, M., Kramer, M. H., Thijs, A., Kostense, P. J., & Nanayakkara, P. W. (2012). How to save costs by reducing unnecessary testing: Lean thinking in clinical practice. *European Journal of Internal Medicine*, *23*(1), 70-75. https://doi.org/10.1016/j.ejim.2011.07.003

Voss, C., Tsikriktsis, N., & Frohlich, M. (2002). Case research in operations management. *International Journal of Operations & Production Management*, *22*(2), 195-219. https://doi.org/10.1108/01443570210414329

Wang, Z., Xu, H., & Liu, Y. (2018). Servant leadership as a driver of employee service performance: Test of a trickle-down model and its boundary conditions. *Human Relations*, *71*(9), 1179-1203. https://doi.org/10.1177/0018726717738320

Waring, J. J., & Bishop, S. (2010). Lean healthcare: rhetoric, ritual and resistance. *Social Science & Medicine*, *71*(7), 1332-1340. https://doi.org/10.1016/j.socscimed.2010.06.028

Womack, J. P., Byrne, A. P., Fiume, O. J., Kaplan, G. S., & Toussaint, J. (2005). *Going lean in health care*. Institute for Healthcare Improvement.

Yin, R. K. (2015). *Qualitative research from start to finish*. Guilford Publications.

Qualitative data coding structure

	CODES LH IMPLEMENTATION
1	IMPLEMENT_CONSULTANT
2	IMPLEMENTATION _TOP_DOWN
3	IMPLEMENTATION _BOTTOM_UP
4	IMPLEMENTATION_VISION_OBJECTIVES
5	IMPLEMENTATION_DEVELOP LEAN HOUSE
6	IMPLEMENTATION_PREPARATION
7	IMPLEMENTATION_DEVELOP_KNOWLEDGE
8	IMPLEMENTATION_DISSEMINATION STRATEGY
9	IMPLEMENTATION_MONITOR_PROGRESS
10	IMPLEMENTATION_ENGAGE LEADERS
11	IMPLEMENTATION_IMPLEMENTION_STEPS
12	IMPLEMENTATION_ENABLING_PRACTICES

	CODES_LEAN_PRACTICES
1	LEAN_VALUE
2	LEAN PRINC_VALUE STREAM
3	LEAN PRINC_PROCESS FLOW
4	LEAN PRINC_PULL
5	LEAN PRINC_JIT
6	LEAN PRINC_FIRST TIME RIGHT
7	LEAN PRINC_LEVEL OUT WORKLOAD
8	LEAN PRINC_VISUAL MANAGEMENT
9	LEAN PRINC_GEMBA
10	LEAN PRINC_STANDARDISATION
11	LEAN PRINC_WASTE
12	LEAN PRINC_KAIZEN
13	LEAN PRINC_HOSHIN

	CODES BARRIERS
1	BARRIER_FUNCTIONAL_SILO
2	BARRIER_HIERARCHY
3	BARRIER_STRUCTURE
4	BARRIERS_COOPERATION
5	BARRIERS_PATIENT
6	BARRIERS_AUTONOMY

	CODE_STRUCTURE
1	DEPARTMENT NURSING
2	DEPARTMENT_PHYSICIAN
3	TEAM_LEADER
4	STAFF
5	DIVISION
6	EXECUTIVE

	CODES PEOPLE
1	LEADER_COMMUNICATE
2	LEADER_DEVELOPMENT
3	LEADER_PARTICIPATION
4	LEADER_ROLEMODEL
	LEAN PRINC_CHALLENGE
5	PEOPLE
6	LEAN PRINC_GROW LEADERS
7	PEOPLE_COACHING
8	PEOPLE_COOPERATION
9	PEOPLE_AUTONOMY
10	PEOPLE_EMPOWERMENT
11	PEOPLE_TEAM

	CODES_OUTCOMES
1	PATIENT
2	FINANCIAL
3	QUALITY/SAFETY
4	EFFICIENCY
5	EMPLOYEE

Dynamic Capability Development through Organizational Routines: A Longitudinal Process Study of Lean Implementation in Two Hospitals

Currently, this version of the chapter is under review at the *International Journal of Operations & Production Management*.

A previous version of this chapter has been presented at the *EurOMA Publishing Workshop*: Van Beers, J. C. A. M., Van Dun, D. H., & Wilderom, C. P. M. (2020). Dynamic capabilities development through Lean strategy implementation: a process study comparing two Dutch hospitals. *EurOMA Publishing Workshop*, 11-12 November 2020, Warwick.

ABSTRACT

Purpose

Despite the importance of dynamic capabilities for organizational success, our knowledge of how those dynamic capabilities emerge from routines is still relatively limited. This paper advances the dynamic capabilities theory by exploring how Lean practices gradually develop into organizational routines, leading to the development of capabilities that together form a continuous improvement dynamic capability.

Design/methodology/approach

We conducted a four-year process study of two similar Dutch university hospitals that started adopting Lean Management; we examined sequences of episodes through a retrospective longitudinal comparative case study approach. We used the collected archival performance data; transcripts of 48 interviews; 13 frontline meeting observations; and documents to conduct an inductive cross-case analysis.

Findings

We identified how a dynamic capability emerged through a staged process, with engagement of top, middle, and frontline leaders. This process gradually established four interconnected capabilities which shaped the hospital-wide continuous improvement dynamic capability: (1) a coherent improvement system, (2) hospital-wide collaborative synergy, (3) integrated accountability linking strategy with daily operations, and (4) a culture of learning-to-learn among employees and teams.

Originality

This paper offers a conceptual framework addressing the challenge of developing strategic dynamic capabilities through changing organizational routines by adopting Lean. It enriches the dynamic capability theory by explaining how routines fuse into capabilities, fostered by leadership across organizational levels, which then form a dynamic capability. The findings offer valuable insights for managers in large, knowledge-intensive organizations seeking to simultaneously enhance efficiency and client satisfaction.

Keywords

Lean healthcare, continuous improvement, dynamic capabilities theory, organizational routines, longitudinal process study.

1. INTRODUCTION

Hospitals across the globe are navigating major challenges as they strive to deliver efficient and high-quality care in an environment of escalating costs, resource scarcity, and increasing patient demands. In response, many hospitals have turned to adopting Lean practices, commonly used in a wide variety of industries, to continuously improve their operations and enhance patient outcomes (D'Andreamatteo et al., 2015). Despite the promise of Lean hospitals, its implementation can be challenging due to the complex, dynamic nature of hospital environments (Fillingham, 2007; Fournier et al., 2023; Waring & Bishop, 2010).

In this paper, we view Lean as a complex hospital-wide system aimed at improving the quality of care by understanding what is valuable for the patient and involving the staff in a process of Continuous Improvement (CI) (Leite et al., 2022; Secchi & Camuffo, 2016). Implementing Lean as a system goes beyond merely implementing a set of Lean practices (Azadegan et al., 2013; Furlan et al., 2011). The Lean system approach is conceived as a process through which organizations seek, create, and store Lean knowledge to foster continuous learning (Secchi & Camuffo, 2016) with the aim of developing a dynamic capability (DC) (Anand et al., 2009) that enables widespread and continuous problem finding, addressing, and solving to better serve its customers (Shah & Ward, 2007). More generally, DCs denote an organization's strategic ability to renew its resources in its changing environment to gain and maintain competitive advantage (Helfat & Peteraf, 2015). Transitioning from early Lean initiatives to having an organization-wide CI DC is a challenge that is not yet well understood (Anand et al., 2009; Schilke et al., 2018; Secchi et al., 2019). New DCs are known to depend on a unique but dense interweaving of single organizational practices, routines, and capabilities (Anand et al., 2009; Csiki et al., 2023; Gutierrez et al., 2022). The present study aims to better understand how, in the context of Lean adoption in a hospital setting, the development of new organization-wide routines evolve into operational capabilities and essentially into a hospital-wide CI DC (Witcher et al., 2008). We conducted a four-year process study in two large Dutch hospitals to answer the question: *How do organizational routines at multiple organizational levels interact in developing continuous improvement as a dynamic capability in the context of Lean implementation in large hospitals?*

We employed an embedded comparative case study design (Caniato et al., 2018) with a retrospective longitudinal process approach (Langley et al., 2013). Data was collected through interviews, document study, and on-site participant observations of daily stand-up meetings (Czarniawska, 2008), as well as archival performance data. Our study contributes to DC theory and knowledge on Lean Hospital adoption in three ways. First, we advance the understanding how routines evolve in an organization-wide DC, through developing specific capabilities. Second, we identified four critical, interconnected capabilities, namely: Improvement system, collaborative synergy, integrated accountability, and learning-to-

learn, all of which contribute to building a CI DC. Thus, we explore how these capabilities, build on organizational routines, emerge, and are bundled and sequenced over time to form a CI DC. Third, we illustrate how the initially isolated implementation of Lean practices in hospitals can eventually develop into an organization-wide DC (Gutierrez et al., 2022). The findings guide hospitals, and other large knowledge-intensive organizations, in their journey toward operational excellence.

2. THEORETICAL BACKGROUND

2.1. Lean in hospitals

Hospitals are highly complex dynamic organizational environments with a large variety of stakeholders, fast-paced changes, a scarcity of resources, a growing demand, and increasing use of technology (Fournier et al., 2023; Powell et al., 2024). The implementation of a Lean system necessitates a fundamental change in the existing way of working, altering how objectives are set, tasks are coordinated, decisions are made, and employees are motivated (De Mast et al., 2021). Implementing Lean as a system goes beyond merely implementing a set of Lean practices (Azadegan et al., 2013; Furlan et al., 2011). The Lean system approach is conceived as a process through which organizations create and store Lean knowledge to foster continuous learning with the aim of developing DCs (Secchi & Camuffo, 2016). Such transformation demands a thorough re-evaluation of entrenched organizational routines and requires an organization-wide approach (Giordani da Silveira et al., 2017). Regrettably, most hospitals gravitate towards small-scale Lean projects rather than adopting an organization-wide approach (Danese et al., 2018; Van Zyl et al., In press). Typically, this piecemeal approach results in a neglect of hospital-wide CI, which is vital to adopt the desired outcome (Burgess & Radnor, 2012). Certain organizational characteristics, related to the hospital's organizational complexity, can then (further) frustrate the Lean implementation process. An example is a disconnected hierarchy, with an overly functional orientation and too much professional autonomy (De Souza & Pidd, 2011). In such organizational settings it is much harder to develop the required DCs which are assumed to be grounded in certain joint routines.

2.2 From routines to a (dynamic) capability

Routines are repetitive, recognizable patterns of interdependent action, carried out by multiple intraorganizational actors (Becker, 2004; Feldman et al., 2016; Zollo & Winter, 2002). Routines both entail an ostensive and a performative aspect (Biesenthal et al., 2019; Feldman & Pentland, 2003). The ostensive part contains the codified rules involved in a standard operating procedure, also referred as 'patterning' (Feldman et al., 2016). The performative aspect refers to how routines are used in practice through specific actions, by specific people, at specific places and times, conceptualized as 'enacting'

(Feldman & Pentland, 2003; Ketokivi & Schroeder, 2004). Initially, organizations identify and standardize individual routines to ensure consistency in operational tasks (Nelson & Winter, 1982). These routines are then coordinated and integrated across functional areas, creating interdependencies that facilitate smoother workflows (Teece et al., 1997). Through continuous execution, routines are internalized by teams and refined based on feedback and experience (Zollo & Winter, 2002). Next, complementarities between routines are recognized and interactions among routines are optimized to realize synergies, which is called the bundling of interrelated routines into capabilities (Peng et al., 2008). Capabilities can be broadly categorized into those that reflect the ability to perform basic functional, operational capabilities, and those that guide the improvement and renewal of the existing activities being DCs (Peng et al., 2008). A collection of interrelated routines with strategic importance can be bundled into a DC if the created capability constitutes adapting renewing and reconfiguring processes in response to the changing environment (Peng et al., 2008; Winter, 2003; Zollo & Winter, 2002).

A DC is defined as "the capacity of an organization to purposefully create, extend, or modify its resource base" (Helfat et al., 2007, p. p.4). To gain competitive advantage, an organization must have the ability to renew its resources in the changing environment. This capacity comes about through consistent managerial choices, which makes them difficult to imitate by competitors (Pisano, 2017). They consist of stable patterns of routines, performed by the actors at various organizational levels, through which high organizational performance can occur (Peng et al., 2008; Schilke et al., 2018; Zollo & Winter, 2002). Teece (2007) categorizes DCs into three clusters of activities: sensing, seizing, and transforming. Sensing involves the identification and assessment of opportunities, challenges, and trends that may impact the organizational performance. This requires organizations to recognize external signals and issues in the environment. Seizing entails capitalizing on these opportunities by strategically allocating resources and prioritizing initiatives to capture value. Finally, transforming involves the continuous adaptation and reconfiguration of the organization's resources and processes to sustain a competitive advantage. These clusters of activities build on the previously discussed bundling of routines into capabilities (Teece et al., 2016). As routines evolve and are integrated, they support the sensing, seizing, and transforming activities, thereby enhancing the organization's ability to dynamically respond to environmental changes and maintain strategic agility (Teece, 2007).

The sizable literature on DCs covers its conceptual dimensions, the antecedents, mechanisms, and consequences (Schilke et al., 2018). While these advances mainly focus on the macro level, the exploration on the micro level, namely how DCs emerge, develop, and are to be maintained or changed is relatively limited (Chen et al., 2023; Csiki et al., 2023; Felin et al., 2012; Felin et al., 2015). Therefore, it is necessary to deepen the understanding of how individual behaviors and practices may develop and are sequenced

into an organizational DC including their aggregation mechanisms (Chen et al., 2023; Salvato & Rerup, 2011). Most DC studies are focused on top management, leaving a void in understanding how DCs amalgamate across different hierarchical levels (Felin et al., 2012; Helfat & Martin, 2015; Schilke et al., 2018). Also, the role of middle management and/or other employees who typically co-create in developing DCs is still under-researched (Pitelis & Wagner, 2019). Yet, the uniqueness of DCs depends on the dense interweaving of individuals, organization, and environment (Nayak et al., 2020). Contemporary research has only recently started to analyze *how* routines develop into DCs over time (Csiki et al., 2023; Furnival et al., 2019; Nayak et al., 2020; Parmigiani & Howard-Grenville, 2011). For instance, researchers have recently begun to focus on clusters of multiple routines (Keller et al., 2022; Sailer et al., 2023), and using an organization-wide examination of DCs (Sunder M & Ganesh, 2020). Therefore, one of the pertinent academic challenges lies in deciphering the complexities of aggregation mechanisms, i.e. how do individuals, teams, and larger organizational structures jointly develop a DC (Chen et al., 2023; Winter, 2013).

2.3. Continuous improvement as a dynamic capability

CI drives the evolution of an organization's Lean system through stepwise adjustments and modifications of products and processes, positively influencing waste reduction, customer satisfaction, and overall performance (Galeazzo et al., 2017, 2021). CI is recognized as a DC, using a set of Lean practices such as Plan–Do–Check–Act (PDCA) and Kaizen (Gutierrez-Gutierrez & Antony, 2020). Through the lens of DCs, the CI DC has been described as a bundle of routines for operational excellence, enabling adaptive changes in the organizational resource base (Ambrosini et al., 2009; Kohlbacher, 2013). However, the literature offers limited understanding about how CI is shaped into a DC at various organizational levels and how organizational routines contribute to this process (Biesenthal et al., 2019; Harris et al., 2009; Salvato & Rerup, 2011; Schilke et al., 2018; Wenzel et al., 2020). Anand et al. (2009) provide an approach to developing CI as a DC by delineating an infrastructural framework that enables organizational routines to systematically evolve into a CI DC, ensuring organizational learning. Yet, to date, it remains unclear which particular CI routines are developed; how they are sequenced; how individuals interact; and how a collective CI DC can be created.

Knol et al. (2019) do provide a comprehensive view about how CI routines evolve in small and medium-sized enterprises throughout various stages of a Lean journey using the eight CI routines identified by Bessant et al. (2001). Developing a new routine starts with managers who are dissatisfied with extant routines (Knol et al., 2022). In the case of building CI, managers may initiate CI routines, through specific Lean practices, encouraging team leaders and employees to engage in these practices (Knol et al., 2022). In the early stage of Lean implementation, essential routines include *understanding CI* (1), being able to articulate the basic value of CI and starting with incremental improvements (Bessant et al.,

2001; Knol et al., 2019). By getting into the *improvement habit* (2) employees become more engaged in CI and start using Lean practices related to CI such as Kaizen Events (Franken et al., 2021); A3 projects; Gemba walks; and Value Stream Mapping (Kristensen et al., 2022). As organizations progress in their Lean journey, routines such as *aligning improvement* (3) and *focusing improvement* (4) become critical. These routines involve adapting the improvement system to fit the organizational structure and using strategic goals to prioritize improvements. Furthermore, through the *shared problem-solving* routine (5) organizational members start developing an improvement mindset and collaboration across different hierarchical levels and departments.

The advanced Lean implementation stage, in which Lean is applied organization-wide, requires additional routines like *leading the way* (6) and *improvement of improvement* (7). Leaders' role modeling and support for employee-led improvements enhance performance (De Jager et al., 2004) and becomes crucial as employees embrace a problem-solving mindset at all levels. The *improvement of improvement* routine focuses on continuously enhancing the improvement system, fostering a culture of continuous improvement. Finally, the *learning organisation* routine (8) refers to using a formal knowledge management system through which employees at all levels articulate, consolidate, and share their learning. Interestingly, this last routine is found to be less critical in small to medium sized companies compared to large organizations (Knol et al., 2019; Matthews et al., 2017).

Thus, although we do have a basic understanding of how CI routines evolve in smaller businesses (Knol et al., 2019) and that CI routines interact with Lean practices (Knol et al., 2022), it is not yet well understood how CI routines develop into a DC (through adaptation and learning). Recognizing this gap, this paper presents a longitudinal study of two hospitals, examining their Lean journey in retrospect.

3. METHODOLOGY

3.1. Research design

Through process-research methods we investigated, inductively, the evolution of Lean implementation in two hospitals (Langley, 1999; Langley, 2013). By observing and analyzing how change episodes occurred (Schilke & Cook, 2013), we identified how organizational routines were developed in two comparable Dutch university hospitals, over a period of four years, and shaped into a CI DC though managerial and employee interaction at several hierarchical levels. We employed an embedded comparative case research design (Caniato et al., 2018) alongside retrospective longitudinal mixed methods. The focus was on the Lean implementation process within each of the two hospitals, whereby we identified and analyzed temporal brackets (i.e., episodes). Allowing for detailed examination of specific

periods or events, each temporal bracket represents a sub-case (Langley et al., 2013). This approach enabled us to compare and contrast the evolution of the Lean journey over different episodes within the hospitals.

3.2. Case selection and description

Using purposive snowball sampling (Yin, 2015), we selected two hospitals based on the following criteria: (1) being in the process of adopting an organization-wide Lean program having reached the 'transition' stage or beyond (Netland & Ferdows, 2016), (2) differentiation in the Lean implementation approaches: one hospital initiated Lean top-down (case 1) and the other hospital followed a bottom-up approach (case 2), as we want to understand if the chosen Lean adoption approach affected how organizational routines develop into a DC. Table 1 outlines the key case characteristics of both hospitals, revealing their factual similarities at the start of the study. Each hospital had commenced Lean implementation three years prior; by the end of this study's data-collection period, each hospital had completed a four-year implementation process.

Table 1.
Case and data-collection characteristics

Case Characteristics	Case 1	Case 2
No. of employees (in FTEs)	6.800	5.285
No. of departments	57	55
Annual patient admissions	27.000	22.000
Data-collection Characteristics		
No. of employees interviewed	27	21
Executives	4	2
Staff[a]	4	3
Department heads	4	4
Medical department heads	3	2
Team leaders	5	5
Employees	5	4
Lean consultants/experts	2	2
No. of pages of the interview transcriptions	298	364
No. of (archival) documents	58 (1.842 pages)	47 (1.505 pages)
No. of on-site field visits	6	7

[a] Staff included finance, human resources, strategy, quality, and supply chain personnel.

3.3. Data collection

Data of both hospital cases were collected retrospectively, over a four-year period as visualized in Figure 1. At T4 we collected as many hospital-based Lean *documents* as we could get. For case one, we analyzed 58 documents, and for case two 47 documents. These

documents included, among others, Lean training materials, Lean practices, presentations, monitoring and implementation progress data, as well as descriptions of organizational structures and planning and control processes. Publicly available annual reports of both hospitals were also downloaded: to analyze organizational-level and strategic Lean related changes and the reported impact over the prior four years.

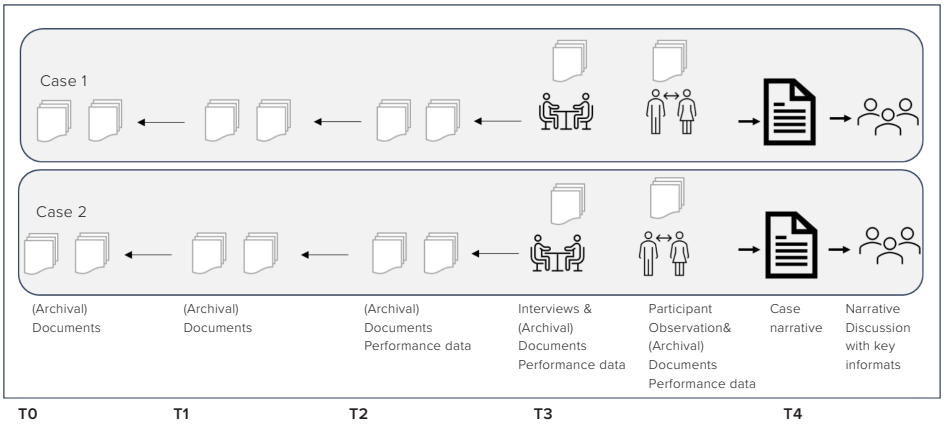


Figure 1.
Data collection across the four years

Access to interviewees was facilitated by a middle manager in each hospital whom we had instructed to avoid any selection bias; both middle managers provided us with a full list of the names and roles of all hospital employees involved in Lean, whereby we made a selection. All the invited participants agreed to be interviewed. The interviews aimed to obtain a comprehensive understanding of various actors' opinions on Lean implementation episodes, factual data, and behaviors (Yin, 2015). The interview questions covered topics such as the Lean implementation approach, Lean practices, organizational changes, collaborations, problem solving, barriers, and results. To prevent confirmation bias, open-ended questions were posed, for example: "how did you become engaged in CI?" and "could you please tell me how problem-solving activities are ingrained in your daily works?" Interviewees provided honest responses, as indicated by their critical remarks about the Lean implementation. For example, finance staff in case 1 questioned the financial returns of their Lean journey, while medical leaders in case 2 criticized their hospital's lack of a holistic approach. Interviewees also provided documents for triangulation purposes as well as to reduce response bias. All interviews were audiotaped and transcribed (298 and 364 pages, respectively); the accuracy of each transcription was verified with each interviewee.

After the interviews, thirteen stand-up meetings were attended. These on-site *participant observations* (Czarniawska, 2008) focused on leader-employee interactions. The meetings entailed five frontline stand-ups at each hospital and three cross-departmental stand-up meetings in case 1. Each meeting was chaired by a team leader we had previously interviewed. Field notes were taken to document practices and methods related to objectives, daily management, and actual process improvements, and especially to capture leader and staff engagement in problem-solving and addressing the Lean-implementation issues.

Finally, we collected *archival key performance indicators* (KPI) data from each case over the entire four-year period. These KPIs related to productivity, patient quality, efficiency, employee satisfaction, and cost reductions. Interviewees provided internal documents used for KPI reporting and monitoring. In both cases, KPIs at the frontline and cross-departmental levels were reported daily, weekly, or monthly, depending on the KPI; consolidated KPI data at the strategic level was only available for case 1 given that case 2 did not monitor a strategic, hospital-wide KPI.

3.4. Data analysis

The data analysis comprised four steps. First, comprehensive single-case narratives were developed by chronologically ordering the data in each case (Eisenhardt, 1989; Langley, 1999; Langley et al., 2013). To validate our two resulting narratives and ensure objectivity, each narrative was discussed during a one-hour session with three of the key informants (Yin, 2015) being the Lean consultant, a division director, and middle manager in each hospital. These sessions resulted in minor corrections. We also compared the interview data with the archival documents and observation notes to identify consistencies and discrepancies. This allowed triangulation of the findings.

Second, we organized each narrative into temporal episodes (Langley, 1999), breaking down the long implementation process into specific time periods. Each episode showed a different part of the Lean implementation journey, which made it easier to understand the changes over time. Furthermore, we categorized four Lean stages: preparation, initiation/pilot, mature/scale up, and structured hospital-wide Lean (Van Beers et al., 2022).

Third, each episode was analyzed to explore how organizational routines evolved at the various stages, whereby we identified the involvement of different actors. For each episode we coded which improvement routines were developed based on the eight Lean improvement routines, e.g. *understanding CI*, *leading the way*, etc. (Bessant et al., 2001; Knol et al., 2019), described in section 2. Additionally, we coded at which organizational level the routine occurred: frontline, middle, and/or top management.

Fourth, through inductive logic (Caniato et al., 2018), cross-case analyses aimed to show how routines, bundled in capabilities, evolved into a CI DC in the two hospitals. This analysis involved tracing the evolution of CI routines and capabilities, while explicitly connecting them to the DC sub dimensions, sensing, seizing, and transforming (Teece, 2007). The process of sensing was linked to how actors within each hospital identified and recognized emerging opportunities and challenges. Seizing was connected to how these opportunities were converted into actionable strategies, while transforming described how the hospitals then adapted their processes and structures to sustain CI as a DC over time. By mapping these DC processes on each capability, we could identify how a CI DC was shaped. This mapping also demonstrated how routines and capabilities were bundled and evolved across hierarchical layers within the hospitals.

4. RESULTS

Both Lean cases achieved significant performance improvements, as indicated in Table 2. Cross-departmental improvements concerned reduced patient throughput time, increased productivity, and surgical volumes. Furthermore, medication error rates and door movement during surgery dropped dramatically. Only in case 1, hospital-wide reduction of patients' pain after surgery was realized. Contrasting both cases, we found that emerging CI routines gel into building four distinct organizing capabilities, namely: improvement system, collaborative synergy, integrated accountability, and learning-to-learn. Together these interconnected capabilities formed a CI DC that contributed to the hospital-wide operational performance improvement, as will be further elaborated below.

Table 2.
Performance improvements realized in case 1 and 2, at T2, T3, and T4

Scope	Case 1		Case 2	
Between departments	Patient throughput time (from patient admission to discharge)	-23%	Costs across nursing wards	-10%
	Productivity across nursing wards	+16%	Bed occupancy rate across nursing wards	+13%
	Surgical volume (nr. of surgeries)	+28%	Patient satisfaction (outpatient department)	+40%
	Saved hours related to unnecessary patient movement before surgery	3,200	Waiting time per patient to start surgery	-30%
	Door movement during surgery (to reduce hospital acquired infections)	-78%	Employee satisfaction nursing	+13%
	Medication error rate	-99%	Errors in providing sterilization equipment to operating wards	-12%
Hospital- wide	Patients that perceived pain after surgery	-72%		

4.1. Improvement System Capability

Triggered by either top management in case 1 and middle management in case 2, both cases adopted Lean practices such as Value Stream Mapping, Kaizen, PDCA, and Gemba walks, which then developed into CI routines and together bundled into an improvement system capability. Through installing these Lean practices, the *understanding CI* and the *CI habit* emerged, which enabled frontline employees to identify opportunities for operational improvement (Sensing) as emphasized by a nursing lead of case 2: "*The utilization of the improvement board along with weekly Kaizen Events, makes it possible to highlight all problems.*" Lean practices such as KPIs, PDCA cycles, and Kaizen Events supported the development of a *focused CI* routine. Building a system with all frontline members to identify and prioritize improvement opportunities that were connected to operational goals, resulted in a process where frontline teams could make focused time-investment decisions and assign resources (Seizing). As explained by a middle manager in case 1: *"We have established goalsetting involving various managerial layers* [frontline and middle management]. *We define the goals together and team leaders are challenged to realize breakthroughs."* A middle manager in case 2 explained *"We created an improvement board with four categories: patient, safety, employee, and finance. We asked team leaders to identify improvements projects under each category."*

Then, frontline leaders shifted from direct to more supporting problem solving in collaboration with their teams, developing the *leading the way* routine. A physician in case 1 explained: *"This format prevents employees from throwing problems at team leaders. Instead, the problems are discussed directly on the work floor during standups, and they are sometimes solved on the same day."* This routine fundamentally changed how issues and opportunities were discovered and solved in the hospital (Transforming). Along the way, teams experimenting with the problem-solving routines ingrained a *CI habit* routine, which resulted in smoother work flows and faster collaborative problem solving. As stated by a senior nurse in case 1: *"I notice that nurses take more initiative to address and solve problems and feel more accountable. They now really have a platform* [stand-ups, Kaizen] *to solve and address these problems."* Or as a nurse in case 2 explained: *"Issues are now solved, and we get feedback from physicians."* The interaction between frontline leaders and employees supported by Lean practices enabled the bundling of four CI routines (*understanding CI, CI habit, focus CI and leading the way*) which together developed into an improvement system capability, embracing stepwise adjustments to frontline operational processes (Transforming).

Overall, the emergence of the improvement system capability in both cases was driven by the integration of Lean practices into daily routines at the frontline level. The key difference between both hospitals lays in the scale and coordination of these efforts. Case 2 experienced in those four years mainly localized improvements, while case 1 achieved broader, organization-wide integration.

4.2. Collaborative Synergy Capability

Along with employees rallying for CI in daily operations, their behavior became noticeably more collaborative, especially from T3 onward. Hence, we noted the development of collaborative synergy among the frontline employees which capability was crucial for achieving comprehensive performance improvements across the entire hospital. In case 1, collaborative synergy was developed through engaging in cross-functional CI initiatives, which were supported by shared Gemba walks, Kaizen Events, and A3 projects. In case 2, collaborative synergy was achieved within single departments, where nursing teams and physicians engaged in multidisciplinary Kaizen Events. These events led to improved communication and problem-solving within departments, but cross-departmental collaboration remained limited. A department head explained: *"What I do see in the departments that work intensively with the improvement boards, is that decision-making is more a collaborative approach, where ideas are shared, and solutions are discussed with all departmental participants."* The lack of a hospital-wide improvement system hindered the development of collaborative synergy on a larger scale.

In case 1, however, collaborative synergy evolved through the bundling of two CI routines: *align CI* and *shared problem solving,* combined with scaling the improvement system capability across departments and organizational layers. The *align CI* routine across departments and hierarchies in case 1 emerged as a pivotal hospital-wide routine during T2 and T3. Shared Gemba walks of both frontline and middle management facilitated direct observation of issues and opportunities and increased engagement and joint understanding between frontline and middle managers (Sensing). A middle manager noted: *"Before initiating the Gemba walks, we lacked a comprehensive understanding of our processes and the obstacles we faced."* Using these new insights allowed middle managers to better prioritize cross-departmental problems and identify opportunities (Sensing). These insights also accelerated the adoption of standard CI templates and infrastructure, as part of the earlier mentioned improvement system capability. Scaling this improvement system effectively across multiple departments and middle management layers helped to align CI and embed a system of cross-functional and cross-hierarchical improvement (Seizing). This scalable improvement system in case 1 helped to align a consistent framework for CI practices like Gemba walks, PDCA cycles, and A3 projects. The system was designed to be easily adaptable, applicable, and scalable at different organizational levels and allowed departments to tailor the standard templates to their specific needs and contexts (Seizing). This way, a cross-functional and hierarchical coordination system emerged that enabled CI across the organization (Transforming). One team leader explained: "*The multidisciplinary events* [Kaizen Events, A3 projects, Gemba walks] *are very effective. In relatively short cycles, problems are discussed between nurses and physicians. Cooperation between nurses and physicians has greatly improved, and we* [nurses] *are more motivated to participate in improvements."*

Only when the cross-functional improvement system was fully established, a *shared problem-solving* routine could be established between multiple departments and frontline and middle management. *Shared problem-solving* triggered cross-departmental challenges and improvement opportunities (Sensing). As employees and leaders from different departments shared insights and best practices, more trends and patterns for improvement were identified and materialized (Transforming). As indicated by a middle manager: *"The collaboration between the departments has developed tremendously and we manage several departments within a set of standard KPIs."*

As a result of these successes in case 1, at T3, top management decided to adopt the CI infrastructure at their own strategic level, including weekly stand-ups and PDCA cycles, thereby establishing the *CI habit* at the strategic level. Structured problem solving through A3 practices was launched between departments and divisions. Because the improvement system proved to be easily scalable, cross-functional improvement initiatives (Seizing) could be efficiency facilitated. CI initiatives could be transformed at multiple levels of the hospital because they were aligned, with considerable support from leaders and cross-functional teams. Collaborative synergy between departments and concomitant results improved significantly, as functional and hierarchical impediments were bypassed through an aligned and shared CI infrastructure.

In summary, collaborative synergy in both hospitals was rooted in the alignment of CI efforts across different levels and functions. However, case 1's more structured and coordinated approach allowed this capability to flourish across the entire organization, while case 2's bottom-up efforts resulted merely in isolated or local successes.

4.3. Integrated Accountability Capability

We observed integrated accountability as the organizational capability to enhance performance and achieve strategic goals through the previously mentioned interconnected improvement system and collaborative synergy across all levels of a hospital. This involves setting clear, cross-functional priorities and KPIs that align top-down targets with frontline operations, fostering a culture of accountability in daily tasks. By integrating Lean practices with strategic objectives and promoting vertical collaboration between top management, middle management, and frontline employees, integrated accountability ensured everyone's focus and alignment. Altogether, this drove sustainable process improvements throughout the hospital. In both cases the *focused CI* routine was established already during the initial Lean stage. The hospital's executive board in case 1, and the division board in case 2, identified the need for a comprehensive operations strategy aimed at enhancing performance and patient outcomes, being the trigger to start with Lean. An executive member of case 1 mentioned: *"We gather information about waste through value stream mapping. But also, what our goals and objectives are and what we want to achieve with Lean. Then teams start up what we*

call the operational management cycle [Value Stream Mapping, PDCA, and Kaizen Events] *to apply continuous improvement"* (Seizing). In both cases, the Lean implementation was evaluated at the end of T1, whereby it was recognized that there was the need for increased focus and clearer frontline targets (Sensing). This resulted in integrating goal setting and KPIs into Kaizen Events and promoting accountability of employees in daily operations (Seizing).

During the scale-up stage, only in case 1 cross-departmental priorities were set through cross-functional KPIs (Seizing) as explained by a middle manager: *"We now have created alignment at several hierarchical levels towards our strategy."* The case 1 top management acknowledged the value of integrating Lean practices at a strategic level to achieve broader organizational goals (Sensing). The adoption of the improvement system and collaborative synergy capabilities by top management involved weekly stand-ups and PDCA cycles, and also was the ultimate step towards a truly integrated hospital wide improvement system. In addition, vertical collaboration and integrated accountability was realized by setting top-down targets and fostering daily accountability at the frontline, ensuring strategic focus and alignment at all levels (Seizing). At the top management level in case 1, also the *focus CI* routine was introduced by installing one strategic KPI: patient pain reduction. This focus required continuous inspecting and adapting at the front, middle, and top-management levels and led to develop its integrated accountability capability. As the guiding divisional director explained: *"That means that my supervisors have stand-up sessions with employees at the frontline. I have stand-ups twice a week with my peers to discuss our KPIs and bottlenecks for improvement that could not be solved within our departments. Then I also have a weekly stand-up with the board to discuss the strategic indicators in a similar way."* This routine was supported by the earlier mentioned hospital-wide improvement system which linked top management, middle management, and frontline to jointly facilitate hospital-wide improvements (Seizing). This CI system was continuously enhanced to work towards achieving the strategic KPI (Transforming). In particular, crucial process improvements were deployed related to this patient pain indicator, by successfully deploying associated KPIs, which boosted all actors' accountability towards achieving them together (Transforming).

In case 2, integrated accountability was much less noticeable. While middle managers and frontline leaders took ownership of CI within their departments, the absence of a coordinated hospital-wide KPI limited the integration of strategic objectives with day-to-day operations. A division head explained: *"The strategic objectives are currently unrelated to Lean. I do know we* [the hospital board and division heads] *are thinking about implementing the strategic objectives with Lean."* The nursing wards successfully embedded CI into their routines, but the lack of an integrated accountability framework prevented these efforts from translating into broader organizational gains. Without a unified strategy for integrating Lean practices at the strategic level, accountability remained localized, limiting the hospital's overall improvement potential.

4.4. Learning-to-learn capability

Ultimately, the three capabilities contributed to a fourth one being the learning-to-learn capability. In case 1, the learning-to-learn capability emerged through the iterative refinement of Lean practices. As frontline employees and leaders engaged in CI, they developed a deeper understanding of how to apply Lean practices more effectively. As stated by a nurse working in a multidisciplinary improvement: *"The improvement team thoroughly investigated the problem. Everybody in the team was invited to share their opinion and all opinions were discussed and valued by the whole team. Only at that point a decision was made as to how to proceed."* The introduction of the *improvement of improvement* routine further reinforced this capability, as it encouraged the systematic evaluation and enhancement of CI processes across the hospital. As explained by a middle manager: *"Every morning we gather* [during stand-ups] *with all medical specialists, all nursing teams, and managers at all levels to discuss how to manage the acute patient admissions. We use this information in our improvement team to improve the flow of our intake. The results are visible: we have a thousand more intakes than last year, and we aim for no refusals at the gate."* In case 2, the learning-to-learn capability was more limited to specific departments that had successfully implemented CI practices. Nursing teams, in particular, demonstrated a strong commitment to learning from their CI efforts, which led to sustained improvements in their workflows. As explained by a team leader: *"We have visualized the patient process flow and then sketched an improved process. Next, we removed some redundant activities and added some activities that would prevent patients to return to the hospital at a later stage. This is how we arrived at significant improvements."* However, the lack of a hospital-wide learning infrastructure hindered the broader development of this capability.

The learning-to-learn capability reflected hospital employees' ability to continuously recognize the need to learn how to engage in CI more effectively. This capability represented an advanced stage of organizational development, where employees actively engaged with the learning process itself to systematically address issues in their daily routines (Sensing). In both hospital cases, the evolution of this capability was stimulated by the development of another capability, namely the improvement system, which helped install a culture of continuous learning by encouraging frontline employees to sense and solve problems daily, boosting their willingness to engage in structured CI (Transforming). This system not only increased collaboration but also let employees recognize that their CI efforts aligned with the hospital's strategic priorities. This shift led employees, rather than just leaders or managers, to adopt problem-solving and team learning responsibilities (Transforming).

Creating collaborative synergy entailed the start of cross-functional and cross-hierarchical learning, creating a system in which people could openly share their learnings across departments and divisions (Seizing). Introducing integrated accountability empowered all hospital levels to work according to the stipulated hospital-wide Lean vision, using one

set of strategic goals that resulted in a chain of system-wide learning, knowledge sharing, and subsequent immediate attempts at applying those insight. The introduction of the *improvement of improvement* routine supported the development of the learning-to-learn capability by systematically improving the organization's ability to learn and refine its CI processes (Transforming).

Altogether, the four sequential capabilities identified in the cross-case analysis point to a comprehensive model for developing a CI DC that is presented in the next section.

5. DISCUSSION

Because we wondered how routines evolve into a DC, we studied the evolution of the CI DC in two large academic hospitals. In case 1, after four years, many concrete performance improvements were realized hospital-wide while the other hospital started anew even though some units had been engaged with CI earlier and had shown significant performance improvements. Drawing upon this retrospective longitudinal comparative study, we provide novel insights about how improvement routines are gradually bundled over time and develop into a CI DC. This DC incorporates four foundational organizational capabilities: Improvement system, collaborative synergy, integrated accountability, and learning-to-learn. Figure 2 displays the derived conceptual model, visualizing how the CI DC is developed, as will be explained now.

In terms of theoretical implications, using a routine-based approach, our model first depicts how Lean practices merge into CI routines, which then developed into an initial *improvement system capability* (Anand et al., 2009; Bessant et al., 2001; Gutierrez-Gutierrez & Antony, 2020; Knol et al., 2022; Knol et al., 2019; Peng et al., 2008). Academic research has only recently begun to study this system-wide clustering of routines (Keller et al., 2022). Offering insights how to develop CI routines in large knowledge-intensive organizations, we reveal deviations from the implementation sequence put forward by Knol et al. (2019), likely due to differences in organizational context. Our findings align with the insights of De Jager et al. (2004) who emphasized the importance of *focus CI* as a critical starting routine, as establishing a common goal is essential for highlighting the urgency of proposed changes and thus enables people to support the improvement system. Second, as a next step, our research shows the need for a *collaborative synergy capability* to enact hospital-wide CI, stressing the importance of integrative capabilities (Helfat & Campo-Rembado, 2016) and coordinated interdependence between and among departments and hierarchical levels to improve performance (Sailer et al., 2023). Such capability mitigates the complexities inherent to the hospital organizational structure (De Souza & Pidd, 2011; Fournier & Jobin, 2018; Van Beers et al., 2022), enabling more effective cross-functional and cross-

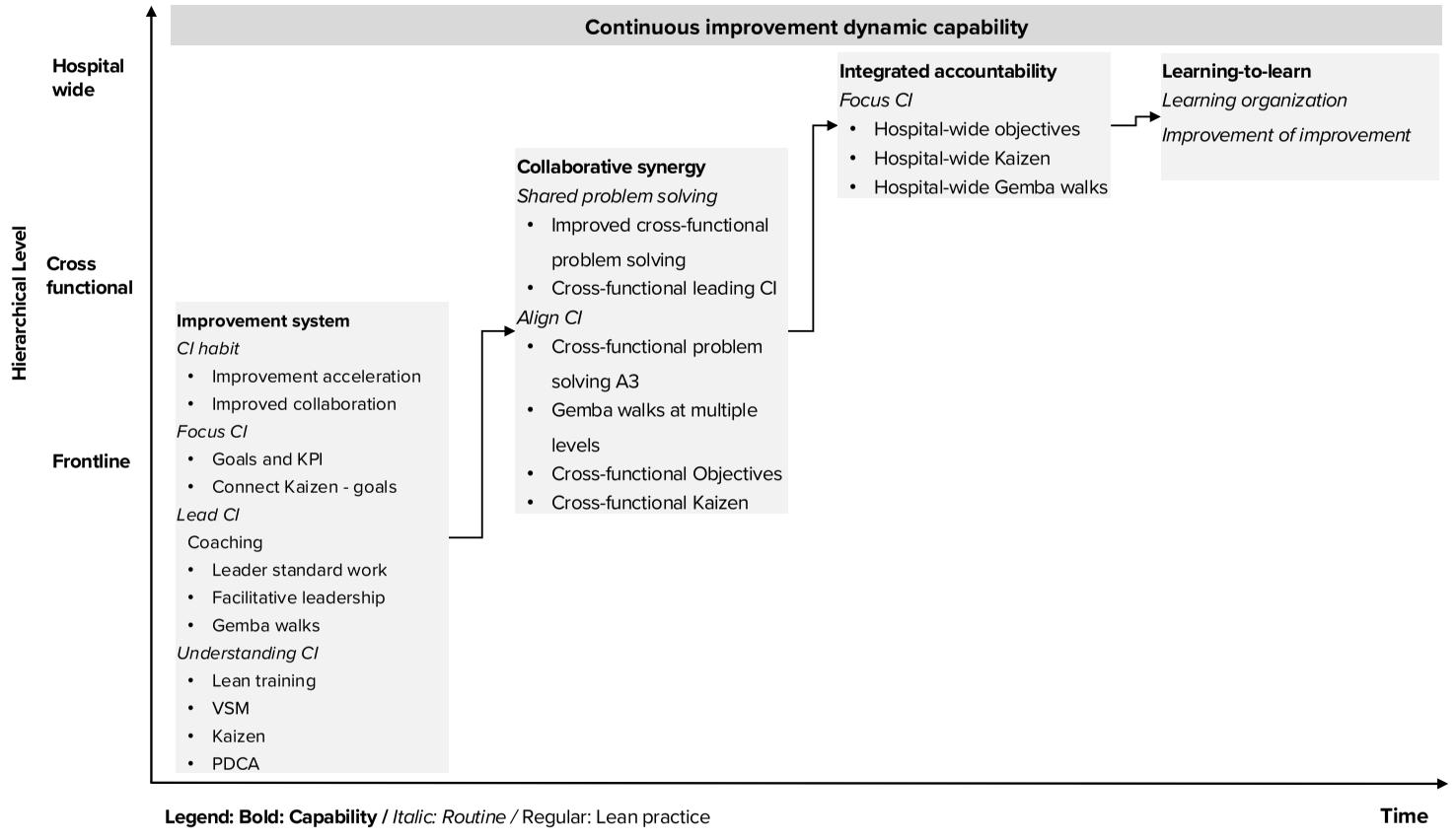


Figure 2.
Conceptual model of the development of a continuous improvement dynamic capability

departmental coordination and communication (Anand et al., 2009). Third, introducing the *integrated accountability capability* leads to alignment among all departments and helps to focus the hospital as a coherent whole-system on achieving its core objectives (Jolayemi, 2009). The third capability involves both top-down strategic alignment and bottom-up accountability (Van Beers et al., 2022). This capability is somewhat similar to the policy deployment dynamic capability (Giordani da Silveira et al., 2017; Jolayemi, 2008; Witcher et al., 2008) although policy deployment is primarily a top-down approach where strategic objectives are cascaded down the hierarchy (Witcher et al., 2008). Fourth, the *learning-to-learn capability* in our conceptual model aligns closely with the learning organization framework (Saabye et al., 2022). This capability fosters a culture of continuous learning through ongoing experimentation across all levels of the organization and integrating this learning in daily work (Kristensen et al., 2022; Saabye et al., 2022; Saabye et al., 2023). Furthermore, a culture of questioning, feedback, and experimentation is widely embedded in the system and even stimulates improvement of the improvement system itself. This *learning organization routine* was not recognized in small and medium organizations on which the study of Knol et al. (2019) was based, but is clearly present in our research among large knowledge-intensive organizations. Altogether, Figure 2 adds to the routine literature by mapping the process of how routines may be bundled and sequenced.

Secondly, our model expands the DC theory. Overall, our conceptual model, with the forementioned capabilities, contributes to the growing body of work that seeks to unpack the microfoundations of DC by explaining *how* bundles of routines evolve (Keller et al., 2022), *how* CI routines are bundled in capabilities (Momeni et al., 2023; Peng et al., 2008), and *how* those capabilities develop into a CI DC over time (Csiki et al., 2023). Unlike prior studies that have primarily focused on routine evolution in isolation, our findings highlight the interdependence and dynamic interplay of routines across different organizational levels, reinforcing the idea that DCs are deeply embedded in the interactions between individuals and organizational processes (Nayak et al., 2020). While previous research has largely emphasized the role of top management in the development of DCs (Helfat & Peteraf, 2015; Schilke et al., 2018), our cross-case analysis explains that the CI DC builds on a stable pattern of routines, performed by actors at different organizational levels within the hospital. Furthermore, the introduced CI system has the ability to adapt, renew, and reconfigure its resource base, resulting in high organizational performance (Schilke et al., 2018). We demonstrate that the DC activities sensing, seizing, and transforming are not restricted to isolated capabilities, but are spread across all organizational levels/units of entire hospitals (Teece, 2018). Our cross-case analysis thus addresses a current academic challenge by advancing our understanding of aggregation mechanisms, showing how individual routines that are stimulated by Lean practices eventually scale up into a CI DC: through specific, ongoing employee interaction across different levels/units (Chen et al., 2023; Winter, 2013).

Thirdly, the present research emphasizes the importance of middle management and employees in developing DCs (Pitelis & Wagner, 2019). As such, it fills a void in understanding how DCs emerge across different hierarchical levels (Helfat & Martin, 2015). Contrary to the conventional notion of DCs developing exclusively at certain organization levels (Helfat & Peteraf, 2015; Helfat & Winter, 2011; Salvato & Rerup, 2011; Winter, 2013), our model suggests a collaborative relationship between frontline initiatives, middle management priorities, and executive approval and facilitation. A purely top-down or bottom-up strategy might either stifle frontline innovation or create a lack of strategic alignment. Instead, an iterative feedback loop between the two, as seen in Lean hospitals (Van Beers et al., 2022), can drive effective CI. Our research contradicts Galeazzo *et al.*'s (2021) suggestion that a top-down approach is preferable when CI is low while a bottom-up approach is helpful for more advanced CI practitioners. Rather, our findings comply with the findings from Secchi and Camuffo (2016) and Chen et al. (2023) that CI, at its core, thrives when it stems from a grassroots level. This entails empowering frontline teams with the practices and processes to initiate change, which then is recognized, supported, and integrated by middle and executive management layers (Bessant et al., 2001; Nonaka et al., 2016).

Finally our research builds on Anand et al. (2009) model and provides empirical grounding for the microfoundations that aggregate into a CI DC (Chen et al., 2023) by dissecting the details of a hospital-wide *improvement system capability* and the *collaborative synergy capability* between leaders and employees at multiple levels. Given the evolving nature of CI DC, it is crucial to retain a degree of flexibility in the CI approach. As capabilities mature and become institutionalized, the overarching infrastructure should adapt too (Wenzel et al., 2020).

6. PRACTICAL CONTRIBUTIONS

Our study offers actionable insights for hospital leaders, administrators, healthcare professionals, and external consultants involved in Lean programs. Figure 2 presents a trajectory consisting of four stages that could be interpreted as a roadmap for developing and sustaining a CI DC in hospitals and other knowledge-intensive organizations. This approach connects members at all levels in a process of learning and improvement.

Incorporating co-creation into Lean implementation strategies ensures that improvements are not only efficient but also resonate with the needs of all involved stakeholders. In other words, our findings call for hospitals to move beyond traditional top-down change methods and embrace the collaborative co-creation for developing the right or effective capabilities. Rather than approaching Lean as a top-down or isolated initiative, hospitals (and other knowledge-intensive, siloed, or healthcare organizations) can benefit from fostering a culture of co-creation, by inviting diverse voices, ranging from doctors and nurses to managers at

all levels. This can be done by consciously building a hospital-wide improvement system. As such, hospitals can ensure improvement ideas are not only innovative but also grounded in the day-to-day reality.

Finally, our study explains the importance of connecting day-to-day improvements with a hospital's strategic objectives for achieving better outcomes. Integrated accountability ensures alignment of everyone, including frontline staff and executive leadership. The hospital-wide improvement system will help to translate strategic goals into specific departmental objectives, ensuring everyone understands their role in achieving these goals. A regular review process, involving data collection, performance analysis, and necessary adjustments, is essential. Lean practices like PDCA cycles and Kaizen Events foster continuous improvement, engage staff, and ensure effective communication and accountability across all levels of the organization.

7. LIMITATIONS AND FUTURE RESEARCH

Some constraints limit the scope and generalizability of our findings, which might drive future research endeavors in this domain. Naturally, given the inclusion of only two hospitals in one country, the findings might not be generalizable among large hospitals and healthcare systems, especially considering the unique (Dutch national policy driven) attributes of both settings. Sampling a broader range of hospitals, both geographically, rural/urban and in terms of size and specialization, including also private hospitals, is therefore recommended as a next step. Such studies might also incorporate external factors influencing the DC and organizational routine development processes, such as regulatory (policy) changes, technological advancements, or even market competition. While our study focused on gaining an in-depth understanding of the change in internal routines of hospitals while developing a CI DC, specific local environmental changes may have impacted what went on in both hospitals during the four years of our study. Because the data collection finished before the COVID-19 pandemic, which hit healthcare systems across the globe, such external "shocks" may have put the existing CI DC to the test.

As part of future research, it would be fascinating to empirically substantiate and enrich the conceptual model presented herein. Such a validation process across different hospital settings could for instance evaluate the detailed process of establishing each capability including its bundled routines and determine how effectively each capability contributes to the CI DC model. Although our study found links between four capabilities, the strength of these linkages needs further study (Wiengarten et al., 2022). Thus, new research specifically on the linkages between the various capabilities is needed; also, in terms of how they interact and feed each other.

Future research might also investigate other, internal, influencing factors such as hospital size, past change efforts, leadership style, budgets, and patient characteristics. Other studies could examine different healthcare settings, such as primary care clinics or long-term care facilities, or other knowledge-intensive organizations, which might be subject to different internal and external influencing factors. This is important as this study has shown that a serious embedment of a CI DC is able to yield performance effects; the clear performance differences between both studied hospitals tell that tale.

8. CONCLUSION

This study contributes to the literature on DCs, organizational routines, and Lean practices by developing a roadmap of how a CI DC unfolds in a complex hospital environment. Our research revealed a staged CI DC development process. Initially, a frontline improvement system capability emerged, bundling four improvement routines and aiding staff in adopting Lean practices. Subsequently, a collaborative synergy capability was established to overcome structural complexities and siloed units, facilitating a participative CI system. The third capability, integrated accountability, created interdependence between strategy and day-to-day accountability. Finally, a learning-to-learn capability integrated learning at all hospital levels, forming the final component of a CI DC. In sum, the implementation and reinforcement of CI routines at all hierarchical levels can foster a CI DC (consisting of four sub capabilities), leading to markedly improved performance results in large healthcare organizations. Because of the exploratory nature of our study, further research is invited to generalize our conceptual model. This study can thus serve as a foundation for future research to delve deeper into understanding how routines help build DCs in different large knowledge-intensive organizations.

9. REFERENCES

Ambrosini, V., Bowman, C., & Collier, N. (2009). Dynamic capabilities: an exploration of how firms renew their resource base. *British Journal of Management*, *20*, S9-S24. https://doi.org/10.1111/j.1467-8551.2008.00610.x

Anand, G., Ward, P. T., Tatikonda, M. V., & Schilling, D. A. (2009). Dynamic capabilities through continuous improvement infrastructure. *Journal of Operations Management 27*(6), 444-461. https://doi.org/10.1016/j.jom.2009.02.002

Azadegan, A., Patel, P. C., Zangoueinezhad, A., & Linderman, K. (2013). The effect of environmental complexity and environmental dynamism on lean practices. *Journal of Operations Management*, *31*(4), 193-212. https://doi.org/10.1016/j.jom.2013.03.002

Becker, M. C. (2004). Organizational routines: a review of the literature. *Industrial and Corporate Change*, *13*(4), 643-678. https://doi.org/10.1093/icc/dth026

Bessant, J., Caffyn, S., & Gallagher, M. (2001). An evolutionary model of continuous improvement behaviour. *Technovation*, *21*(2), 67-77. https://doi.org/10.1016/S0166-4972(00)00023-7

Biesenthal, C., Gudergan, S., & Ambrosini, V. (2019). The role of ostensive and performative routine aspects in dynamic capability deployment at different organizational levels. *Long Range Planning*, *52*(3), 350-365. https://doi.org/10.1016/j.lrp.2018.03.006

Burgess, N., & Radnor, Z. (2012). Service improvement in the English National health service: complexities and tensions. *Journal of Management and Organization*, *18*(5), 594-607. http://search.proquest.com/docview/1268162038?accountid=17193

Caniato, F., Doran, D., Sousa, R., & Boer, H. (2018). Designing and developing OM research: from concept to publication. *International Journal of Operations & Production Management*, *38*(9), 1836-1856. https://doi.org/10.1108/ijopm-01-2017-0038

Chen, Y., Liu, L., Li, W., Xie, Z., & Wei, C. (2023). Microfoundations of dynamic capabilities: a systematic review and a multilevel framework. *Management Decision*, *61*(6), 1717-1753. https://doi.org/10.1108/md-05-2022-0615

Csiki, O., Demeter, K., & Losonci, D. (2023). How to improve firm performance? the role of production capabilities and routines. *International Journal of Operations & Production Management*, *43*(13), 1-26. https://doi.org/10.1108/ijopm-03-2022-0221

Czarniawska, B. (2008). Organizing: how to study it and how to write about it. *Qualitative Research in Organizations and Management: an International Journal*, *3*(1), 4-20. https://doi.org/10.1108/17465640810870364

D'Andreamatteo, A., Lanni, L., Lega, F., & Sargiacomo, M. (2015). Lean in healthcare: a comprehensive review. *Health Policy*, *119*(9), 1197-1209. https://doi.org/10.1016/j.healthpol.2015.02.002

Danese, P., Manfè, V., & Romano, P. (2018). A systematic literature review on recent lean research: state-of-the-art and future directions. *International Journal of Management Reviews*, *20*(2), 579-605. https://doi.org/10.1111/ijmr.12156

De Jager, B., Minnie, C., De Jager, J., Welgemoed, M., Bessant, J., & Francis, D. (2004). Enabling continuous improvement: a case study of implementation. *Journal of Manufacturing Technology Management*, *15*(4), 315-324. https://doi.org/10.1108/17410380410535017

De Mast, J., Lameijer, B. A., Linderman, K., & Van de Ven, A. (2021). Exploring the process of management system implementation: a case of Six Sigma. *International Journal of Operations & Production Management*, *42*(13), 1-24. https://doi.org/10.1108/ijopm-09-2020-0645

De Souza, B. L., & Pidd, M. (2011). Exploring the barriers to lean health care implementation. *Public Money & Management*, *31*(1), 59 - 66. https://doi.org/10.1080/09540962.2011.545548

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review*, *14*(4), 532-550.

Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly*, *48*(1), 94-118.

Feldman, M. S., Pentland, B. T., D'Adderio, L., & Lazaric, N. (2016). Beyond routines as things: Introduction to the Special Issue on Routine Dynamics. *Organization Science*, *27*(3), 505-513. https://doi.org/10.1287/orsc.2016.1070

Felin, T., Foss, N. J., Heimeriks, K. H., & Madsen, T. L. (2012). Microfoundations of routines and capabilities: individuals, processes, and structure. *Journal of Management Studies*, *49*(8), 1351-1374. https://doi.org/10.1111/j.1467-6486.2012.01052.

Felin, T., Foss, N. J., & Ployhart, R. E. (2015). The Microfoundations Movement in Strategy and Organization Theory. *The Academy of Management Annals*, *9*(1), 575-632. https://doi.org/10.1080/19416520.2015.1007651

Fillingham, D. (2007). Can lean save lives? *Leadership in Health Services*, *20*(4), 231-241. https://doi.org/10.1108/17511870710829346

Fournier, P., Bahl, L., Van Dun, D. H., Johnson, K. J., & Cadieux, J. (2023). Let's talk about it: the impact of nurses' implicit voice theories on individual agility and quality of care. *International Journal of*

Operations & Production Management, *44*(5), 1007-1033. https://doi.org/10.1108/ijopm-11-2022-0752

Fournier, P., & Jobin, M. (2018). Understanding before implementing: the context of Lean in public healthcare organizations. *Public Money & Management*, *38*(1), 37-44. https://doi.org/10.1080/09540962.2018.1389505

Franken, J. C. M., Van Dun, D. H., & Wilderom, C. P. M. (2021). Kaizen event process quality: towards a phase-based understanding of high-quality group problem-solving. *International Journal of Operations & Production Management*, *41*(6), 962-990. https://doi.org/10.1108/ijopm-09-2020-0666

Furlan, A., Vinelli, A., & Dal Pont, G. (2011). Complementarity and lean manufacturing bundles: an empirical analysis. *International Journal of Operations & Production Management*, *31*(8), 835-850. https://doi.org/10.1108/01443571111153067

Furnival, J., Boaden, R., & Walshe, K. (2019). A dynamic capabilities view of improvement capability. *Journal of Health Organization and Management*, *33*(8), 821-834. https://doi.org/10.1108/JHOM-11-2018-0342

Galeazzo, A., Furlan, A., & Vinelli, A. (2017). The organizational infrastructure of continuous improvement – an empirical analysis. *Operations Management Research*, *10*(1-2), 33-46. https://doi.org/10.1007/s12063-016-0112-1

Galeazzo, A., Furlan, A., & Vinelli, A. (2021). The role of employees' participation and managers' authority on continuous improvement and performance. *International Journal of Operations & Production Management*, *41*(13), 34-64. https://doi.org/10.1108/ijopm-07-2020-0482

Giordani da Silveira, W., Pinheiro de Lima, E., Gouvea da Costa, S. E., & Deschamps, F. (2017). Guidelines for hoshin kanri implementation: development and discussion. *Production Planning & Control*, *28*(10), 843-859. https://doi.org/10.1080/09537287.2017.1325020

Gutierrez-Gutierrez, L., & Antony, J. (2020). Continuous improvement initiatives for dynamic capabilities development. *International Journal of Lean Six Sigma*, *11*(1), 125-149. https://doi.org/10.1108/IJLSS-07-2018-0071

Gutierrez, L., Lameijer, B. A., Anand, G., Antony, J., & Sunder M, V. (2022). Beyond efficiency: the role of lean practices and cultures in developing dynamic capabilities microfoundations. *International Journal of Operations & Production Management*, *42*(13), 506-536. https://doi.org/10.1108/ijopm-02-2022-0086

Harris, M. L., Collins, R. W., & Hevner, A. R. (2009). Control of flexible software development under uncertainty. *Information Systems Research*, *20*(3), 400-419. https://doi.org/10.1287/isre.1090.0240

Helfat, C. E., & Campo-Rembado, M. A. (2016). Integrative capabilities, vertical integration, and innovation over successive technology lifecycles. *Organization Science*, *27*(2), 249-264. https://doi.org/10.1287/orsc.2015.1045

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, S. (2007). *Dynamic capabilities: understanding strategic change in organizations*. Blackwell publishing.

Helfat, C. E., & Martin, J. A. (2015). Dynamic managerial capabilities: Review and assessment of managerial impact on strategic change. *Journal of Management*, *41*(5), 1281-1312. https://doi.org/10.1177/0149206314561301

Helfat, C. E., & Peteraf, M. A. (2015). Managerial cognitive capabilities and the microfoundations of dynamic capabilities. *Strategic Management Journal*, *36*(6), 831-850. https://doi.org/10.1002/smj.2247

Helfat, C. E., & Winter, S. G. (2011). Untangling Dynamic and Operational Capabilities: strategy for the (N) ever-Changing World. *Strategic Management Journal*, *32*(11), 1243-1250. https://doi.org/10.1002/smj.955

Jolayemi, J. K. (2008). Hoshin kanri and hoshin process: A review and literature survey. *Total Quality Management & Business Excellence*, *19*(3), 295-320. https://doi.org/10.1080/14783360701601868

Jolayemi, J. K. (2009). Policy deployment: a review and comparisons of two best practices models. *Total Quality Management & Business Excellence*, *20*(8), 877-902. https://doi.org/10.1080/14783360903128363

Keller, A., Konlechner, S., Güttel, W. H., & Reischauer, G. (2022). Overcoming path-dependent dynamic capabilities. *Strategic Organization*, *0*(0), 1-31. https://doi.org/10.1177/14761270221125807

Ketokivi, M. A., & Schroeder, R. G. (2004). Strategic, structural contingency and institutional explanations in the adoption of innovative manufacturing practices. *Journal of Operations Management*, *22*(1), 63-89. https://doi.org/10.1016/j.jom.2003.12.002

Knol, W. H., Lauche, K., Schouteten, R. L. J., & Slomp, J. (2022). Establishing the interplay between lean operating and continuous improvement routines: a process view. *International Journal of Operations & Production Management*, *42*(13), 243-273. https://doi.org/10.1108/ijopm-06-2020-0334

Knol, W. H., Slomp, J., Schouteten Roel, L. J., & Lauche, K. (2019). The relative importance of improvement routines for implementing lean practices. *International Journal of Operations & Production Management*, *39*(2), 214-237. https://doi.org/10.1108/IJOPM-01-2018-0010

Kohlbacher, M. (2013). The impact of dynamic capabilities through continuous improvement on innovation:

the role of business process orientation. *Knowledge and Process Management*, *20*(2), 71. https://doi.org/10.1002/kpm.1405

Kristensen, T. B., Saabye, H., & Edmondson, A. (2022). Becoming a learning organization while enhancing performance: the case of LEGO. *International Journal of Operations & Production Management*, *42*(13), 438-481. https://doi.org/10.1108/ijopm-10-2021-0676

Langley, A. (1999). Strategies for Theorizing from Process Data. *Academy of Management Review*, *24*(4), 691-710. https://doi.org/10.5465/amr.1999.2553248

Langley, A., Smallman, C., Tsoukas, H., & Van De Ven, A. H. (2013). Process studies of change in organization and management: unveiling temporality, activity, and flow. *Academy of Management Journal*, *56*(1), 1-13. https://doi.org/10.5465/amj.2013.4001

Leite, H., Williams, S., Radnor, Z., & Bateman, N. (2022). Emergent barriers to the lean healthcare journey: baronies, tribalism and scepticism. *Production Planning & Control*, *35*(2), 115-132. https://doi.org/10.1080/09537287.2022.2054386

Matthews, R. L., MacCarthy, B. L., & Braziotis, C. (2017). Organisational learning in SMEs: a process improvement perspective. *International Journal of Operations & Production Management*, *37*(7), 970-1006. https://doi.org/10.1108/IJOPM-09-2015-0580

Momeni, K., Raddats, C., & Martinsuo, M. (2023). Mechanisms for developing operational capabilities in digital servitization. *International Journal of Operations & Production Management*, *43*(13), 101-127. https://doi.org/10.1108/ijopm-04-2022-0259

Nayak, A., Chia, R., & Canales, J. I. (2020). Noncognitive Microfoundations: Understanding Dynamic Capabilities as idiosyncractically refined sensitivities and predispositions. *Academy of Management Review*, *45*(2), 280-303. https://doi.org/10.5465/amr.2016.0253

Nelson, R. R., & Winter, S. G. (1982). *An evolutionary theory of economic change*. Belknap Press of Harvard University Press.

Netland, T. H., & Ferdows, K. (2016). The S-curve effect of lean implementation. *Production and Operations Management*, *25*(6), 1106-1120. https://doi.org/10.1111/poms.12539

Nonaka, I., Hirose, A., & Takeda, Y. (2016). 'Meso'-Foundations of Dynamic Capabilities: team-level synthesis and distributed leadership as the source of dynamic creativity. *Global Strategy Journal*, *6*(3), 168-182. https://doi.org/10.1002/gsj.1125

Parmigiani, A., & Howard-Grenville, J. (2011). Routines revisited: exploring the capabilities and practice perspectives. *Academy of Management Annals*, *5*(1), 413-453. https://doi.org/10.1080/19416520.2011.589143

Peng, D. X., Schroeder, R. G., & Shah, N. T. (2008). Linking routines to operations capabilities: a new perspective. *Journal of Operations Management*, *26*(6), 730-748. https://doi.org/10.1016/j.jom.2007.11.001

Pisano, G. P. (2017). Toward a prescriptive theory of dynamic capabilities: connecting strategic choice, learning, and competition. *Industrial and Corporate Change*, *26*(5), 747-762. https://doi.org/10.1093/icc/dtx026

Pitelis, C. N., & Wagner, J. D. (2019). Strategic shared leadership and organizational dynamic capabilities. *The Leadership Quarterly*, *30*(2), 233-242. https://doi.org/10.1016/j.leaqua.2018.08.002

Powell, D. J., Laubengaier, D. A., Tortorella, G. L., Saabye, H., Antony, J., & Cagliano, R. (2024). Digitalization in lean manufacturing firms: a cumulative capability development perspective. *International Journal of Operations & Production Management*, *44*(6), 1249-1278. https://doi.org/10.1108/ijopm-05-2023-0414

Saabye, H., Kristensen, T. B., & Wæhrens, B. V. (2022). Developing a learning-to-learn capability: insights on conditions for Industry 4.0 adoption. *International Journal of Operations & Production Management*, *42*(13), 25-53. https://doi.org/10.1108/ijopm-07-2021-0428

Saabye, H., Powell, D. J., & Coughlan, P. (2023). Lean and action learning: towards an integrated theory? *International Journal of Operations & Production Management*, *43*(13), 128-151. https://doi.org/10.1108/ijopm-06-2022-0371

Sailer, P., Loscher, G. J., & Kaiser, S. (2023). Coordinated Interdependence: how patterning governs flexibility in a routine cluster. *Journal of Management Studies*, *61*(5), 1884-1915. https://doi.org/10.1111/joms.12960

Salvato, C., & Rerup, C. (2011). Beyond collective entities: multilevel research on organizational routines and capabilities. *Journal of Management*, *37*(2), 468-490. https://doi.org/10.1177/0149206310371691

Schilke, O., & Cook, K. S. (2013). A cross-level process theory of trust development in interorganizational relationships. *Strategic Organization*, *11*(3), 281-303. https://doi.org/10.1177/1476127012472096

Schilke, O., Hu, S., & Helfat, C. E. (2018). Quo vadis, dynamic capabilities? a content-analytic review of the current state of knowledge and recommendations for future research. *Academy of Management Annals*, *12*(1), 390-439. https://doi.org/10.5465/annals.2016.0014

Secchi, E., Roth, A., & Verma, R. (2019). The Impact of Service Improvisation Competence on Customer Satisfaction: evidence from the Hospitality Industry. *Production and Operations Management*, *28*(6), 1329-1346. https://doi.org/10.1111/poms.12969

Secchi, R., & Camuffo, A. (2016). Rolling out lean production systems: a knowledge-based

perspective. *International Journal of Operations & Production Management*, *36*(1), 61-85. https://doi.org/10.1108/ijopm-04-2014-0194

Shah, R., & Ward, P. (2007). Defining and developing measures of lean production. *Journal of Operations Management*, *25*(4), 785-805. https://doi.org/10.1016/j.jom.2007.01.019

Sunder M, V., & Ganesh, L. S. (2020). Identification of the Dynamic Capabilities Ecosystem: a systems thinking perspective. *Group & Organization Management*, *46*(5), 893-930. https://doi.org/10.1177/1059601120963636

Teece, D., Leih, S., & Peteraf, M. (2016). Dynamic capabilities and organizational agility: risk, uncertainty, and strategy in the innovation economy. *California Management Review*, *58*(4), 13-35. https://doi.org/10.1525/CMR.2016.58.4.13

Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic management journal*, *28*(13), 1319-1350. https://doi.org/10.1002/smj.640

Teece, D. J. (2018). Dynamic capabilities as (workable) management systems theory. *Journal of Management & Organization*, *24*(3), 359-368. https://doi.org/10.1017/jmo.2017.75

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, *18*(7), 509-533.

Van Beers, J. C. A. M., Van Dun, D. H., & Wilderom, C. P. M. (2022). Effective hospital-wide lean implementation: top-down, bottom-up or through co-creative role modeling? *International Journal of Lean Six Sigma*, *13*(1), 46-66. https://doi.org/10.1108/IJLSS-02-2021-0024

Van Zyl-Cillié, M. M., Van Dun, D. H., & Meijer, H. (2024). Toward a roadmap for sustainable lean adoption in hospitals: a Delphi study. *BMC Health Services Research*, *24*(1), 1-17. https://doi.org/10.1186/s12913-024-11529-4

Waring, J. J., & Bishop, S. (2010). Lean healthcare: rhetoric, ritual and resistance. *Social Science & Medicine*, *71*(7), 1332-1340. https://doi.org/10.1016/j.socscimed.2010.06.028

Wenzel, M., Danner-Schröder, A., & Spee, A. P. (2020). Dynamic capabilities? unleashing their dynamics through a practice perspective on organizational routines. *Journal of Management Inquiry*, *30*(4), 395-406. https://doi.org/10.1177/1056492620916549

Wiengarten, F., Durach, C. F., Franke, H., Netland, T. H., & Schmidt, F. K. (2022). Impact pathways: towards an adapted understanding of the development of operational capabilities. *International Journal of Operations & Production Management*, *43*(13), 50-67. https://doi.org/10.1108/ijopm-08-2022-0475

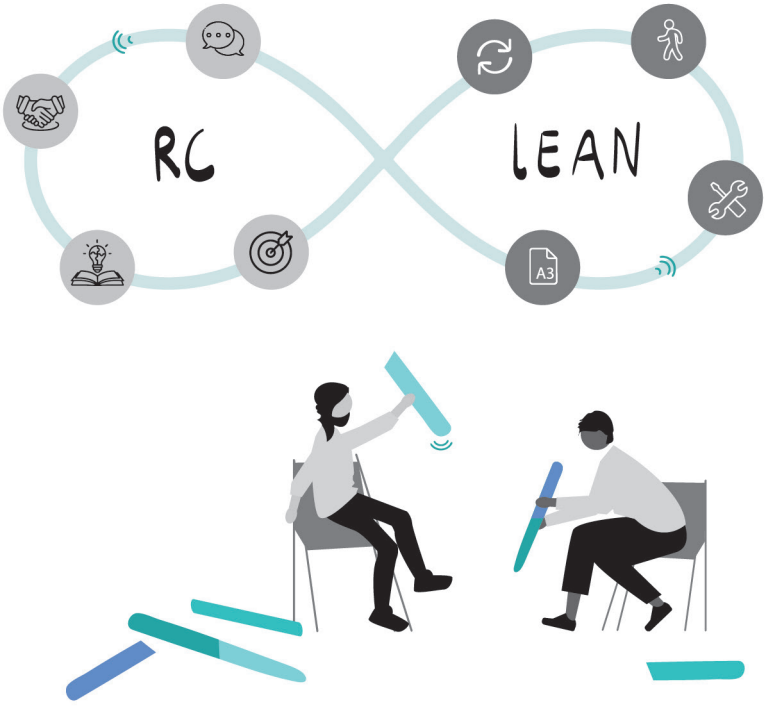
Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, *24*(10), 991-995. https://doi.org/10.1002/smj.318

Winter, S. G. (2013). Habit, Deliberation, and Action: Strengthening the Microfoundations of Routines and Capabilities. *Academy of Management Perspectives*, *27*(2), 120-137. https://doi.org/10.5465/amp.2012.0124

Witcher, B. J., Sum Chau, V., & Harding, P. (2008). Dynamic capabilities: Top executive audits and hoshin kanri at Nissan South Africa. *International Journal of Operations & Production Management*, *28*(6), 540-561. https://doi.org/10.1108/01443570810875359

Yin, R. K. (2015). *Qualitative research from start to finish*. Guilford Publications.

Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, *13*(3), 339-351. https://doi.org/10.1287/orsc.13.3.339.2780


RC
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How Relational Coordination Contributes to a Shared Infrastructure for Lean Learning in Large Hospitals

This chapter currently under review at *Journal of Applied Behavioral Science*.

A previous version of this chapter has been presented at the *31th EurOMA conference*: Van Beers, J. C. A. M., and Van Dun, D. H (2024). The relationship between Lean hospital adoption, learning, and relational coordination: an embedded multiple-case process study. *31th EurOMA conference 2024: "Transforming people and processes for a better world*", 1-3 July, Barcelona.

IV

ABSTRACT

Many large hospitals are struggling with hierarchical silos, increasing healthcare demands, financial constraints, and labor shortages, all of which undermine their ability to provide quality care. Adopting Lean addresses these challenges as it stimulates staff learning, efficiency, quality, and employee and patient satisfaction. We wanted to explore how relational coordination relates to adopting Lean in those complex knowledge-intensive organizations. This retrospective longitudinal process study of eight Dutch hospital units made use of qualitative interviews and observational data. Findings show that advancing through four Lean stages to the final learning stage is interlinked with the four theoretical relational coordination dimensions: shared goals; shared knowledge; mutual respect; and communication, resulting in hospital performance improvements. One crucial additional dimension is revealed, namely a shared infrastructure for Lean learning. To overcome organizational barriers for more efficient and patient-driven cross-functional collaboration and sustainable operational improvements, these five dimensions, together, offer various practical, and theoretical implications.

Keywords

Relational coordination theory, Learning, Lean, Large hospitals.

1. INTRODUCTION

Across many societies, worldwide, there is a strong need to optimize healthcare due to increasing demands on its systems while reducing financial resources and/or lacking specialized labor (Danese et al., 2018). This situation makes the implementation of Lean both vital and challenging, given the need for quality care (Danese et al., 2018). Lean healthcare in hospitals involves human staff who understand what is valuable for patients as well as a process of continuous improvement and a guiding operational strategy with which to improve both the quality of care and efficiency (Graban, 2008). Using Lean practices, such as waste reduction and continuous improvement, streamlines workflow, reduce errors, and improves patient satisfaction (de Souza, 2009). We argue in this paper that Lean's pursuit of value in a hospital can be even more successful after relational coordination (RC) is fully established (Shah, 2008). The RC theory assumes that superior performance is achieved when work is coordinated through communication among all workers in an organization. This coordination is elevated by the presence of shared goals, shared knowledge, mutual trust, and effective communication (Bolton et al., 2021). This is particularly the case in hospital settings that transition from a vertical, hierarchical coordination to a more horizontal, collaborative coordination, when RC enables high-quality collaboration among hospital professionals, ensuring that care is delivered in a timely, efficient, and patient-centered manner (Gittell, 2002).

Lean regards not simply the adoption of Lean practice bundles, but has been widely described as a learning system (Saabye et al., 2022), grounded in four stages (knowing, understanding, thinking, and learning) (Hines et al., 2004). Implementing Lean well in large hospitals, as an organization-wide learning system supported by top management, can reap large gains (Van Beers et al., 2022). Adopting Lean as such a system has the potential to significantly enhance RC and therefore organizational performance in complex healthcare settings (McMackin & Flood, 2019). Thus, understanding how various Lean stages influence RC dimensions is crucial because it can reveal the mechanisms through which hospitals can achieve sustainable improvements in patient care, operational efficiency, and staff collaboration (Bolton et al., 2021). Despite the increasing scholarly attention devoted to both Lean and RC theory, the interaction between these two frameworks remains underexplored (McMackin & Flood, 2019). Current research has not adequately examined the joint evolution of Lean stages and RC dimensions, nor how the interplay between these dynamics contributes to sustainable performance improvements within large healthcare institutions. Therefore, this study answers the question: *How are the four Lean-implementation stages (knowing, understanding, thinking, and learning) related to relational coordination to drive performance improvement in a large hospital setting?*

In a retrospective longitudinal process study, we compare eight hospital units in two large Dutch hospitals that had adopted Lean. Data were collected through 62 semi-structured

interviews, supplemented by documents and performance metrics, allowing for an in-depth analysis of how Lean stages and RC dimensions/efforts jointly evolve over time. By utilizing an abductive approach, this research iteratively refines existing theory; specifically, it contributes new insights into the interaction between Lean and RC theory in hospital settings by mapping these effects across different Lean stages.

Our first specific theoretical contribution lies in extending the RC framework of Bolton et al. (2021) by introducing a new dimension, 'shared infrastructure,' which is pivotal in overcoming hierarchical silos and fostering collaboration across large hospitals. This infrastructure, enabled through Lean practices, supports the relational dynamics required for effective coordination in healthcare settings. In addition, we extend the knowledge of how Lean evolves as a learning system, offering insights into how Lean and RC theory can aid in spurring sustainable performance improvements in large hospitals.

This paper is organized as follows. First, we provide a comprehensive review of the literature on Lean in the relevant healthcare and RC theory. The methodology section details our chosen research design. The cross-case analysis shows how Lean stages and RC drive performance improvements in the eight focal hospital units. In our discussion the theoretical and practical implications of our findings are presented. We conclude with recommendations for both future research and hospital leaders.

2. THEORETICAL BACKGROUND

2.1. Lean in hospitals: Evolution from Lean practices to learning systems

The healthcare sector, particularly hospitals, faces growing demand, given an ageing population, pandemics, and crowded emergency departments (Leite et al., 2022). This heightened demand puts immense pressure on hospital systems, often constrained by limited financial and workforce resources (Williams & Radnor, 2018). While Lean has been proposed as a solution to enhance performance, its implementation in healthcare has proven challenging, due to this industry's characteristics (Fournier & Jobin, 2018).

The complex and unpredictable nature of large hospitals, marked by fluctuating demand and the necessity for a highly specialized workforce while collaborating in a complex organizational structure, complicates Lean's success (Nembhard et al., 2009). Lean implementation is further complicated in hospitals because the professional services they provide involve co-creation and knowledge-intensive work. The need for high levels of expertise, collaboration, and customization makes it challenging to standardize processes and reduce variability as typically required by Lean (Staats et al., 2011). The hierarchical professional structure, led by doctors, adds to this complexity (Leite et al., 2019), given that

healthcare requires personalized interactions among these clinicians with nurses, other employees, and patients, etc. (Fournier & Jobin, 2018). Understanding these complexities is crucial for successfully implementing Lean in a large hospital setting.

Since its introduction in the early 2000s, Lean in hospitals has evolved significantly (de Souza, 2009). Initially, the focus was on applying Lean practices that were used in manufacturing, often without considering the unique needs of hospital settings. Early implementations were isolated and lacked a comprehensive approach, which limited their effectiveness (Burgess & Radnor, 2013). Over time, Lean's emphasis shifted toward value-driven approaches, such as value stream mapping, which helped hospitals better understand and optimize their processes (Marin-Garcia et al., 2021). This evolution marked a move from isolated practices to a system-wide approach to continuous improvement (Radnor et al., 2012). Recognizing the need for such an approach, some hospitals indeed began to view Lean as an organization-wide system of continuous improvement. Key aspects of Lean included evaluating existing processes, adopting improvements, and monitoring performance (Radnor et al., 2012). This organization-wide approach needed committed leadership and collaborative efforts among improvement specialists and operational leaders (Van Elp et al., 2021). In recent years, although rarely studied in hospitals, Lean has been increasingly applied as an organization-wide learning system, where continuous improvement and adaptability are core principles (Powell & Reke, 2019). Lean organizations are capable of ongoing learning and development, integrating Lean practices into their culture and operations to enhance quality and efficiency (Tortorella et al., 2020). This perspective aligns Lean with the broader concept of a learning organization, emphasizing the importance of developing problem-solving capabilities and fostering a culture of continuous improvement (Ballé et al., 2019).

2.2. Lean Learning in hospitals

The evolution of Lean in hospitals complies with Hines et al. (2004), based on McGill (1993) classification of organizational learning, suggesting four Lean stages: (1) The "knowing" stage focuses on applying explicit knowledge of Lean practices during the initial Lean implementation. (2) The "understanding" stage, in which organizations begin to grasp Lean's systemic nature and how the Lean practices and principles interconnect. (3) The "thinking" stage, during which an organizational culture of continuous improvement and structured problem solving is developed. And (4) the "learning" stage in which Lean thinking is fully integrated into the ways of working, decision-making processes, and continuous learning cycles. During these four stages of Lean, organizations transition from a more operational focus on waste reduction to a strategic, adaptable, Lean-value system (Hines et al., 2004).
Traditional approaches to Lean in hospitals have primarily focused on the implementation of problem-solving methods without fully embedding these practices into the organizational culture (Tortorella et al., 2020). This approach has proven to be insufficient, as it fails to cultivate a deeper, learning-oriented capability within the organization (Powell et al., 2024).

Hence, effective Lean implementation would need a shift towards a more comprehensive learning system: one that prioritizes leaders' and employees' Lean understanding and actual improvement through their own, in-situ experimentation, reflecting, and empowering processes (Cusumano et al., 2021). Rather than merely viewing Lean practices as mechanisms for eliminating waste, they should be understood also as instruments for identifying new data/insights and old issues. Lean practices such as A3 thinking, Toyota Kata, and Lean leadership are integral to this systematic learning process. Such a process must also facilitate the development of leaders, from problem solvers to enablers of effective team learning (Kristensen et al., 2022). Ballé et al. (2019, p. 3) described Lean as a learning system designed to "continuously develop people and create a culture of problem solving" in which challenges are confronted by involving all employees as problem solvers in exploring issues and discovering unknown solutions through experiential learning (Kristensen et al., 2022). Ballé et al. (2019, p. 3) continued by stating that "Lean practices are techniques to create the conditions for such experiential learning, and the lean approach turns management upside down by turning the chain of command into a chain of help: challenge and support, rather than command and control."

Indeed, a more nuanced and fairly recent approach to Lean emphasizes the development of a "learning-to-learn" capability, allowing individuals to continuously identify and address problems in a dynamic and evolving context (Saabye et al., 2022). Leaders must facilitate learning by creating psychologically safe environments in which to foster adopting Lean as a learning system (Fenner et al., 2022; Saabye et al., 2022). Viewing Lean through a learning lens promotes a holistic-organizational approach to integrating Lean practices into the culture and operational strategy to enhance overall quality and efficiency. On balance, the essence of Lean lies in an organization's ability to learn continuously (Hines et al. (2004).

2.3. Relational coordination theory

RC theory offers a framework for understanding how effective coordination in complex work processes can be achieved through the interaction of communication and relationships that induce better performance (Bolton et al., 2021). RC is particularly relevant in settings where employees must collaborate on highly interdependent tasks under conditions of uncertainty and time constraints, such as a hospital (Gittell, 2002). RC theory identifies communication as a critical dimension of effective coordination, emphasizing four key aspects. First, *frequent* communication fosters familiarity and builds relationships, which are essential for effective coordination (Bolton et al., 2021). Second, *timely* communication (e.g., of updates), which is vital for maintaining workflow and preventing disruptions. Third, *accurate* communication, given that even frequent and timely communication can be detrimental if the information is inaccurate, as this can lead to errors (Gittell, 2011). Accurate communication builds trust and encourages knowledge sharing (Levin & Cross, 2004). Fourth, communication should facilitate collaborative *problem solving*. Interdependence

can often lead to conflict and blame-shifting, which hinder problem solving and reduce overall performance. Problem solving communication helps overcome these challenges by focusing on collective solutions rather than individual blame (Gittell, 2011).

Additionally, RC theory emphasizes the importance of so-called relational dimensions, i.e., shared goals, shared knowledge, and mutual respect (Gittell, 2006). *Shared goals* are essential for aligning the efforts of all participants toward a common purpose (Johnson et al., 2019). Shared goals encourage participants to move beyond optimizing their own sub-tasks and to consider the broader work process, leading to more cohesive and effective teamwork (Ghosh & Wu, 2023). *Shared knowledge* involves a deep understanding of how each participant's tasks interconnect with those of others. With this knowledge one can effectively anticipate the impacts of changes and determine who needs to be informed and when. However, shared knowledge is often impeded by differences in training, expertise, and socialization. The distinct "world views" that are shaped by individuals' unique professional backgrounds may hinder communication and coordination. Bridging these divides through shared understanding is key to improving coordination and ensuring that all team members act with the overall goals in mind. Thus, shared knowledge ensures that participants understand how their tasks interconnect (Spitzer et al., 2023). *Mutual respect* depends on participants' valuing and respecting each other's contributions (Coetzee et al., 2019). Disrespect can lead to divisions and undermine the collaborative spirit needed for coordination, especially in contexts where different occupational groups vary in status (Wiedner & Mantere, 2018). Conversely, when participants respect each other's competence, they are more likely to engage in constructive communication and collaborative problem solving which enhances their unit's effectiveness (George et al., 2022).

In summary, RC theory states that the coordination of work is most effectively conducted through frequent, high-quality communication and through high-quality relationships among participants. It argues that relationships of shared goals, shared knowledge, and mutual respect support frequent, high-quality communication and vice versa, and that these dimensions jointly enable participants to effectively coordinate their work. Mutual influence between communication and relationships lies at the heart of RC and can improve organizational performance (Bolton et al., 2021).

2.4. How Lean and RC theory might connect to drive performance in a hospital setting

Lean, with an emphasis on continuous improvement and iterative learning, aligns closely with the relational dimensions of RC theory (Bolton et al., 2021; McMackin & Flood, 2019). Both frameworks emphasize the importance of shared goals, shared knowledge, and mutual respect in fostering effective coordination and improving performance in complex environments. Lean nurtures the cross-functional teamwork and problem-solving abilities that are essential for developing strong RC dimensions, particularly during its later,

learning stages (Saabye et al., 2023). By embedding continuous learning into the culture, Lean supports the relational dynamics needed for effective coordination across different departments and disciplines (McMackin & Flood, 2019). In this way, Lean helps break down organizational silos, enabling smoother communication and goal alignment, which are pivotal for hospital-wide coordination efforts. While both Lean and RC theory have been widely studied in healthcare settings, there is limited empirical research examining how the learning stages of Lean impact both the evolution of RC dimensions and organizational performance (Bolton et al., 2021). This gap is critical because understanding how distinct levels of Lean, ranging from the "knowing" to the "learning" stages, affect the development of shared goals, shared knowledge, and mutual respect is essential for leveraging the full potential of both frameworks in highly interdependent environments such as large hospitals. Table 1 outlines how Lean practices correspond to the supporting 'structures' of RC, illustrating the alignment between the two frameworks.

Table 1.
Connecting Lean practices to supporting structures for relational coordination

Supporting structures for relational coordination	Matching Lean practices
Training & teamwork	Team-based continuous improvement Kaizen (Franken et al., 2021; Van Dun & Wilderom, 2016)
Relational job design including clear roles with flexible boundaries and across role coordination (Gittell, 2000)	Organizing tasks and responsibilities for effective collaboration and coordination (Hines, 2022)
Shared accountability across roles for shared goals (Gittell et al., 2010)	A3 and Hoshin Kanri (Barnabè et al., 2019)
Shared conflict resolution to build relationships (Gittell, 2000; Gittell et al., 2010)	Value stream mapping (Marin-Garcia et al., 2021) and Kaizen events (Franken et al., 2021; Hadid & Mansouri, 2014)
Boundary spanner roles to bridge the gap between functional areas (Gittell, 2002)	Lean leadership and Kaizen Events aim to optimize the flow between departments (Casciaro et al., 2019)
Relational leadership to build high-quality relationships between colleagues and supervisors (Gittell, 2002)	Lean leadership emphasizing the importance of strong relationships and effective communication (Netland et al., 2021)
Shared meetings between interdependent roles (Bolton et al., 2021)	Daily stand-up meetings as part of the Lean daily management system (Taher et al., 2016).
Shared protocols that visualize the process and interdependencies (Gittell et al., 2000)	5S, Standard Operating Procedures, and A3 (D'Andreamatteo et al., 2015; Tortorella et al., 2019)
Shared information systems accessible to all relevant stakeholders (Claggett & Karahanna, 2018)	Kanban and visual management (Lanza-León et al., 2021)
Shared spaces to facilitate team collaboration and communication (Bolton et al., 2021)	Visual management and daily stand-up meetings (Taher et al., 2016)

Moreover, we expect that when higher stages of Lean are achieved, e.g., by embedding Lean as a learning system, this will result in stronger RC dimensions and enhanced performance, especially in large hospital settings characterized by high complexity and functional interdependence. This study thus seeks to explore the interrelationship between the four

Lean stages and RC dimensions, addressing a critical gap in the literature on how these stages affect performance improvement in hospitals. While previous research has examined Lean and RC independently, little attention has been given to how they interact and impact performance improvements, particularly in complex healthcare environments. By investigating these dynamics, this research contributes to a deeper understanding of how Lean practices and RC interact to (positively) influence organizational outcomes, offering valuable insights for improving healthcare delivery.

3. METHODOLOGY

3.1. Research design

We used an abductive approach (Ketokivi & Choi, 2014), to explore and potentially extend the existing theory of RC. Our research focused on how the four stages of Lean (Hines et al., 2004) interact with the RC dimensions (shared goals, shared knowledge, and mutual respect) and how these interactions relate to operational performance within large hospitals. Our research employed a multiple-embedded case study approach (Caniato et al., 2018) using retrospective longitudinal process methods (Langley et al., 2013). We collected data from two large Dutch hospitals that had adopted a Lean strategy, whereby we specifically focused on Lean implementations across departments and divisions. An abductive approach using multiple cases is well-suited for exploring and elaborating existing theories. Our examining of real-world practices and interactions in complex settings allows for the iterative development of theory (Edmondson & McManus, 2007), given that both RC and Lean are established but theoretically still evolving concepts (McMackin & Flood, 2019).

3.2. Case selection and description

Using purposive snowball sampling, eight cross-functional units were selected from the two hospitals, with each case representing a specific Lean stage (knowing, understanding, thinking, and learning) as defined by Hines et al. (2004). Both hospitals were organized into divisions that oversaw broader functional areas, such as surgery or internal medicine, which were further subdivided into specific departments, like cardiology or anesthesia. Both hospitals had started implementing Lean three years earlier and their implementation approaches differed: Hospital A (cases 1-4) initiated Lean in a bottom-up fashion while hospital B, started in a top-down way (cases 5-8). To select the four cases in the hospital A, the first author leveraged his role as a Lean consultant in that hospital; he identified all cross-functional Lean initiatives which offered him direct access to all relevant materials. This led to the selection of cases in the knowing and understanding Lean stages; hospital A did not have Lean initiatives in the more mature Lean stages of thinking and learning. Through the first author's network we were then introduced to hospital B (cases 5-8), and selected four more cases, in the Lean thinking and learning stage, using purposive

snowball sampling. In the process of selecting all eight cases we reviewed the available supportive documentation about the purpose and approach of their Lean implementation. Also, in all cases value stream mapping (VSM) exercises were completed and supported by an external Lean consultant to identify bottlenecks and improvement areas. Altogether, this enabled us to select two cases per Lean stage, allowing for a clear comparison of the effects of distinct Lean stages on the development of RC dimensions.

The key characteristics of the eight cases are in Table 2, including the duration of the Lean intervention, involved departments, Lean practices involved (see also Appendix 1 for a clarification of these practices), Lean stage, and interviewees. In all cases every member of the involved departments engaged in the Lean intervention. The interviewees held diverse roles, ranging from nurses and physicians to leaders at various levels, facility, and lab personnel as well as consultants. All interviewees had undergone Lean training at the start of the Lean intervention (T1) and had been working in the hospital for some time, making them well-acquainted with the specific organizational context. While the Lean interventions in cases 1 to 3 were stopped after 6 to 9 months as indicated in Table 2, the other five cases continued Lean after our data collection phase was completed.

3.3. Reflexivity

In qualitative research, such as ours, it is essential to remain aware of potential biases that may arise from the researcher's involvement, particularly when they play dual roles, such as acting both as a researcher and a consultant. As Grodal et al. (2020) pointed out, the researcher's position and background play a significant role in shaping the qualitative research process and outcomes and thus requires researcher reflexivity. In this study, the first author was involved as an external consultant in cases 1 to 4. His dual role in Lean implementation and data collection could have introduced biases that might skew the evaluation of performance outcomes. In these cases, however, Lean implementation was *less* successful compared to cases 5 to 8, where the first author was not involved as a consultant. To mitigate the risk of bias, several strategies were employed. Triangulation of data-collection methods, including interviews, document analysis, and performance metrics, was used to cross-verify findings. Additionally, the first author reflected with the second author, who also had experience as a Lean consultant in hospital settings but was not directly involved in the cases studied here. This collaboration allowed for critical reflection and comparison of findings, helping to reduce the impact of any potential biases.

Table 2.
Key case characteristics and data collection methods

Lean intervention	Case 1	Case 2	Case 3	Case 4
Goal	Improve product delivery	Improve supply chain efficiency	Improving the process of sterile equipment handling	Improve preoperative admission process
Duration	6 months	6 months	9 months	14 months
Involved departments	Medical instruments, purchasing, operating theatre, and intensive care	Logistics and nursing	Central sterilization, operating theatre, and anesthesiology	Polyclinic and laboratories
Lean practices	Training, VSM, visual management, A3	Training, vision, VSM, coaching, visual management, A3	Training, VSM, coaching, visual management, A3, KPIs	Training, vision, VSM, coaching, visual management, A3, KPIs, Kaizen events
Learning type	Knowing	Knowing	Understanding	Understanding
Interviewees	Technicians, purchasers, intensivists, department leader, consultant	Nurses, logistic coordinators, logistics technician, department leader, consultant	Sterile processing technicians, team/ department leaders, anesthesiologist, consultant	Polyclinic staff, laboratory technician, team/ department leaders, consultant
	Case 5	**Case 6**	**Case 7**	**Case 8**
Goal	Increase productivity nursing department and hematology	Improve efficiency between three nursing wards, surgery, and thorax	Reduce door movement operating room to reduce patient infection	Reduce post-surgery operative pain for all patients at all nursing wards
Duration	16 months	18 months	18 months	24 months
Involved departments	Nursing and hematology	Nursing, thorax, and intensive care	Operating theatre, central sterilization, anesthesiology, logistics, recovery, and nursing wards	Nursing wards (all divisions), intensive care, operating theatre, anesthesiology
Lean practices	Training, vision, VSM, coaching, visual management, A3, KPIs, standups, Kaizen events, standard work, 5S, PDCA	Training, vision, VSM, coaching, visual management, A3, KPIs, standups, Kaizen events, standard work, 5S, PDCA	Training, vision, VSM, coaching, visual management, A3, KPIs, standups, Kaizen events, standard work, 5S, PDCA, Gemba	Training, vision, VSM, coaching, visual management, A3, KPIs, standups, Kaizen events, standard work, 5S, PDCA, Hoshin Kanri, Gemba
Learning type	Thinking	Thinking	Learning	Learning
Interviewees	Nurses, team/ department/division leaders, physician, consultant	Nurses, team/ department/division leaders, Medical head, consultant	Nurses, team/ department/division leaders, physicians, consultant	Nurses, team/ department/division leaders, physicians, anesthesiologist, consultant

3.4. Data collection

We conducted 62 *semi-structured interviews* with 32 key stakeholders across two-time points (T1: beginning, and T2: end of the Lean intervention); the interviews took approximately 60 minutes each. The timing of T2 varied, reflecting the different durations of each cross-functional Lean intervention. With six consultants and eight leaders, we had

multiple interviews about the adopted Lean practices and ways of working relating to the coordination of work, bottlenecks, changes, and results over time. Questions were open-ended to avoid confirmation bias, for example: *How would you describe the collaboration with the other department?* And: *How did you engage in cross-functional issues?* We evaluated with the interviewees, whether and how efforts were made to establish common objectives across functions and hospital-wide strategic initiatives. This evaluation assessed the impact of the four Lean stages. 60% of the interviews were audiotaped and then transcribed; the other interviews were documented via elaborate note-taking.

To ensure the validity and reliability of the data collected from the interviews, additional steps were taken. To limit common method bias, interviews were complemented with numerous *documents* including training materials, Lean presentations that introduced the Lean practices, progress data, and the organizational structure and coordination processes (Yin, 2015). Documents were also used to establish chronology in the storyline for each case about how the Lean intervention evolved over time. VSM documentation for each case was gathered at T1, which contained vital information about the current cross-functional process steps for each case and how various roles and departments interacted in the care delivery process. VSM documents also gave insights into bottlenecks between various process substages and provided input per case for determining the state of each RC dimension. We provide an example how we used information from the VSM documents in coding the RC dimensions in Table 3.

Table 3.
Relational coordination (RC) dimensions score at start of Lean adoption

Excerpt from VSM dataset	RC dimension identified	RC score
Case 3: "There is no communication about the status of sterile equipment, we need to know when cleaned and sterilized equipment is available" [physician]. "It is not clear when operation theatre needs sterile equipment, which rooms they need it and when exactly" [Lead instruments].	Communication	Low
Case 4: "Lab results are only received after we have visited our patients". [Nurse]	Shared knowledge	Low
Case 5: "Both management and work floor experienced distance between doctors and nurses. Nursing has the feeling as if the capacity issue is not a joint issue, we have conflicting objectives [between the nursing and physician departments]. There are accusations on both sides, and this is not good for mutual understanding. This has been going on for several months." [nursing lead]	Shared goals / mutual trust	Low / Low
Case 6: "Patient visits are chaotic; we never know when nursing has prepared the patient for discharge". [Physician]	Mutual trust	Low

Key performance indicators (KPIs) for six cases were retrieved from the hospitals' own databases. For cases 1 and 2 we could not collect KPI data. The set of measured KPIs differed

in each case. All KPIs had a clear definition of measurement, start date, frequency, and status, as visualized progress over time compared to its goal. The KPIs were designed to allow the hospital to maintain control over realized productivity, quality, and safety, all of which are closely monitored by regulatory inspections, making it in the hospital's best interest to accurately track these metrics. KPIs were measured on a weekly base in cases 4 to 8, which enabled following the progress meticulously. For instance, in case 5 the progress on KPIs was visualized in graphs on the KPI boards on the wall, whereby the actual progress was compared with a target timeline to understand if the teams were ahead or below the target, and KPI progress indicators were stated in red, orange, or green depending on their state.

3.4. Data analysis

As briefly mentioned in the research design section, our study utilized abductive reasoning, which is particularly useful in cases where existing theories do not fully explain the observed phenomena (Ketokivi & Choi, 2014). Abductive analysis involves iteratively moving between theory and data to get new insights, rather than confirming or refuting hypotheses (Ketokivi & Choi, 2014; Shani et al., 2019). This approach was instrumental in our research as it allowed unexpected findings and refinement of the theoretical RC framework; new patterns emerged from the data in terms of how the interaction between Lean and RC dimensions bridge the hierarchical divides and siloed coordination in a complex setting such as a large hospital.

The analysis began with the creation of detailed single case narratives, where we organized case descriptions chronologically and systematically coded interview transcripts and documents based on the codes for Lean stages (Hines et al., 2004) and RC dimensions (Bolton et al., 2021). This process was also essential for tracing the evolution of Lean implementation within each case (Langley et al., 2013).

Each case was then analyzed separately to observe the evolution of Lean practices and the dimensions of RC from T1 to T2. This allowed us to capture the dynamic nature of Lean implementation and how it interacted with RC over time. The use of extreme case analysis was particularly valuable here. Extreme case analysis is beneficial in highlighting the range of variability within the data, making it easier to discern patterns that might not be evident in more moderate cases (Flyvbjerg, 2006). By focusing on the earliest (knowing) and most advanced (learning) Lean stages, we were able to compare the most divergent cases, which helped to identify critical differences and overlaps in Lean practices, RC dimensions, and their outcomes.

RC was systematically scored as low, medium, or high at both T1 and T2, providing a clear framework for evaluating changes over time. Initially, these assessments were based on VSM outcomes and interviews at T1; they were further refined at T2 through comprehensive case narratives that incorporated all data sources. This method ensured that our scoring was

robust and reflective of the actual changes occurring within each case (Shani et al., 2019). Using a longitudinal process approach, we tracked the progress of Lean adoption over time within each case. For each Lean stage, we mapped the evolution of RC dimensions. For instance, in the understanding stage, we explored how shared knowledge began to emerge through early problem-solving practices like Kaizen Events. In the learning stage, we tracked the application of Lean practices such as Gemba walks and continuous improvement and learning cycles. These practices fostered deeper mutual respect and communication among departments.

Finally, we conducted a cross-case analysis to identify patterns and themes across the eight cases. This step was crucial for understanding the broader implications of our findings and for generalizing the insights gained from individual cases to a wider context. By comparing the eight cases, we were able to develop a more nuanced understanding of how Lean stages and RC dimensions interact to influence the enhancement of organizational performance in large healthcare settings.

4. RESULTS

This chapter presents the performance outcomes and changes observed across eight hospital cases, examined through the lens of Lean stages and their interaction with RC dimensions, highlighting how these elements collectively influenced hospital improvements. From Table 4 it becomes clear that three out of the four knowing and understanding cases did not lead to any results when it comes to performance improvement. Only case 4 managed to increase patient satisfaction and reduced patient waiting time by 15%. Furthermore, both thinking cases were successful, increasing among others hospital revenues, productivity, cost efficiency, and bed utilization. In case 5, however, it came with a price as nurses' perceived work pressure increased. Finally, both learning cases achieved positive results, even though they were also the most complex ones due to the involvement of multiple disciplines and divisions across the entire hospital. Case 8 even resulted in 72% reduction of pain perceived by patients after surgery: a novel KPI that they had never been able to implement before. Each case thus demonstrated varying degrees of performance improvements, which are further highlighted below. The cross-case analysis documented how RC evolved across the eight cases, influenced by the integration of Lean practices through distinct Lean stages.

Table 4.
Cross-case analysis

Case	1		2		3		4	
Type	Knowing		Knowing		Understanding		Understanding	
Results	No results, stopped after 6 months		No results, stopped after 6 months		No results, stopped after 9 months		10% increase patient satisfaction, 15% patient wait time reduction	
Period	T1	T2	T1	T2	T1	T2	T1	T2
Shared goals	L	L	L	M	L	M	L	H
Shared knowledge	L	L	L	L	L	L	L	H
Mutual respect	L	L	L	L	L	L	L	M
Communication	L	M	L	M	L	M	L	H

Case	5		6		7		8	
Type	Thinking		Thinking		Learning		Learning	
Results	28% increase of transplantations, 12.5% productivity increase, but increased work pressure		10% cost reduction nursing wards, 13% increase bed utilization, increased job satisfaction		84% reduction door movement in 16 operating rooms including 5 surgery disciplines		72% reduction patient pain perceived after surgery	
Period	T1	T2	T1	T2	T1	T2	T1	T2
Shared goals	L	H	L	H	L	H	L	H
Shared knowledge	L	H	L	H	L	H	L	H
Mutual respect	L	H	L	H	L	H	L	H
Communication	L	H	L	H	L	H	L	H

Note. L = Low, M = Medium, H = High.

In the following section, we present the results by first discussing how Lean practices and RC dimensions evolved in each Lean stage. First, we examine the knowing stage with the introduction of Lean practices. Next, we analyze the understanding stage, focusing on improvements in problem-solving and collaboration. Then, we explore the thinking stage, emphasizing interdepartmental collaboration. Finally, we discuss the learning stage, where Lean practices were fully integrated, driving continuous improvement and learning.

In the knowing stage (cases 1-2), cross-functional teams began by familiarizing themselves with Lean practices such as training, KPIs, VSM, standups, visual management, Kaizen, and A3 thinking. While this initial phase helped set the foundation by addressing immediate operational challenges, the teams struggled with sustaining Lean efforts. A department head in case 1 noted: "*Lean Projects have started. Each one starting full of enthusiasm, but later it is hard to complete the full Lean cycle, because we are not trained - do not have the tools and knowledge on how to proceed - and that is fatal.*" Despite efforts to establish KPIs to promote shared goals, there was limited knowledge sharing and low levels of trust between teams. Teams were primarily focused on learning new Lean practices rather than

collaboration. However, a shift began with the introduction of more focused operational discussions, driven by standups and Kaizen events. These practices sparked an emerging interest in deeper engagement with Lean adoption. As indicated by a team leader in case 2 "*Before, problems were discussed all over the place, but nothing happened. Now, once we discover a problem, it is posted on the action board, we collaboratively decide who will solve it."* While knowledge sharing remained limited in this early stage, Lean practices marked the first steps toward more collaborative communication and shared goals.

The understanding stage (cases 3- 4) showed promising developments. External consultants provided coaching, which empowered leaders and teams to use Lean practices more effectively. Teams became more proactive in problem solving during standups, Kaizen, and A3 thinking events. The consultant who worked on case 4 explained: "*Teams that have been engaged in Kaizen improved their problem-solving skills; more issues are highlighted and teams take responsibility to solve the issues."* Team leaders in case 4 shifted from direct problem solving to facilitating a more collaborative and empowered workforce, sharing knowledge, with goals starting to fuse more around joint operational improvements. This evolution led to visible improvements in operational efficiency and patient interaction. In contrast, case 3 struggled with limited interdepartmental collaboration and weak problem-solving capabilities. Though there were signs of improvement with the introduction of operational discussions, overall progress remained slow.

The thinking stage marked a turning point, where teams began addressing more complex, interdepartmental challenges through collaborative problem solving. A medical lead in case 6 stated: "*Through Kaizen Events and standups we discuss problems standing around two whiteboards. The value of having various disciplines* [in the discussion]*, is making more detailed inquiries about a topic. Asking other colleagues if they had similar problems helped immensely in implementing the best solution."* In this stage, Lean practices like Gemba walks, standups, and Kaizen played a pivotal role in bridging departmental gaps, and fostering collaboration, reinforced by shared goals. Interdepartmental collaboration became more structured and problem solving more proactive. Weekly standups allowed department leaders to raise unresolved issues to the division level for further discussion. As a nurse in case 5 shared: "*Through weekly standups our department managers can present issues and opportunities at division level: problems that cannot be solved at departmental level."* These standups not only facilitated communication but also laid the groundwork for aligning goals across departments, moving away from siloed operations towards a more integrated approach. Leaders gained new insights from direct observation at the frontline, rather than relying solely on office-based decision-making. As a department leader in case 6 reflected: *"We believed that we knew from our office desks what was happening and built solutions around our beliefs, until we took our blue* [nursing] *suit and started to do a walk for two hours every day. If you do this for a few weeks, your perception of reality is*

changing." These Gemba walks helped leaders to better understand the actual challenges faced by frontline staff, allowing them to develop solutions that were more grounded in day-to-day operations.

The thinking stage also showed significant improvement in interdepartmental communication. In case 5, initial tensions between nurses and physicians gave way to more collaborative interactions. A nursing division leader recalled how, over time, physicians began to actively participate in Lean sessions, *"At first, physicians did not join the sessions and we always took the side of the patient. During one session, one physician joined but she came in late. She explained why; she had been working on an urgent patient matter. Then our irritation was gone. Over time more physicians joined, which enriched discussions. I now see nurses and physicians having fun and at the same time bringing serious topics to the table."* This shift towards reciprocal communication fostered greater mutual respect and stronger collaborative problem solving, which became essential for addressing more complex challenges. Additionally, enhanced feedback loops between nurses and physicians improved communication and problem-solving effectiveness. Cases 5 and 6 both demonstrated a robust infrastructure for shared problem solving, whereas earlier cases struggled to fully embed these practices. Operational efficiencies became more visible, and problem-solving teams grew more empowered, setting the stage for further integration of Lean practices into the hospital. Key achievements of the thinking stage included strong interdepartmental collaboration, strong alignment of departmental goals, and enhanced cross-functional problem-solving capabilities. As a division leader in case 5 noted: "*Before, we only had our production measure, but over the past 2 years our monitoring model completely changed, we measure patient safety, like surgical site infections, medication errors, dismissal dates and operational effectiveness like patient wait times, where we have clear targets."* This focus on measurable outcomes reinforced a shared commitment to both operational efficiency and patient care, aligning goals across departments.

The Learning stage, cases 7 and 8, represented the full integration of Lean practices and the expansion of an improvement infrastructure across the entire hospital. This phase was characterized by frequent Kaizen events, cross-functional problem solving, and Gemba walks which collectively fostered a culture of continuous improvement. The emphasis on both individual and group learning was key to this stage, as employees at all levels began to take ownership of continuous improvement and develop a deeper understanding of their interdependencies within the hospital system. In case 8, a physician shared how communication evolved, *"Team leaders started to connect about ideas. Successful ideas in one department were adopted in other departments. We have much more discussions with each other instead of about each other."* This shows how group learning and open communication became embedded, allowing ideas to spread across departments. Strategic alignment in case 8 was achieved through the implementation of interconnected Plan-Do-

Check-Act (PDCA) cycles and Hoshin kanri. These Lean practices ensured that improvement initiatives were aligned with the hospital's long-term strategic goals. For example, the hospital-wide focus on reducing post-operative pain led to the establishment of a standardized pain reduction protocol, which involved collaboration between anesthesiology, surgery, and nursing teams. As a result, post-operative pain levels decreased dramatically across all departments, demonstrating the impact of system thinking in aligning improvement efforts across various functional units.

Leadership at all levels (i.e., team, department, division, and executive leadership) adopted a facilitative, coaching-based approach, empowering employees to lead improvement initiatives. A department head in case 8 explained: *"You can also ask your staff, 'What do you think? What do these problems consist of, and how significant are they? What are some workable solutions? By engaging and involving them in this way, you will notice that they begin to take ownership."* This reflects the growth of individual learning, as employees became more engaged and began to contribute valuable insights, fostering a culture of mutual respect. The same department head also noted a shift in mindset and a growing culture of mutual respect describing an unexpected change in the behavior of one of his team members: "*By consistently involving her and valuing her input, she not only became more engaged but also thrived, contributing exceptional ideas that exceeded our expectations*." A similar change was presented in case 7, where department leaders encouraged staff to take responsibility for improvement projects. As a nurse from Case 7 noted: *"We no longer wait for directives from management. If we see a problem, we solve it ourselves or bring it to the next standup for discussion."* This empowered approach led to tangible improvements, such as reducing operating-room delays through collaborative Kaizen events that brought together ideas from surgeons, nurses, and administrative staff. Gemba walks were another key practice of the learning stage. In case 7**,** hospital leaders at various levels participated in daily Gemba walks to observe and interact with frontline employees directly. This practice not only enhanced the visibility of operational challenges but also created a culture of open communication, where staff felt empowered to voice concerns and propose improvements. A division leader from case 7 remarked: *"Our daily Gemba walks have become the most valuable tool for us to identify process inefficiencies and engage employees in real-time problem solving."*

The integration of Kaizen events, A3 problem solving, and Gemba walks further strengthened a culture of continuous improvement. The use of A3 problem-solving techniques, combined with PDCA cycles, enabled members in case 7 to systematically address recurring issues in patient safety, such as unnecessary door movements in the operating theatre, which was reduced by 84%. The integration of Lean practices not only broadened the scope of improvement initiatives from localized operational issues to extensive, cross-departmental efforts, but also deepened the integration of shared goals, where strategic objectives were

aligned across departments. Or, as the journey was explained by a division leader in case 8: "*I am not just sitting at my desk anymore, sending emails that I want to see progress. I dive into the problem together with various nursing wards and discuss with department leaders how to improve. We have put endless efforts in standardizing our metrics throughout the entire hierarchy, and every morning at 12 o'clock I receive a beautiful visual chart that indicates the results of all participating departments. Just this week, at our meeting at the executive board, we could show a positive trend.*" This illustrates how shared goals, shared knowledge, and mutual respect came together through a shared infrastructure, where leaders facilitate collaboration via a standardized system, with interconnected goals at multiple levels, driving collective progress and continuous improvement.

The increasing use of data for evidence-based improvement became a foundational element for continuous learning and adaptation during the learning stage. As an operating theatre division leader of case 7 explained: *"Through our integrated PDCA cycles we now have a shared KPIs to reduce failings to start surgery. Our aim is to reduce this to 2% and we have related KPIs at all clinics* [the maximum time to deliver patients to the operating ward is 15 minutes]. *Clinic leads and operating wards now have a continuous information channel to communicate deviations from the scheduled time."* Interconnected PDCA cycles at both the department (horizontal) and division (vertical) levels enhanced shared goals and knowledge, and strengthened communication. The success of multidisciplinary A3 problem-solving projects further demonstrated elevated levels of shared knowledge and mutual respect. A partnership between the Cardiology team and a neighboring hospital, in case 7, led to a significant reduction in errors in the Cardiac Care Unit. A physician explained: *"Our division leader called a colleague from the other hospital and organized a session with their Cardiology team. It appeared, once we explained our problem, that the other hospital team was not aware of our protocol. Once we had organized an alignment session, the errors in our Cardiac care unit dropped from 14 to 0 in 5 weeks. This was a brilliant success, because together we did something that we did not expect to happen: making improvement across the borders of our hospital."*

In conclusion, it is evident that advancing through the Lean stages, particularly in the thinking and learning phase, facilitates the strengthening of RC dimensions, enabling the achievement of performance improvements that span across multiple departments and disciplines.

5. DISCUSSION

This research aims to examine how the various stages of Lean implementation (Hines et al., 2004) interact with the RC dimensions to improve performance in large or complex healthcare

settings. The cross-case analysis reveals that starting from the Lean thinking stage (Hines et al., 2004), integration between Lean practices and RC dimensions accelerates, enhancing RC levels, and in turn improving performance. We now first explain how the existing RC theory of Bolton et al. (2021) must be expanded to address the complexity of large hospitals (Fournier & Jobin, 2018). We propose adding a *shared infrastructure,* as a new relational dimension to better support the complex dynamics in a hospital setting, as depicted in Figure 1. Then, we suggest that achieving the final Lean learning stage and concomitant RC contributes to improved performance in hospitals.

The cases in the early Lean stages exhibit low levels of RC, largely due to the inherent complexity of healthcare work where hierarchical structures and siloed roles often obstruct cross-functional and other coordination (Fournier et al., 2023). Incremental improvements arise from more frequent and problem-solving type communication, primarily through VSM, which raises awareness of inter- and intradepartmental interdependencies and bottlenecks (Marin-Garcia et al., 2021). However, early-stage communication functions more as a procedural requirement of Lean practices rather than a substantive mechanism for collaboration. Only in later Lean stages, e.g., Lean thinking and Lean learning, more significant advancements in RC become evident. For instance, shared goals are more effectively embedded into collaborative initiatives, marking a shift from top-down goal setting to a more inclusive process (Eldor, 2020). The inclusion of all employees in creating a shared vision ensures that each participant's voice is heard and valued, which fosters an environment of mutual respect (Fournier et al., 2023). When individuals feel their contributions are recognized and integrated into the overall objectives, respect for one another's roles and expertise naturally increases (Galeazzo et al., 2014). The adoption of Lean practices like Kaizen events, daily standups, Gemba walks, and A3 problem solving facilitates timely, accurate, and problem-solving communication, which is crucial for addressing complex issues and improving coordination (Bolton et al., 2021). Lean practices encourage team members to work together across disciplines and force them to engage in constructive dialogue, share insights and knowledge, and collaborate on solutions (McMackin & Flood, 2019), which in turn enhances mutual understanding and respect (Coetzee et al., 2019). By addressing complex challenges together, team members develop a deeper appreciation for the skills and knowledge that others bring to the table (Edmondson & Lei, 2014).

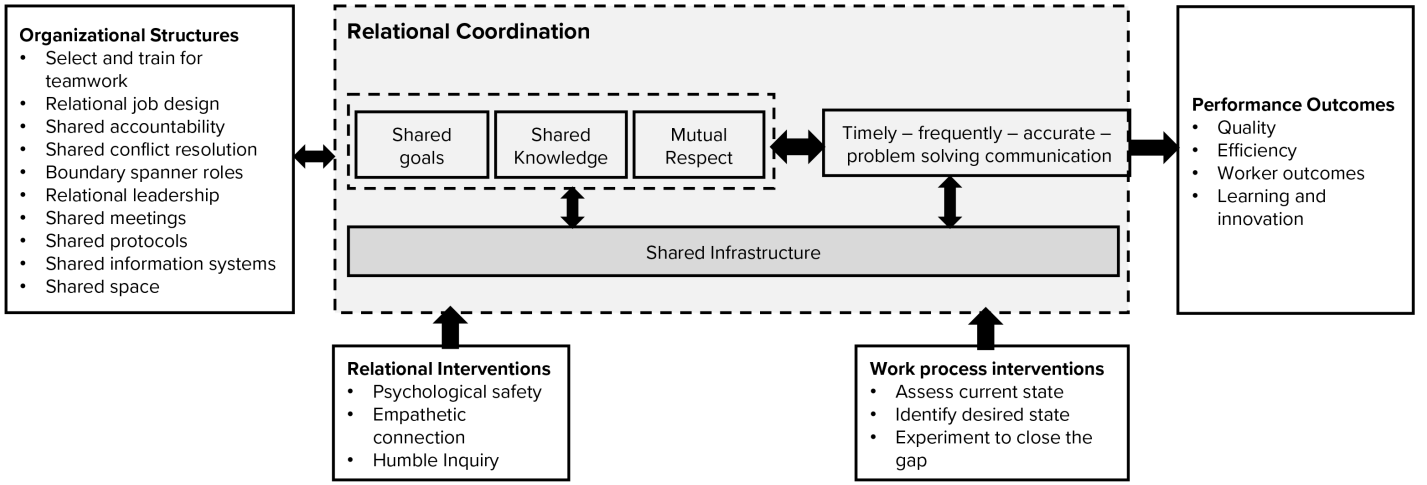

Figure 1.
Updated Relational Coordination Theory framework adapted from Bolton et al. (2021, p. 292)

In cases 5 to 8, the thinking and learning stages of Hines et al. (2004), we observed the emergence of a 'shared infrastructure' as a new RC dimension. This shared infrastructure refers to the integration of organizational, relational and technical systems (Anand et al., 2009) that support the RC dimensions of shared goals, shared knowledge, mutual respect, and communication. Drawing on Anand et al. (2009), a shared infrastructure includes standardized Lean practices, such as PDCA cycles, Kaizen events, and A3 thinking, creating a common language for problem solving across departments (Jiang et al., 2015; Jiang et al., 2016). These practices promote continuous learning by establishing lateral and parallel participation, consisting of cross-functional teams, allowing RC dimensions to grow hospital-wide (Anand et al., 2009). Shared infrastructure facilitates continuous learning and co-creation (Van Beers et al., 2022), bridges hierarchical divides and ensures that RC is actively practiced, thus driving performance (Galeazzo et al., 2017). This concept is particularly relevant in hospital settings, where the complexity of operations requires robust structures to support relational coordination (Fournier & Jobin, 2018). The relational dimension of a shared infrastructure is critical to sustaining an environment of continuous learning and adaptation (Galeazzo et al., 2017). For example, integrated Kaizen events create a conducive environment to learn and improve (Anand et al., 2009). Participatory practices, such as Kaizen events and A3 problem-solving sessions, engage multidisciplinary teams in tackling complex challenges, thereby building shared knowledge and mutual trust (Choo et al., 2007). Co-creation processes, including Gemba walks and standups, facilitate regular interactions between team members and leaders, reinforcing shared goals and mutual respect (Van Beers et al., 2022). Knowledge brokers, such as internal consultants and leaders at various levels, play a critical role in this shared infrastructure by enhancing prioritizing and collaboration across departments and ensuring that the knowledge and best practices are effectively disseminated and adopted (Burgess & Currie, 2013; Burke, 2014). Ultimately, shared infrastructure helps to break down silos and mitigate resistance from nurses, physicians and other professionals in a hospital who may be reluctant to embrace new ways of working (Leite et al., 2022). The relational dimension of shared infrastructure thus becomes a crucial enabler for other RC dimensions. Hence, we propose:

> P1. *In complex healthcare environments a shared infrastructure builds Lean practices and fosters relational coordination by promoting continuous learning, dismantling hierarchical barriers, and cultivating shared goals, shared knowledge, mutual respect, and communication. This, in turn, enhances overall organizational performance.*

Although the adoption of Lean up until the final Lean learning stage has not been extensively explored in the academic context of hospitals, this study demonstrates that the Lean learning stage enables hospitals to embed an organizational culture deeply rooted in continuous improvement and structured problem solving (Saabye et al., 2023). As Lean

becomes integrated into daily routines, communication across departments becomes more collaborative, fostering a systematic approach to tackling complex, interdependent challenges such as improving patient care and operational efficiency (Fournier & Jobin, 2018). Lean, in this context, is fully integrated into the hospital's decision-making processes and continuous learning cycles (Saabye et al., 2022). This integration transforms collaboration into a learning-oriented endeavor (Barker Scott & Manning, 2022), showing temporary hubs of employees participating through A3 thinking (Mortensen & Haas, 2018) and having employees seek both improvement and learning in cross-functional value streams (Cross et al., 2008; Marin-Garcia et al., 2021).

The evolution of hospitals into learning organizations aligns with Kristensen et al. (2022), who highlight the importance of developing "learning-to-learn" capabilities. In this framework, leaders transcend traditional managerial roles to become facilitators of learning, guiding both individual and group learning through knowledge articulation and codification processes (Furlan et al., 2019). This transformation, described in the cross-case analysis, aligns with the broader concept of learning organization (Marsick & Watkins, 2003), wherein problem-solving capabilities are continuously developed, and knowledge is actively disseminated across a hospital (Ballé et al., 2019; Saabye et al., 2022; Tortorella, Fettermann, et al., 2019). Social Lean practices, such as standups, Gemba walks, and Kaizen events, play a critical role in this transformation by fostering environments of shared reflection and continuous feedback (Bortolotti et al., 2018; Cua et al., 2001). These practices break down departmental silos and create a culture where learning and problem solving become collective rather than isolated activities. As addressed in the former paragraph, building a shared infrastructure is essential for the learning routines to flourish across the entire hospital. (Anand et al., 2009; Galeazzo et al., 2017) to create systems to capture and share learnings across the organization (Kristensen et al., 2022).

Thus, achieving the Lean learning stage in hospitals has the potential to achieve sustainable performance improvements. These advancements are driven by the establishment of a robust culture of collaboration, built upon shared goals, shared knowledge, mutual respect, effective communication, and the ongoing reinforcement of a shared infrastructure. Therefore, we propose:

> P2. *During the final Lean learning stage, hospitals can achieve highly sustainable performance improvements in healthcare delivery, driven by a well-developed collaborative culture of shared goals, shared knowledge, mutual respect, and effective communication, as well as a widely shared infrastructure.*

In summary, this study presents an adapted RC framework specifically tailored to hospitals,

aiding them in navigating the complexities of modern healthcare while enhancing organizational performance, with learning playing a pivotal role in this process.

6. PRACTICAL IMPLICATIONS

This paper can serve as a practical guide for change agents and leaders seeking to integrate Lean practices while building effective RC within large hospitals. Being complex systems, large hospitals need an overarching shared infrastructure that supports learning and collaboration within and among all departments. This study outlines how to create such coordination structures: by integrating hospital-wide Lean practices that promote shared goals, and shared knowledge, and foster mutual respect and effective communication, culminating in a shared learning infrastructure that ensures that many Lean practices are aligned with one another throughout the entire hospital.

The key to successful Lean adoption in complex organizations is establishing this supportive, organization-wide shared infrastructure that connects diverse professional groups and departmental silos. Such a shared infrastructure could be well-suited for supporting integrated care pathways, ensuring that units work together more effectively. As a hospital manager, having a shared infrastructure in place can be a game changer for both day-to-day operations and long-term outcomes. Imagine being able to move patients more quickly through their care journey because every department—whether it is surgery, nursing, or administration—has the information they need at their fingertips. Patient discharges happen more efficiently because the process is standardized, and nurses and physicians are aligned and collaborate to oversee flexibility or changes every day.

Leaders play a critical role in establishing both Lean and RC, so hospitals must move away from hierarchical, directive leadership models toward facilitative leadership styles that support collaboration and shared learning. Facilitative leaders connect people, promote open communication, and bridge gaps between disciplines and departments. This leadership style is essential for establishing and reaching shared goals, particularly in environments where professional identities and expertise can be a source of division. Leaders who emphasize support, rather than control, ensure that improvements are co-created and sustained across the organization.

The practical implications of this research are not limited to hospitals. In other large, bureaucratic organizations—such as government agencies, academic institutions, and manufacturing or large knowledge-intensive firms, the interaction between Lean and RC can be similarly leveraged to align departments and disciplines, foster collaborative problem solving, and create resilient learning systems. Leaders across these sectors can

draw on the lessons from this paper to create systems that intertwine Lean practices with RC, creating an adaptive, learning-oriented organization capable of sustaining high, patient- or client-oriented performance.

7. STRENGTHS, LIMITATIONS, AND FUTURE RESEARCH

This paper makes several key contributions to understanding the intersection between Lean stages and RC in complex healthcare environments. By introducing the novel dimension of *shared infrastructure* to the RC framework, this research expands the RC theory necessary for effective coordination in hospital settings. Furthermore, it highlights how Lean's evolution from a practice-based approach to a learning system facilitates deeper integration of RC dimensions. A clear strength of this study lies in its longitudinal, multi-case approach, which allows for a detailed exploration of how Lean and RC interact over time across the four varying stages of Lean. By focusing on hospitals as complex systems, characterized by high interdependence, this study provides actionable insights for industries where coordination across functional and hierarchical boundaries is crucial for high patient- or client-driven performance.

The present study has some main limitations. First, the research focuses on specific hospital settings in the Netherlands, which may limit the generalizability of findings to other healthcare systems or sectors outside healthcare. Second, while the eight case studies provide rich, detailed insights, they may not capture the full spectrum of variables affecting the quality of RC. The in-depth nature of the case studies allows for a comprehensive understanding but may lack the generalizability to non-hospital settings. Third, this research does not include the role of external organizational factors, such as regulatory pressures, financial constraints, or patient-population demographics. These factors could also significantly influence the performative development of RC. Another potential source of bias arises from the imbalance in available documents between the cases: in hospital A (cases 1-4), where the first author had a consulting role, we had more access compared to hospital B (cases 5-8). To mitigate this, we focused on gathering comparable data from key stakeholders across all cases and held regular reflective sessions between the first and second author to challenge the first author's assumptions.

It is crucial to better understand the sequencing of the RC dimensions and to explore the newly introduced dimension of shared infrastructure. Future studies should focus on an even more detailed examination of how the four RC dimensions are interconnected and influence each other over time in settings without Lean adoption. Moreover, the construct of *shared infrastructure* introduced in this paper requires more rigorous examination.

Quantitative studies that measure the effects of this shared infrastructure in relation with the other RC dimensions on performance outcomes are needed to advance the RC theory even further. A mixed methods approach could also be valuable, combining quantitative data to establish patterns and qualitative data to explore the underlying dynamic mechanisms of a shared infrastructure. The present research broadens RC theory and sets the stage for exploring how a shared infrastructure within an organization contributes to high-quality coordination as well as learning and performance for all stakeholders involved.

8. REFERENCES

Anand, G., Ward, P. T., Tatikonda, M. V., & Schilling, D. A. (2009). Dynamic capabilities through continuous improvement infrastructure. *Journal of Operations Management 27*(6), 444-461. https://doi.org/10.1016/j.jom.2009.02.002

Ballé, M., Chaize, J., & Jones, D. (2019). Lean as a learning system: what do organizations need to do to get the transformational benefits from Toyota's method? *Development and Learning in Organizations*, *33*(3), 1-4. https://doi.org/10.1108/dlo-11-2018-0147

Barker Scott, B. A., & Manning, M. R. (2022). Designing the collaborative organization: a framework for how collaborative work, relationships, and behaviors generate collaborative capacity. *The Journal of Applied Behavioral Science*, *60*(1), 149-193. https://doi.org/10.1177/00218863221106245

Barnabè, F., & Giorgino, M. C. (2017). Practicing lean strategy: hoshin kanri and x-matrix in a healthcare-centered simulation. *The TQM Journal*, *29*(4), 590-609. https://doi.org/10.1108/tqm-07-2016-0057

Barnabè, F., Guercini, J., & Perna, M. D. (2019). Assessing performance and value-creation capabilities in Lean healthcare: insights from a case study. *Public Money & Management*, *39*(7), 503-511. https://doi.org/10.1080/09540962.2019.1598197

Bolton, R., Logan, C., & Gittell, J. H. (2021). Revisiting relational coordination: a systematic review. *The Journal of Applied Behavioral Science*, *57*(3), 290-322. https://doi.org/10.1177/0021886321991597

Bortolotti, T., Boscari, S., Danese, P., Medina Suni, H. A., Rich, N., & Romano, P. (2018). The social benefits of kaizen initiatives in healthcare: an empirical study. *International Journal of Operations & Production Management*, *38*(2), 554-578. https://doi.org/10.1108/ijopm-02-2017-0085

Burgess, N., & Currie, G. (2013). The knowledge brokering role of the hybrid middle level manager: the case of healthcare. *British Journal of Management*, *24*(1), 132-S142. https://doi.org/10.1111/1467-8551.12028

Burgess, N., & Radnor, Z. (2013). Evaluating lean in healthcare. *International Journal of Health Care Quality Assurance*, *26*(3), 220-235. https://doi.org/10.1108/09526861311311418

Burke, W. W. (2014). Changing loosely coupled systems. *The Journal of Applied Behavioral Science*, *50*(4), 423-444. https://doi.org/10.1177/0021886314549923

Caniato, F., Doran, D., Sousa, R., & Boer, H. (2018). Designing and developing OM research: from concept to publication. *International Journal of Operations & Production Management*, *38*(9), 1836-1856. https://doi.org/10.1108/ijopm-01-2017-0038

Casciaro, T., Edmondson, A. C., & Jang, S. (2019). Cross-silo leadership. *Harvard Business Review*, *97*(3), 130-139.

Choo, A. S., Linderman, K. W., & Schroeder, R. G. (2007). Method and context perspectives on learning and knowledge creation in quality management. *Journal of Operations Management*, *25*(4), 918-931. https://doi.org/10.1016/j.jom.2006.08.002

Claggett, J. L., & Karahanna, E. (2018). Unpacking the structure of coordination mechanisms and the role of relational coordination in an era of digitally mediated work processes. *Academy of Management Review*, *43*(4), 704-722. https://doi.org/10.5465/amr.2016.0325

Coetzee, R., Van Dyk, L., & Van der Merwe, K. R. (2019). Towards addressing respect for people during lean implementation. *International Journal of Lean Six Sigma*, *10*(3), 830-854. https://doi.org/10.1108/ijlss-07-2017-0081

Cross, R., Ehrlich, K., Dawson, R., & Helferich, J. (2008). Managing collaboration: improving team effectiveness through a network perspective. *California Management Review*, *50*(4), 74-98. https://doi.org/10.2307/41166457

Cua, K. O., McKone, K. E., & Schroeder, R. G. (2001). Relationships between implementation of TQM, JIT, and TPM and manufacturing performance. *Journal of operations management*, *19*(6), 675-694. https://doi.org/10.1016/S0272-6963(01)00066-3

Cusumano, M. A., Holweg, M., Howell, J., Netland, T., Shah, R., Shook, J., Ward, P., & Womack, J. (2021). Commentaries on "The lenses of lean". *Journal of Operations Management*, *67*(5), 627-639. https://doi.org/10.1002/joom.1138

D'Andreamatteo, A., Lanni, L., Lega, F., & Sargiacomo, M. (2015). Lean in healthcare: a comprehensive review. *Health Policy*, *119*(9), 1197-1209. https://doi.org/https://doi.org/10.1016/j.healthpol.2015.02.002

Danese, P., Manfè, V., & Romano, P. (2018). A systematic literature review on recent lean research: state-of-the-art and future directions. *International Journal of Management Reviews*, *20*(2), 579-605. https://doi.org/10.1111/ijmr.12156

de Souza, L. B. (2009). Trends and approaches in lean healthcare. *Leadership in Health Services*, *22*(2), 121-139. https://doi.org/10.1108/17511870910953788

Edmondson, A. C., & Lei, Z. (2014). Psychological safety: the history, renaissance, and future of an interpersonal construct. *Annual Review of Organizational Psychology and Organizational Behavior*, *1*(1), 23-43. https://doi.org/10.1146/annurev-orgpsych-031413-091305

Edmondson, A. C., & McManus, S. E. (2007). Methodological fit in management field research. *Academy of Management Review*, *32*(4), 1246-

1264. https://doi.org/10.5465/amr.2007.26586086

Eldor, L. (2020). How collective engagement creates competitive advantage for organizations: a business-level model of shared vision, competitive Intensity, and service performance. *Journal of Management Studies*, *57*(2), 177-209. https://doi.org/10.1111/joms.12438

Fenner, S. V., Arellano, M. C., Von Dzengelevski, O., & Netland, T. H. (2022). Effect of lean implementation on team psychological safety and learning. *International Journal of Operations & Production Management*, *43*(2), 308-331. https://doi.org/10.1108/ijopm-04-2022-0238

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, *12*(2), 219-245. https://doi.org/10.1177/1077800405284363

Fournier, P.-L., Bahl, L., Van Dun, D. H., Johnson, K. J., & Cadieux, J. (2023). Let's talk about it: the impact of nurses' implicit voice theories on individual agility and quality of care. *International Journal of Operations & Production Management*, *44*(5), 1007-1033. https://doi.org/10.1108/ijopm-11-2022-0752

Fournier, P., & Jobin, M. (2018). Understanding before implementing: the context of Lean in public healthcare organizations. *Public Money & Management*, *38*(1), 37-44. https://doi.org/10.1080/09540962.2018.1389505

Franken, J. C. M., Van Dun, D. H., & Wilderom, C. P. M. (2021). Kaizen event process quality: towards a phase-based understanding of high-quality group problem-solving. *International Journal of Operations & Production Management*, *41*(6), 962-990. https://doi.org/10.1108/ijopm-09-2020-0666

Furlan, A., Galeazzo, A., & Paggiaro, A. (2019). Organizational and perceived learning in the workplace: a multilevel perspective on employees' problem solving. *Organization Science*, *30*(2), 280-297. https://doi.org/10.1287/orsc.2018.1274

Galeazzo, A., Furlan, A., & Vinelli, A. (2014). Understanding environmental-operations integration: the case of pollution prevention projects. *International Journal of Production Economics*, *153*, 149-160. https://doi.org/10.1016/j.ijpe.2014.02.015

Galeazzo, A., Furlan, A., & Vinelli, A. (2017). The organizational infrastructure of continuous improvement – an empirical analysis. *Operations Management Research*, *10*(1-2), 33-46. https://doi.org/10.1007/s12063-016-0112-1

George, G., Chaturvedi, S., Corbishley, C., & Atun, R. (2022). Relational co-ordination and stigma at work: how frontline employees ompensate for failures in public health systems. *Journal of Management Studies*, *61*(3), 752-784. https://doi.org/10.1111/joms.12813

Ghosh, S., & Wu, A. (2023). Iterative coordination and innovation: prioritizing value over novelty. *Organization Science*, *34*(6), 2182-2206. https://doi.org/10.1287/orsc.2021.1499

Gittell, J. H. (2000). Organizing work to support relational co-ordination. *International Journal of Human Resource Management*, *11*(3), 517-539. https://doi.org/10.1080/095851900339747

Gittell, J. H. (2002). Coordinating mechanisms in care provider groups: relational coordination as a mediator and input uncertainty as a moderator of performance effects. *Management Science*, *48*(11), 1408-1426. https://doi.org/10.1287/mnsc.48.11.1408.268

Gittell, J. H. (2006). *Relational coordination: coordinating work through relationships of shared goals, shared knowledge and mutual respect*. Camberley. Edward Elgar Publishing Ltd. https://doi.org/10.4337/9781781950548

Gittell, J. H. (2011). *Relational coordination: guidelines for theory, measurement and analysis*. Waltham, Massachusetts. Brandeis University.

Gittell, J. H., Fairfield, K. M., Bierbaum, B., Head, W., Jackson, R., Kelly, M., Laskin, R., Lipson, S., Siliski, J., & Thornhill, T. (2000). Impact of relational coordination on quality of care, postoperative pain and functioning, and length of stay: a nine-hospital study of surgical patients. *Medical Care*, *38*(8), 807-819. https://doi.org/jstor.org/stable/3766961

Gittell, J. H., Seidner, R., & Wimbush, J. (2010). A relational model of how high-performance work systems work. *Organization Science*, *21*(2), 490-506. https://doi.org/10.1287/orsc.1090.0446

Graban, M. (2008). *Lean Hospitals: improving quality, patient safety, and employee satisfaction*. New York, NY. Productivity Press.

Grodal, S., Anteby, M., & Holm, A. (2020). Achieving rigor in qualitative analysis: the role of active categorization in theory building. *Academy of Management Review*, *46*(3), 591-612. https://doi.org/10.5465/amr.2018.0482

Hadid, W., & Mansouri, S. A. (2014). The lean-performance relationship in services: a theoretical model. *International Journal of Operations and Production Management 34*(6), 750-785. https://doi.org/10.1108/IJOPM-02-2013-0080

Hines, P. (2022). Human centred lean: introducing the people value stream. *International Journal of Lean Six Sigma*, *13*(5), 961-988. https://doi.org/10.1108/IJLSS-03-2021-0061

Hines, P., Holweg, M., & Rich, N. (2004). Learning to evolve: a review of contemporary lean thinking. *International Journal of Operations & Production Management*, *24*(10), 994-1011. https://doi.org/10.1108/01443570410558049

Jiang, W., Mavondo, F. t., & Matanda, M. J. (2015). Integrative capability for successful partnering: a critical dynamic capability. *Management Decision*,

53(6), 1184-1202. https://doi.org/10.1108/md-04-2014-0178

Jiang, Y., Jackson, S. E., & Colakoglu, S. (2016). An empirical examination of personal learning within the context of teams. *Journal of Organizational Behavior*, *37*(5), 654-672. https://doi.org/https://doi.org/10.1002/job.2058

Johnson, M., Burgess, N., & Sethi, S. (2019). Temporal pacing of outcomes for improving patient flow: design science research in a national health service hospital. *Journal of Operations Management*, *66*(1-2), 35-53. https://doi.org/10.1002/joom.1077

Ketokivi, M., & Choi, T. (2014). Renaissance of case research as a scientific method. *Journal of Operations Management*, *32*(5), 232-240. https://doi.org/10.1016/j.jom.2014.03.004

Kristensen, T. B., Saabye, H., & Edmondson, A. (2022). Becoming a learning organization while enhancing performance: the case of LEGO. *International Journal of Operations & Production Management*, *42*(13), 438-481. https://doi.org/10.1108/ijopm-10-2021-0676

Langley, A., Smallman, C., Tsoukas, H., & Van De Ven, A. H. (2013). Process studies of change in organization and management: unveiling temporality, activity, and flow. *Academy of Management Journal*, *56*(1), 1-13. https://doi.org/10.5465/amj.2013.4001

Lanza-León, P., Sanchez-Ruiz, L., & Cantarero-Prieto, D. (2021). Kanban system applications in healthcare services: a literature review. *The International Journal of Health Planning and Management*, *36*(6), 2062-2078. https://doi.org/10.1002/hpm.3276

Leite, H., Bateman, N., & Radnor, Z. (2019). Beyond the ostensible: an exploration of barriers to lean implementation and sustainability in healthcare. *Production, Planning & Control*, *31*(1), 1-18. https://doi.org/10.1080/09537287.2019.1623426

Leite, H., Williams, S., Radnor, Z., & Bateman, N. (2022). Emergent barriers to the lean healthcare journey: baronies, tribalism and scepticism. *Production Planning & Control*, *35*(2), 115-132. https://doi.org/10.1080/09537287.2022.2054386

Levin, D. Z., & Cross, R. (2004). The strength of weak ties you can trust: the mediating role of trust in effective knowledge transfer. *Management Science*, *50*(11), 1477-1490. https://doi.org/10.1287/mnsc.1030.0136

Marin-Garcia, J. A., Vidal-Carreras, P. I., & Garcia-Sabater, J. J. (2021). The role of value stream mapping in healthcare services: a scoping review. *International Journal of Environmental Research and Public Health*, *18*(3). https://doi.org/10.3390/ijerph18030951

Marsick, V. J., & Watkins, K. E. (2003). Demonstrating the value of an organization's learning culture: the dimensions of the learning organization questionnaire. *Advances in Developing Human Resources*, *5*(2), 132-151. https://doi.org/10.1177/1523422303005002002

McGill, M. E. (1993). Unlearning the organization. *Organizational Dynamics*, *22*(2), 67-79. https://doi.org/10.1016/0090-2616(93)90054-5

McMackin, J., & Flood, P. (2019). A theoretical framework for the social pillar of lean. *Journal of Organizational Effectiveness: People and Performance*, *6*(1), 39-55. https://doi.org/10.1108/joepp-06-2018-0039

Mortensen, M., & Haas, M. R. (2018). Perspective—rethinking teams: from bounded membership to dynamic participation. *Organization Science*, *29*(2), 341-355. https://doi.org/10.1287/orsc.2017.1198

Nembhard, I. M., Alexander, J. A., Hoff, T. J., & Ramanujam, R. (2009). Why does the quality of health care continue to lag? Insights from management research. *The Academy of Management Perspectives*, *23*(1), 24-42. https://doi.org/jstor.org/stable/27747492

Netland, T. H., Schloetzer, J. D., & Ferdows, K. (2021). Learning lean: rhythm of production and the pace of lean implementation. *International Journal of Operations & Production Management*, *41*(2), 131-156. https://doi.org/10.1108/ijopm-02-2020-0092

Powell, D., & Reke, E. (2019). No lean without learning: rethinking lean production as a learning system. In *Advances in Production Management Systems. Production Management for the Factory of the Future* (pp. 62-68). https://doi.org/10.1007/978-3-030-30000-5_8

Powell, D. J., Laubengaier, D. A., Tortorella, G. L., Saabye, H., Antony, J., & Cagliano, R. (2024). Digitalization in lean manufacturing firms: a cumulative capability development perspective. *International Journal of Operations & Production Management*, *44*(6), 1249-1278. https://doi.org/10.1108/ijopm-05-2023-0414

Radnor, Z. J., Holweg, M., & Waring, J. (2012). Lean in healthcare: the unfilled promise? *Social Science & Medicine*, *74*(3), 364-371. https://doi.org/10.1016/j.socscimed.2011.02.011

Saabye, H., Kristensen, T. B., & Wæhrens, B. V. (2022). Developing a learning-to-learn capability: insights on conditions for Industry 4.0 adoption. *International Journal of Operations & Production Management*, *42*(13), 25-53. https://doi.org/10.1108/ijopm-07-2021-0428

Saabye, H., Powell, D. J., & Coughlan, P. (2023). Lean and action learning: towards an integrated theory? *International Journal of Operations & Production Management*, *43*(13), 128-151. https://doi.org/10.1108/ijopm-06-2022-0371

Shah, R. (2008). Explaining anomalous high performance in a health care supply chain. *Decision Sciences*, *39*(4), 759-789. https://doi.org/ 10.1111/j.1540-5915.2008.00211

Shani, A. B., Coghlan, D., & Alexander, B. N. (2019). Rediscovering abductive reasoning in organization development and change research. *The Journal of Applied Behavioral Science*, *56*(1), 60-72. https://doi.org/10.1177/0021886319893016

Spitzer, E. G., Kaitz, J., Fix, G. M., Harvey, K. L. L., Stadnick, N. A., Sullivan, J. L., Williamson, A. K., & Miller, C. J. (2023). Developing relational coordination: a qualitative study of outpatient mental health teams. *Administration and Policy in Mental Health and Mental Health Services Research*, *50*(4), 591-602. https://doi.org/10.1007/s10488-023-01261-2

Staats, B. R., Brunner, D. J., & Upton, D. M. (2011). Lean principles, learning, and knowledge work: evidence from a software services provider. *Journal of Operations Management*, *29*(5), 376-390. https://doi.org/10.1016/j.jom.2010.11.005

Taher, D., Landry, S., & Toussaint, J. (2016). Breadth vs. depth: how to start deploying the daily management system for your lean transformation. *Journal of Hospital Administration*, *5*(6), 90-96. https://doi.org/10.5430/jha.v5n6p90

Tortorella, G., Van Dun, D. H., & De Almeida, A. G. (2020). Leadership behaviors during lean healthcare implementation: a review and longitudinal study. *Journal of Manufacturing Technology Management*, *31*(1), 193-215. https://doi.org/10.1108/JMTM-02-2019-0070

Tortorella, G. L., Cauchick-Miguel, P. A., & Gaiardelli, P. (2019). Hoshin kanri and A3: a proposal for integrating variability into the policy deployment process. *The TQM Journal*, *31*(2), 118-135. https://doi.org/10.1108/tqm-06-2018-0076

Tortorella, G. L., Fettermann, D., Cauchick Miguel, P. A., & Sawhney, R. (2019). Learning organisation and lean production: an empirical research on their relationship. *International Journal of Production Research*, *58*(12), 3650-3666. https://doi.org/10.1080/00207543.2019.1633028

Van Beers, J. C. A. M., Van Dun, D. H., & Wilderom, C. P. M. (2022). Effective hospital-wide lean implementation: top-down, bottom-up or through co-creative role modeling? *International Journal of Lean Six Sigma*, *13*(1), 46-66. https://doi.org/10.1108/IJLSS-02-2021-0024

Van Dun, D. H., & Wilderom, C. P. M. (2016). Lean-team effectiveness through leader values and members informing. *International Journal of Operations and Production Management*, *36*(11), 1530-1550. https://doi.org/10.1108/IJOPM-06-2015-0338

Van Elp, B., Roemeling, O., & Aij, K. H. (2021). Lean leadership: towards continuous improvement capability in healthcare. *Health Services Management Research*, *0*(0), 1-9. https://doi.org/10.1177/09514848211001688

Wiedner, R., & Mantere, S. (2018). Cutting the cord: mutual respect, organizational autonomy, and independence in organizational separation processes. *Administrative Science Quarterly*, *64*(3), 659-693. https://doi.org/10.1177/0001839218779806

Williams, S., & Radnor, Z. (2018). An integrative approach to improving patient care pathways. *International Journal of Health Care Quality Assurance*, *31*(7), 810-821. https://doi.org/10.1108/IJHCQA-07-2017-0132

Yin, R. K. (2015). *Qualitative research from start to finish*. New York. Guilford Publications.

APPENDIX A. LEAN PRACTICES DESCRIPTION

Lean Practice	Description	Source
A3 Thinking	A structured problem-solving approach using an A3-sized paper, promoting root cause analysis and continuous learning	(Kristensen et al., 2022)
Coaching	A leadership approach where managers and Lean leaders guide employees in problem-solving, fostering a continuous learning culture through support and guidance	(Kristensen et al., 2022)
Hoshin Kanri	A strategic planning method used to align company goals and initiatives with daily activities, ensuring long-term goals are integrated into regular processes	(Barnabè et al., 2019)
Kaizen Events	Kaizen involves making small, incremental improvements to processes, products, or services on a regular basis, with the goal of enhancing efficiency, quality, and overall performance.	(Franken et al., 2021)
Key Performance Indicators (KPIs)	Metrics used to track performance against specific objectives, providing data-driven insights into progress and areas needing improvement	(Barnabè & Giorgino, 2017)
Standups	Regular, brief meetings designed to keep teams aligned, address issues, and plan short-term actions in a highly collaborative and visible manner	(Taher et al., 2016)
Value Stream Mapping (VSM)	A process analysis approach used to map the flow of materials and information through a system, identifying waste and opportunities for improvement	(Marin-Garcia et al., 2021)
Vision	A shared organizational vision guiding Lean implementation and continuous improvement, often aligned with long-term strategic goals	(Barnabè & Giorgino, 2017)
Visual Management	The use of visual practices like boards, charts, and signage to make information accessible to all employees, enhancing transparency and accountability	(Kristensen et al., 2022)
Yellow Belt Training	Introductory training on Lean principles and practices, aimed at employees who support improvement efforts but are not deeply involved in Lean deployment	(Hadid & Mansouri, 2014)

Discussion

Through the three empirical studies presented in this Ph.D. dissertation, I have reported how Lean can be implemented effectively in hospital settings; how continuous improvement (CI) is developed as a dynamic capability (CI DC); and how various Lean stages based on Hines et al. (2004) affect so-called relational coordination (RC). The findings of these studies are crucial for better understanding how to effectively implement Lean in hospitals (and other large, knowledge-driven organizations) which have to continuously meet patient needs; respond to environmental pressures; and address the rising costs of care with a highly specialized workforce (Williams & Radnor, 2018). In this dissertation, I view Lean as a complex system aimed at enriching the quality of care by staff who knows what is valuable for patients in processes of CI and learning (Saabye et al., 2023; Secchi & Camuffo, 2016). The research is guided by the following main question: *How can large hospitals implement lean as a hospital-wide system to foster continuous improvement and staff learning, thereby enhancing performance?* My dissertation highlights hospitals' transformation journeys where Lean is a strategic enabler for driving change, CI, and learning by the hospital staff (Ballé et al., 2019; Powell et al., 2024). In this concluding chapter, I synthesize the key findings from each study, discuss the theoretical contributions of my Ph.D. research, explore the practical implications for organizations, outline a future research agenda, and conclude with reflections on the overall contribution of this dissertation.

1. KEY FINDINGS AND THEORETICAL CONTRIBUTIONS

The theoretical contributions of this dissertation are multi-faceted, integrating several insights stemming from the fields of Operations Management, Organizational Change, Strategic Management, and Organizational Behavior. Below I will expand on the key findings and theoretical contributions per empirical chapter.

1.1. Key findings and theoretical contributions of study 1

In the first study, presented in chapter 2, I investigated the effectiveness of different Lean implementation strategies. Using a longitudinal process study (Langley et al., 2013) I compared two approaches: a top-down and a bottom-up approach. Comparing two academic hospital cases I revealed six implementation stages to embed Lean as a hospital wide management system, being: strategize, prepare, pilot, evaluate, scale-up, and structure. A recent study from Van Zyl-Cillié et al. (2024) suggests a similar step-wise implementation approach. This study shows that a hybrid Lean approach, combining top-down strategic oversight with bottom-up engagement and improvement, leads to a successful Lean transformation; in fact, I do extend and detail the integrative approach of Kim et al. (2014).

From an organizational change management lens, I expand the knowledge on co-creation, a concept not widely used in transformations, being a process where more than one

organizational actor systematically joins forces to interact, learn, and share information to create value (Vargo & Lusch, 2015). I show that co-creation cannot be delegated but requires managers at all hierarchical levels to engage and work with all employees "to create valuable experiences together" (Ramaswamy, 2011, p. 195). Ingraining co-creation into the implementation effectively addresses barriers such as hierarchy, silos, and professional autonomy (Fournier & Jobin, 2018), ensuring that Lean practices are embedded across all organizational levels and CI becomes a fundamental aspect of the organizational culture. The emphasis on co-creation and using a hybrid implementation approach provides new insights into how organizational change can be managed more effectively, including how 'guiding coalitions' should act (Mithani & O'Brien, 2020; Stouten et al., 2018). Successful Lean implementation requires senior leaders to be actively involved, not just as sponsors but as role models and co-creators. This resonates with current change management and social learning theory, highlighting the importance of leadership commitment and cross-hierarchical collaboration in driving successful (Lean) organizational transformations (Argote et al., 2021; Stouten et al., 2018; Van Dun, 2024; Wang & Liu, 2022).

1.2. Key findings and theoretical contributions of study 2

The second empirical study, presented in chapter 3, explored the relationship between Lean, CI, and DCs, ending with a new model that explains how a CI DC develops over time. The study shows *how* CI can be conceptualized as a DC, through developing specific organizational routines that integrate Lean practices into a hospital-wide framework. The conceptual model presented in Figure 1, below, outlines a stepwise, routine-based approach for developing a CI DC. The model traces the progress from implementing Lean practices to their bundling and sequencing into CI routines, which are subsequently aggregated into capabilities, positioning CI as a DC that drives long-term adaptability and CI.

Building on Anand et al.'s (2009) model, this study provides empirical evidence for the microfoundations that aggregate into a CI DC (Chen et al., 2023). It emphasizes the need of maintaining flexibility in the CI approach as capabilities mature and become institutionalized, with the overarching infrastructure adapting to the evolving nature of the CI DC to ensure continuous relevance and effectiveness (Wenzel et al., 2020). Hence, this study contributes to the DC theory by offering a comprehensive model that explains how CI routines evolve into a CI DC over time (Csiki et al., 2023). It challenges the conventional view that DCs primarily develop at the top management level (Helfat & Peteraf, 2015; Schilke et al., 2018). Instead, I highlight the interdependence and dynamic interplay of routines across all the various organizational levels. Moreover, I demonstrate that DC activities (i.e., sensing, seizing, and, transforming) are distributed across the entire organization, reinforcing the notion that DCs are deeply embedded in the interactions between individuals, organizational processes, and environmental contexts (Teece, 2018).

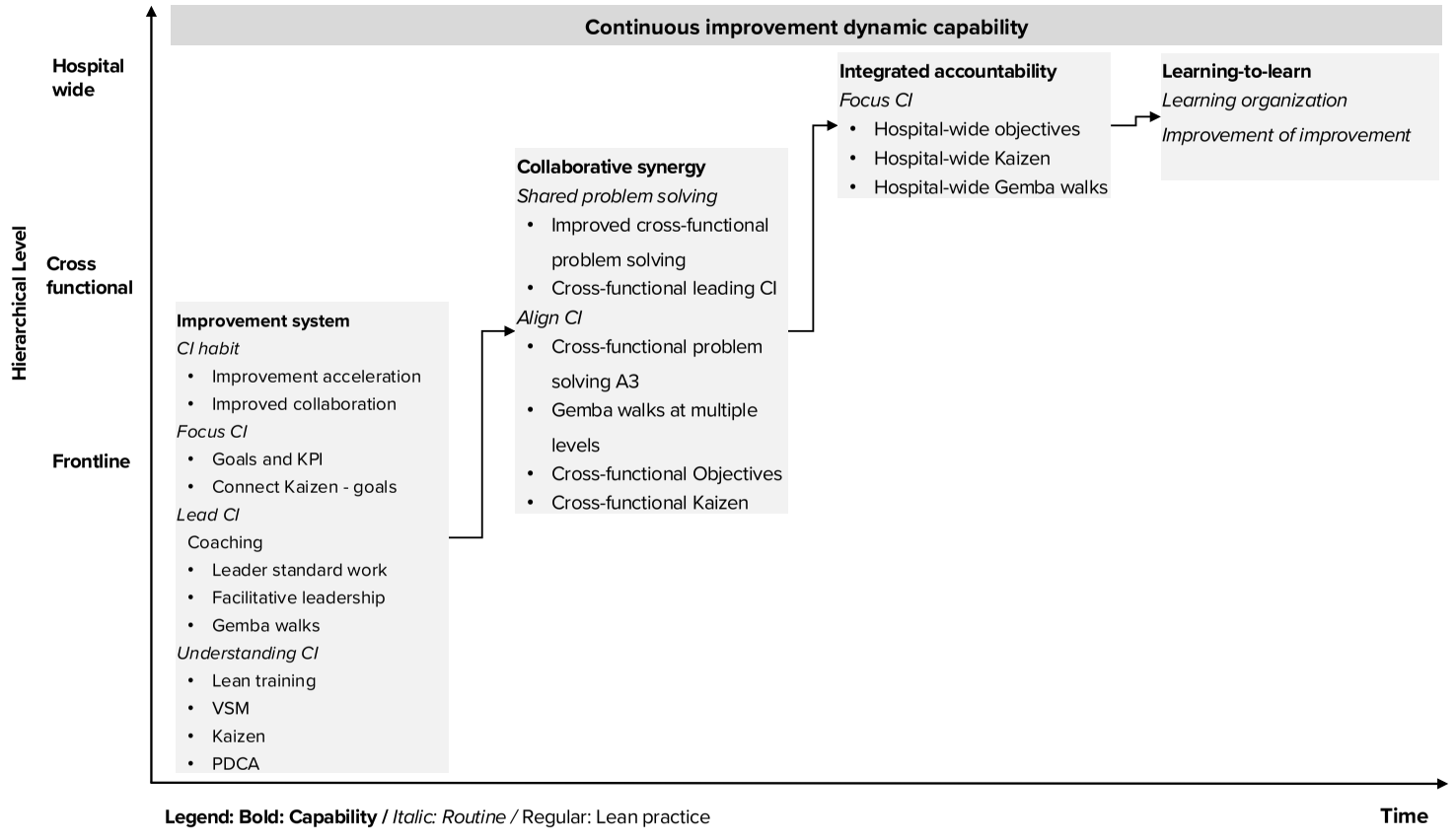

Figure 1.
Conceptual model of the development of a continuous improvement dynamic capability

The study also contributes to the literature by demonstrating how Lean practices bundle into CI routines, forming an initial improvement system capability. This aligns with recent academic interest in the system-wide clustering and sequencing of routines (Keller et al., 2022) and extends the understanding of how these clusters enhance performance (Bessant et al., 2001; Knol et al., 2022; Knol et al., 2019). Central to this conceptual framework is the development of a collaborative synergy capability, an integrative capability (Jiang et al., 2015), which facilitates effective cross-functional and cross-boundary coordination and communication within complex organizational structures, such as hospitals (De Souza & Pidd, 2011; Fournier & Jobin, 2018). Collaborative synergy explains how interdependent routines are bundled, extending the concept of coordinated interdependence across departments and hierarchical levels to enact hospital-wide CI and improve overall performance (Sailer et al., 2023).

1.3. Key findings and theoretical contributions of study 3

The third study, in chapter 4, examined how four Lean stages, based on Hines et al. (2004) relate to the key dimensions in the RC theory (Bolton et al., 2021): what could be their combined impact on organizational performance? The study revealed that advancing Lean is closely tied to enhancing RC dimensions (i.e., shared goals, shared knowledge, mutual respect, and effective communication), leading to performance improvements. Furthermore, the study introduced *shared infrastructure* as a critical new relational dimension, emphasizing the importance of organization-structural elements in effective efforts to break down silos and enhance cross-functional collaboration in complex, knowledge-intensive organizations, as depicted in Figure 2.

Shared infrastructure is particularly crucial in complex hospital settings, where stodgy hierarchical structures and ditto roles often obstruct cross-departmental coordination (Fournier & Jobin, 2018). Shared infrastructure refers to an integrated organizational, relational, and technical coordination system (Anand et al., 2009) that encompasses Lean practices, such as Gemba walks, PDCA cycles, Kaizen events, and A3 problem solving, with a common language for the facilitation of problem solving across departments (Jiang et al., 2015). Through a shared infrastructure, continuous learning and co-creation are facilitated by establishing lateral and parallel staff-participation structures that bridge hierarchical divides ensuring that RC is practiced consistently across the entire hospital (Galeazzo et al., 2017).

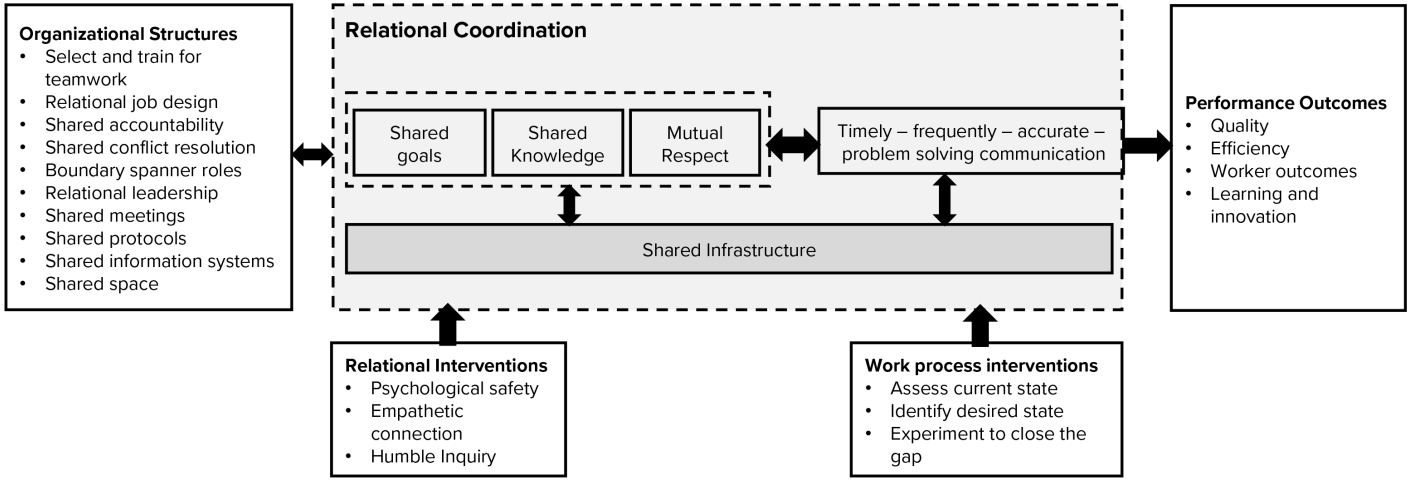

Figure 2.
Updated Relational Coordination Theory framework adapted from Bolton et al. (2021, p. 292)

Furthermore, this study demonstrates that the connection between Lean practices and the theoretical RC dimensions becomes stronger when the Lean adoption moves to the more mature stages, specifically during the Lean thinking and Lean learning stages (Hines et al., 2004). This is important as high-performance work systems that foster these RC dimensions are suggested to offer organizations a sustainable source of competitive advantage (Gittell et al., 2010). It is exactly during these mature Lean stages that a shared infrastructure is embedded as an RC dimension. Once Lean practices become fully embedded into a large hospital's coordinating and decision-making processes, including continuous learning cycles, it fosters a learning-oriented, collaborative work culture. This aligns with the broader concept of a learning organization, where problem-solving capabilities are continuously developed, and knowledge is actively and effectively shared across all staff in an organization (Saabye et al., 2023).

2. LIMITATIONS AND FUTURE RESEARCH AGENDA

This dissertation opens several avenues for relevant future research. I touched upon a variety of interconnected topics, but I primarily focused on improving Dutch public hospitals. It might well be that the results of the three studies manifest in a distinct way across countries. Given the insights by Danese et al. (2018) on the variability of Lean adoption in various countries, future studies should tackle how cultural dimensions impact a hybrid Lean adoption that combines top-down directives with bottom-up initiatives. Lean implementation is a fundamental change in an organization's way of working and might be seen as disruptive by employees and leaders (De Mast et al., 2021). This resonates with Bruyneel et al. (2019) who reported a wide variety in working relationships across European countries between physicians and nurses related to teamwork, collaboration, performance recognition, including for instance the value of sharp nurses' observations. Country-specific variations of such factors as well as differing health systems may have impacted the outcomes of my empirical studies as the impact of culture matters (Boscari et al., 2018). It is thus advised to compare the Dutch findings to hospitals in other countries that either already have or wish to implement lean, including the National Health System in the United Kingdom where the implementation of CI was extensively investigated (Burgess et al., 2022)

Although the findings were derived from public hospitals, it would be interesting to expand this research to other knowledge-intensive sectors, such as technology firms with large engineering or IT departments, or higher education institutions. In particular, to test the generalizability of the conceptual frameworks developed in chapters 3 and 4. These sectors, similar to healthcare, are characterized by complex environments, specialized knowledge work, and a need for high levels of coordination and collaboration across diverse teams and functions (Fournier & Jobin, 2018). For instance, in large technology firms, where

innovation, agility, and continuous adaptation are critical, studying the CI DC could offer valuable insights into how organizations continuously evolve and improve their processes and products/services. Furthermore, examining RC in large technology firms could reveal how interdepartmental collaboration and communication drive continuous learning and improved performance. Similarly, large education institutions, with complex organizational structures and emphasis on knowledge creation and dissemination often face challenges related to coordinating across various departments, faculties, and administrative bodies. Studying how a CI DC is being developed in such organizations could reveal how CI might enhance institutional performance in terms of research output, teaching quality, and operational efficiency (especially now university budgets are under pressure (Van der Velde, 2024). Moreover, the role of DCs in supporting academic institutions to strategically navigate changes in funding, policy, and global competition could provide valuable lessons for managing strategic transformations in knowledge-intensive environments (Heaton et al., 2023). Similarly, exploring how RC could be developed in university settings, by establishing shared goals, shared knowledge, mutual respect, effective communication, and a shared infrastructure across hierarchical levels, may contribute to creating more efficient and effective university systems. These studies could make use of the methodology of action research, which follows iterative cycles of planning, action, observation, and reflection. Action research is particularly well-suited not only for investigating the development of DCs and RC but also for actively contributing to the (organizational) development of the participants (Balthu & Clegg, 2021; Coughlan & Coghlan, 2024; Saabye et al., 2023). As emphasized by Coughlan and Coghlan (2002), action research entails a collaborative process where researchers engage directly with organizational employees, facilitating joint reflection on practical interventions. In my view, such an approach would also contribute to bridging the gap that is sometimes perceived between practice and academia.

Since the popularization of Lean in a wide range of sectors, many industries have pinpointed digital transformation as a next strategic priority. Yet, there remains limited understanding of how organizations do undergo this transformation (Fitzgerald et al., 2014), although research related to Industry 4.0 claims that “Lean practices tend to be more impactful” (Tortorella et al., 2019, p. 875) if they are related to specific digital technologies that allow a better understanding of customer demand. Warner and Wäger (2019) contribute to this by offering a conceptual model of digital transformation through the lens of DCs, identifying nine microfoundations that underlie the development of DCs necessary for digital transformation. An intriguing avenue for future exploration is examining the conceptual model I developed in chapter 3 for developing CI DCs in relation to facilitating digital transformation. For instance, by adopting the improvement system capability in the CI DC model, digital transformation could enhance sensing capabilities through mechanisms similar to “digital scouting”, which refers to an organization’s ability to actively identify and assess emerging digital technologies and trends that could impact its operations and

performance, as described by Warner and Wäger (2019). Additionally, the CI DC model may describe the establishment of an infrastructure for rapid prototyping (Day & Schoemaker, 2016), balancing digital portfolios through integrated accountability, and enhancing digital maturity via learning-to-learn capabilities. In other words, the CI DC model may prove helpful in explaining the determinants of other large organizational transformations than lean adoption, such as digital transformation.

Additionally, my dissertation's results can be seen through the lens of organizations that wish to develop agility. Organizational agility refers to the ability to rapidly sense, act, and adapt to environmental changes while keeping operational robustness (Motwani & Katatria, 2024). Several key mechanisms which are vital for cultivating agility are well connected to the studies in this dissertation; this includes the ability to scan the environment for emerging opportunities, establishing an effective decision-making framework, maintaining an infrastructure that facilitates continuous connection across all organizational levels, and fostering a learning-to-learn capability to enable ongoing adaptation and improvement (Motwani & Katatria, 2024). The scaled agile framework (Turetken et al., 2017), as one of the largest practical contributions to the agile literature, provides a comprehensive set of proven principles and competencies for achieving organization agility in large organizations. Interestingly, CI is not well described in this practical scaled agility framework and these frameworks focus primarily on closely adhering to clear roles and responsibilities. Hence, agile frameworks could benefit more from integrating RC.

Future research could also further explore, based on the results of my dissertation, on how the CI DC could strengthen organizational resilience in the face of hospital's dealing with external challenges like COVID-19 in hospitals (Harland et al., 2021). By embedding CI as a DC into the hospital fabric, hospitals can better sense, adapt, and respond to external shocks (Kähkönen et al., 2021). Embedding CI as a DC, helped by researchers who could adopt action research approaches, is likely to enable organizations to rapidly reconfigure resources, maintain operational stability, and continue delivering essential services during crises. Furthermore, a strong RC fostered through Lean, helps to build trust, shared knowledge, and collaborative problem solving, which are essential when organizations need to navigate complex, unpredictable environments.

Building on the foundation of DCs and RC explored in this study, future research could investigate how the integration of Lean Green practices might further enhance sustainability advantage in healthcare. Lean Green, eliminates non-value-added activities while simultaneously minimizing the environmental impact of operations. This dual focus aligns Lean's emphasis on process efficiency, waste reduction, and continuous improvement with sustainability goals such as resource conservation, pollution reduction, and carbon footprint minimization (Garza-Reyes, 2015; Piercy & Rich, 2015). As demonstrated in this dissertation,

hospitals implementing Lean practices already cultivate DCs. These capabilities, essential to Lean transformations, can be equally leveraged to foster sustainability given that hospitals have grown increasingly aware of the enormous amounts of waste they produce; think for instance of the number of plastic gloves used by doctors and nurses, packaging, as well as unused materials in the operating theatre (Van Demark et al., 2018). Drawing on Knoppen and Knight (2022), who highlight how DCs balance environmental, social, and economic outcomes, hospitals can extend these capabilities towards achieving sustainability advantage. By applying the model developed in this research, hospitals could align sustainability goals with CI efforts, ensuring that environmental performance is integrated with core operational and care delivery processes.

The integration of Lean practices with RC theory offers a promising framework for enhancing organizational performance, yet the dynamics and interactions between RC dimensions require further explorations. Recent research by Bolton et al. (2021) has suggested that the sequencing of RC dimensions, such as shared goals, shared knowledge, and mutual respect, plays a critical role in fostering effective collaboration. Future quantitative studies could employ research tools, such as structural equation modelling, to statistically test the interdependencies among these dimensions over time and across different organizational settings. Additionally, detailed examinations of the newly introduced concept of shared infrastructure could be further operationalized through the development of a new survey scale, which should then be rigorously validated.

Finally, the intersection between DC theory and RC theory is recognized as an area of further research, particularly in relation to managing knowledge and innovation (Fu, 2014). Current studies suggest that RC, with its emphasis on shared goals, shared knowledge, mutual respect, and communication, plays a role in enhancing DCs by facilitating the integration, reconfiguration, and deployment of organizational resources in response to environmental changes (Gittell et al., 2010). Future studies could explore the microfoundations of DCs through the lens of RC, examining how day-to-day relational practices contribute to strategic agility (Helfat et al., 2007; Zollo & Winter, 2002). Additionally, longitudinal research could provide insights into how RC evolves and supports DCs over time, particularly during periods of organizational transformation or market disruption (Ambrosini & Bowman, 2009). In hospitals, RC can enhance a CI DC by ensuring that information and knowledge flow smoothly and efficiently among the different professionals (including doctors, nurses, and administrators). For instance, when improving clinical pathways, or adopting new medical technology, shared goals, knowledge, and respect will help to align the various expertise needed to co-create such (process) innovations successfully.

In sum, the rich insights from this dissertation lay a solid foundation for future research in the areas of Lean, CI DC, and RC theory. By exploring these future directions, academics can

build on the findings presented herein: to develop an even more nuanced understanding.

3. PRACTICAL IMPLICATIONS

The findings across the three studies offer many practical implications for organizational leaders, change agents, and healthcare professionals involved in Lean implementation in large hospitals and other knowledge-intensive work systems. In this section, I will emphasize these implications from the perspective of various key stakeholders.

This dissertation once again proves that it is essential that hospital executives actively engage in Lean adoption initiatives. Lean cannot be delegated to middle managers or to teams. It does require top leadership to be visible and heavily involved in Lean themselves. This means more than just giving strategic direction. Hospital executives need to be part of the process, by investing time in Lean training, attending key meetings, observing frontline operations, and showing their commitment to CI. By doing so, they set the tone for the entire organization, modeling the behaviors they expect from others, building trust, and creating a culture where Lean is embraced across all departments.

Middle management also play a pivotal role in driving hospital-wide change by creating an environment for alignment in goals, decision-making, and relational coordination. It is essential for middle managers to support frontline leaders in executing the overall strategy while ensuring that strategy is continuously aligned with frontline and departmental goals. Practices such as Gemba walks, where middle managers observe operations and engage with employees to gauge current sentiment can help maintain this alignment. Collaborating with peers is vital for balancing between strategic objectives and operational needs. To bridge this gap between frontline teams and top management, middle management must have a thorough understanding of Lean practices and the principles behind this. To achieve this, I recommend that middle managers proactively build routines grounded in Lean practices such as Plan-Do-Check-Act (PDCA), A3 problem-solving, and Kaizen events, while actively listening to the insights and ideas shared by frontline teams. Establishing multidisciplinary improvement teams that can adapt to evolving care demands or new opportunities is key. Additionally, each department should have a Lean improvement agenda that aligns with the hospital's broader strategic goals, ensuring coherence and continuous progress across the organization.

Frontline leaders should focus on creating a team of problem solvers, a problem-solving environment where their teams feel safe to speak up, share ideas, and learn from mistakes. Utilizing the routines outlined in my dissertation, frontline leaders can implement the Lean practices, raise awareness of their value among their teams, and establish these practices as habits for CI. The goal is to build a team of problem solvers, rather than being the sole problem

solver, and to facilitate the team in their efforts. For instance, one could think of empowering a team of nurses and physicians to assess different handover protocols, such as adding a ten-minute overlap between shifts. The leader's role is to support the team by providing the necessary time and resources they need for experimentation and facilitating open discussions about the outcomes, successful or not, to build mutual trust among team members. Furthermore, creating key performance data, like patient wait times and infection rates, visible to all teams is crucial. Introducing departmental dashboards that are reviewed daily during stand-ups helps to track performance and make people aware of the status. However, it is not enough to merely present data; it must be actively used in decision-making processes. For instance, when considering changes to patient care pathways, teams should review performance data before deciding on a course of action. By being present and engaged in the field, fostering a data-driven culture, and empowering teams to take initiative in experimenting and improvement, Lean can become an integral part of the hospital operations.

As an in- or external change agent, guiding the successful implementation of Lean is crucial. While Lean may appear to be common sense it involves the careful development of the right routines and relationships across the entire hospital. One of the most fundamental actions is to design a clear Lean adoption strategy and promote the importance of a hybrid approach, initially to top management first and then to a broader coalition. Lean implementation cannot succeed in isolation; it requires leaders to actively participate while facilitating problem-solving, rather than solving the problems themselves. A key task is to help leaders shift their focus from directing to coaching, which requires day-to-day presence and support.

Furthermore, early on, leaders will need support to understand how to facilitate team-based problem solving rather than fixing problems themselves. By regularly interacting with them, change agents can raise their awareness and guide them in this novel approach. For instance, during a daily standup, leaders can be encouraged to ask the team for their ideas on improving workflow and then be coached on how to support the team's experiments, rather than dictating solutions.

It is important for change agents to monitor the broader impact of Lean, both operationally and culturally. Are Lean practices improving efficiency, patient care, and collaboration? Are leaders truly facilitating change, or are they still stepping in to solve problems? By continuously guiding, coaching, and assessing, the change agents ensures that Lean does not just take root, but becomes part of the hospital's long-term DNA. Change agents should be present at the frontline, observing the adoption of Lean practices and assessing whether they are achieving the desired results. Using data and insights gained from these observations, (change) strategies can be adjusted in real-time. For example, if patient flow improvements in one department are not delivering expected results, the change agent can help the team refine their approach, test new ideas, and measure outcomes.

A nurses' or physicians' role in Lean implementation goes beyond delivering care; it involves actively participating in improving how care is provided. Next to their regular work, one of their most valuable contributions is fostering a problem-solving environment where all team members, from doctors to nurses to support staff, feel empowered to share ideas and take ownership of improvements, and avoid that nurses face challenges in shifting priorities of doctors (Richmond & Burgess, 2023). This means not only providing care but also collaborating to find better ways to deliver it. For instance, during daily standups, areas of improvement, such as medication delays, may be identified. Rather than waiting for solutions from management, nurses and physicians are invited to take the initiative to propose ideas and proactively start solving them.

Ultimately, my dissertation highlights the importance of shared goals, shared knowledge, mutual respect, and shared infrastructure. This starts with the collaboration between the key players in a hospital, doctors, and nurses. Understanding each other's work contributes to the improving patient care and operational efficiency. For instance, when nurses and physicians combine their expertise—nurses drawing on their observations from post-operative care and physicians identifying key risk factors to reduce patient pain after surgery—both parties can jointly contribute to better patient outcomes. Similarly, when nurses implement detailed discharge instructions and physicians provide clinical insights, their combined efforts are likely to result in better aligned, patient-centered care improvements.

4. CONCLUSION

This dissertation provides valuable insights into how Lean can be effectively implemented in knowledge-intensive organizations and how it interacts with DC and RC theory. The research emphasizes the importance of leadership, organizational routines, and staff learning to drive successful Lean transformations. By addressing both theoretical and practical dimensions, this dissertation's work contributes to the ongoing dialogue between academia and practice, offering a foundation for future research and practical application in Lean-driven organizational change. The insights from this dissertation have broader implications for the future of organizational design and strategy. As organizations continue to evolve in response to a rapidly changing environment, the lessons learned from Lean implementation can provide valuable guidance on how to build more resilient, adaptive, and collaborative or agile organizations. This dissertation, therefore, represents not just a contribution to the field of Lean studies, but also a stepping stone towards a more profound understanding of how organizations can thrive in the face of their own complexity and their need for change.

5. REFERENCES

Ambrosini, V., & Bowman, C. (2009). What are dynamic capabilities and are they a useful construct in strategic management? *International Journal of Management Reviews*, *11*(1), 29-49. https://doi.org/10.1111/j.1468-2370.2008.00251.x

Anand, G., Ward, P. T., Tatikonda, M. V., & Schilling, D. A. (2009). Dynamic capabilities through continuous improvement infrastructure. *Journal of Operations Management 27*(6), 444-461. https://doi.org/10.1016/j.jom.2009.02.002

Argote, L., Lee, S., & Park, J. (2021). Organizational learning processes and outcomes: major findings and future research directions. *Management Science*, *67*(9), 5399-5429. https://doi.org/10.1287/mnsc.2020.3693

Ballé, M., Chaize, J., & Jones, D. (2019). Lean as a learning system: what do organizations need to do to get the transformational benefits from Toyota's method? *Development and Learning in Organizations*, *33*(3), 1-4. https://doi.org/10.1108/dlo-11-2018-0147

Balthu, K. C., & Clegg, B. (2021). Improving professional service operations: action research in a law firm. *International Journal of Operations & Production Management*, *41*(6), 805-829. https://doi.org/10.1108/ijopm-10-2020-0696

Bessant, J., Caffyn, S., & Gallagher, M. (2001). An evolutionary model of continuous improvement behaviour. *Technovation*, *21*(2), 67-77. https://doi.org/10.1016/S0166-4972(00)00023-7

Bolton, R., Logan, C., & Gittell, J. H. (2021). Revisiting relational coordination: a systematic review. *The Journal of Applied Behavioral Science*, *57*(3), 290-322. https://doi.org/10.1177/0021886321991597

Boscari, S., Bortolotti, T., Netland, T. H., & Rich, N. (2018). National culture and operations management: a structured literature review. *International Journal of Production Research*, *56*(18), 6314-6331. https://doi.org/10.1080/00207543.2018.1461275

Bruyneel, L., Lesaffre, E., Meuleman, B., & Sermeus, W. (2019). Power distance and physician-nurse collegial relations across 14 European countries: national culture is not merely a nuisance factor in international comparative research. *Journal of Nursing Scholarship*, *51*(6), 708-716. https://doi.org/10.1111/jnu.12514

Burgess, N., Currie, G., Crump, B., & Dawson, A. (2022). *Leading change across a healthcare system: how to build improvement capability and foster a culture of continuous improvement: Lessons from an evaluation of the NHS-VMI partnership*. Warwick Business School

Chen, Y., Liu, L., Li, W., Xie, Z., & Wei, C. (2023). Microfoundations of dynamic capabilities: a systematic review and a multilevel framework. *Management Decision*, *61*(6), 1717-1753. https://doi.org/10.1108/md-05-2022-0615

Coughlan, P., & Coghlan, D. (2002). Action research for operations management. *International Journal of Operations and Production Management*, *22*(2). https://doi.org/info:doi/10.1108/01443570210417515

Coughlan, P., & Coghlan, D. (2024). Reflecting on how action research enables theorising in operations management: a provocation to interiority. *Production Planning & Control*, 1-10. https://doi.org/10.1080/09537287.2023.2299864

Csiki, O., Demeter, K., & Losonci, D. (2023). How to improve firm performance? the role of production capabilities and routines. *International Journal of Operations & Production Management*, *43*(13), 1-26. https://doi.org/10.1108/ijopm-03-2022-0221

Danese, P., Manfè, V., & Romano, P. (2018). A systematic literature review on recent lean research: state-of-the-art and future directions. *International Journal of Management Reviews*, *20*(2), 579-605. https://doi.org/10.1111/ijmr.12156

Day, G. S., & Schoemaker, P. J. H. (2016). Adapting to fast-changing markets and technologies. *California Management Review*, *58*(4), 59-77. https://doi.org/10.1525/cmr.2016.58.4.59

De Mast, J., Lameijer, B. A., Linderman, K., & Van de Ven, A. (2021). Exploring the process of management system implementation: a case of Six Sigma. *International Journal of Operations & Production Management*, *42*(13), 1-24. https://doi.org/10.1108/ijopm-09-2020-0645

De Souza, B. L., & Pidd, M. (2011). Exploring the barriers to lean health care implementation. *Public Money & Management*, *31*(1), 59 - 66. https://doi.org/10.1080/09540962.2011.545548

Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2014). Embracing digital technology: a new strategic imperative. *MIT Sloan Management Review*, *55*(2), 1-16. https://doi.org/10.5555/12345678

Fournier, P., & Jobin, M. (2018). Understanding before implementing: the context of Lean in public healthcare organizations. *Public Money & Management*, *38*(1), 37-44. https://doi.org/10.1080/09540962.2018.1389505

Fu, N. (2014). The role of relational resources in the knowledge management capability and innovation of professional service firms. *Human Relations*, *68*(5), 731-764. https://doi.org/10.1177/0018726714543479

Galeazzo, A., Furlan, A., & Vinelli, A. (2017). The organizational infrastructure of continuous improvement – an empirical analysis. *Operations*

Management Research, *10*(1-2), 33-46. https://doi.org/10.1007/s12063-016-0112-1

Garza-Reyes, J. A. (2015). Lean and green – a systematic review of the state of the art literature. *Journal of Cleaner Production*, *102*, 18-29. https://doi.org/10.1016/j.jclepro.2015.04.064

Gittell, J. H., Seidner, R., & Wimbush, J. (2010). A relational model of how high-performance work systems work. *Organization Science*, *21*(2), 490-506. https://doi.org/10.1287/orsc.1090.0446

Harland, C. M., Knight, L., Patrucco, A. S., Lynch, J., Telgen, J., Peters, E., Tátrai, T., & Ferk, P. (2021). Practitioners' learning about healthcare supply chain management in the COVID-19 pandemic: a public procurement perspective. *International Journal of Operations & Production Management*, *41*(13), 178-189. https://doi.org/10.1108/ijopm-05-2021-0348

Heaton, S., Teece, D., & Agronin, E. (2023). Dynamic capabilities and governance: an empirical investigation of financial performance of the higher education sector. *Strategic Management Journal*, *44*(2), 520-548. https://doi.org/10.1002/smj.3444

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, S. (2007). *Dynamic capabilities: foundations*.

Helfat, C. E., & Peteraf, M. A. (2015). Managerial cognitive capabilities and the microfoundations of dynamic capabilities. *Strategic Management Journal*, *36*(6), 831-850. https://doi.org/10.1002/smj.2247

Hines, P., Holweg, M., & Rich, N. (2004). Learning to evolve: a review of contemporary lean thinking. *International Journal of Operations & Production Management*, *24*(10), 994-1011. https://doi.org/10.1108/01443570410558049

Jiang, W., Mavondo, F. t., & Matanda, M. J. (2015). Integrative capability for successful partnering: a critical dynamic capability. *Management Decision*, *53*(6), 1184-1202. https://doi.org/10.1108/md-04-2014-0178

Kähkönen, A.-K., Evangelista, P., Hallikas, J., Immonen, M., & Lintukangas, K. (2021). COVID-19 as a trigger for dynamic capability development and supply chain resilience improvement. *International Journal of Production Research*, *61*(8), 2696-2715. https://doi.org/10.1080/00207543.2021.2009588

Keller, A., Konlechner, S., Güttel, W. H., & Reischauer, G. (2022). Overcoming path-dependent dynamic capabilities. *Strategic Organization*, *0*(0), 1-31. https://doi.org/10.1177/14761270221125807

Kim, Y. H., Sting, F. J., & Loch, C. H. (2014). Top-down, bottom-up, or both? Toward an integrative perspective on operations strategy formation. *Journal of Operations Management 32*(7-8), 462-474. https://doi.org/10.1016/j.jom.2014.09.005

Knol, W. H., Lauche, K., Schouteten, R. L. J., & Slomp, J. (2022). Establishing the interplay between lean operating and continuous improvement routines: a process view. *International Journal of Operations & Production Management*, *42*(13), 243-273. https://doi.org/10.1108/ijopm-06-2020-0334

Knol, W. H., Slomp, J., Schouteten Roel, L. J., & Lauche, K. (2019). The relative importance of improvement routines for implementing lean practices. *International Journal of Operations & Production Management*, *39*(2), 214-237. https://doi.org/10.1108/IJOPM-01-2018-0010

Knoppen, D., & Knight, L. (2022). Pursuing sustainability advantage: The dynamic capabilities of born sustainable firms. *Business Strategy and the Environment*, *31*(4), 1789-1813. https://doi.org/10.1002/bse.2984

Langley, A., Smallman, C., Tsoukas, H., & Van De Ven, A. H. (2013). Process studies of change in organization and management: unveiling temporality, activity, and flow. *Academy of Management Journal*, *56*(1), 1-13. https://doi.org/10.5465/amj.2013.4001

Mithani, M. A., & O'Brien, J. P. (2020). So what exactly is a "coalition" within an organization? A review and organizing framework. *Journal of Management*, *47*(1), 171-206. https://doi.org/10.1177/0149206320950433

Motwani, J., & Katatria, A. (2024). Organization agility: a literature review and research agenda. *International Journal of Productivity and Performance Management*, *ahead-of-print*. https://doi.org/10.1108/ijppm-07-2023-0383

Piercy, N., & Rich, N. (2015). The relationship between lean operations and sustainable operations. *International Journal of Operations & Production Management*, *35*(2), 282-315. https://doi.org/10.1108/IJOPM-03-2014-0143

Powell, D. J., Laubengaier, D. A., Tortorella, G. L., Saabye, H., Antony, J., & Cagliano, R. (2024). Digitalization in lean manufacturing firms: a cumulative capability development perspective. *International Journal of Operations & Production Management*, *44*(6), 1249-1278. https://doi.org/10.1108/ijopm-05-2023-0414

Ramaswamy, V. (2011). It's about human experiences... and beyond, to co-creation. *Industrial Marketing Management*, *40*(2), 195-196. https://doi.org/10.1016/j.indmarman.2010.06.030

Richmond, J. G., & Burgess, N. (2023). Prosocial voice in the hierarchy of healthcare professionals: the role of emotions after harmful patient safety incidents. *Journal of Health Organization and Management*, *37*(3), 327-342. https://doi.org/10.1108/jhom-01-2022-0027

Saabye, H., Powell, D. J., & Coughlan, P. (2023). Lean and action learning: towards an integrated theory? *International Journal of Operations & Production Management*, *43*(13), 128-151. https://doi.org/10.1108/ijopm-06-2022-0371

Sailer, P., Loscher, G. J., & Kaiser, S. (2023). Coordinated Interdependence: how patterning governs flexibility in a routine cluster. *Journal of Management Studies*, *61*(5), 1884-1915. https://doi.org/10.1111/joms.12960

Schilke, O., Hu, S., & Helfat, C. E. (2018). Quo vadis, dynamic capabilities? a content-analytic review of the current state of knowledge and recommendations for future research. *Academy of Management Annals*, *12*(1), 390-439. https://doi.org/10.5465/annals.2016.0014

Secchi, R., & Camuffo, A. (2016). Rolling out lean production systems: a knowledge-based perspective. *International Journal of Operations & Production Management*, *36*(1), 61-85. https://doi.org/10.1108/ijopm-04-2014-0194

Stouten, J., Rousseau, D. M., & De Cremer, D. (2018). Successful organizational change: integrating the management practice and scholarly literatures. *Academy of Management Annals*, *12*(2), 752-788. https://doi.org/10.5465/annals.2016.0095

Teece, D. J. (2018). Business models and dynamic capabilities. *Long range planning*, *51*(1), 40-49. https://doi.org/10.1016/j.lrp.2017.06.007

Tortorella, G. L., Giglio, R., & van Dun, D. H. (2019). Industry 4.0 adoption as a moderator of the impact of lean production practices on operational performance improvement. *International Journal of Operations & Production Management*, *39*(6/7/8), 860-886. https://doi.org/10.1108/ijopm-01-2019-0005

Turetken, O., Stojanov, I., & Trienekens, J. J. M. (2017). Assessing the adoption level of scaled agile development: a maturity model for Scaled Agile Framework. *Journal of Software: evolution and process*, *29*(6), 1-18. https://doi.org/10.1002/smr.1796

Van Demark, R. E., Jr., Smith, V. J. S., & Fiegen, A. (2018). Lean and Green Hand Surgery. *J Hand Surg Am*, *43*(2), 179-181. https://doi.org/10.1016/j.jhsa.2017.11.007

Van der Velde, L. P. W. (2024). *Major concerns over announced budget cuts to higher education and science*. University of Twente. Retrieved 18 September 2024 from https://www.uva.nl/en/current/budget-cuts/budget-cuts.html#:~:text=Minister%20Bruins%20is%Van

Van Dun, D. H. (2024). Leading lean transformations: towards a 3D view of lean leadership. In *A Research Agenda for Lean Management* (pp. 165-181). Edward Elgar Publishing.

Van Zyl-Cillié, M. M., Van Dun, D. H., & Meijer, H. (2024). Toward a roadmap for sustainable lean adoption in hospitals: a Delphi study. *BMC Health Services Research*, *24*(1), 1-17. https://doi.org/10.1186/s12913-024-11529-4

Vargo, S. L., & Lusch, R. F. (2015). Institutions and axioms: an extension and update of service-dominant logic. *Journal of the Academy of Marketing Science*, *44*(1), 5-23. https://doi.org/10.1007/s11747-015-0456-3

Wang, J., & Liu, F. (2022). Examining the link between integrated management systems and firm performance: do the integration strategies matter? *International Journal of Operations & Production Management*, *43*(2), 332-372. https://doi.org/10.1108/ijopm-04-2022-0277

Warner, K. S., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: an ongoing process of strategic renewal. *Long Range Planning*, *52*(3), 326-349. https://doi.org/10.1016/j.lrp.2018.12.001

Wenzel, M., Danner-Schröder, A., & Spee, A. P. (2020). Dynamic capabilities? unleashing their dynamics through a practice perspective on organizational routines. *Journal of Management Inquiry*, *30*(4), 395-406. https://doi.org/10.1177/1056492620916549

Williams, S., & Radnor, Z. (2018). An integrative approach to improving patient care pathways. *International Journal of Health Care Quality Assurance*, *31*(7), 810-821. https://doi.org/10.1108/IJHCQA-07-2017-0132

Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, *13*(3), 339-351. https://doi.org/10.1287/orsc.13.3.339.2780

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5S	A Lean workplace organization method: Sort, Set in order, Shine, Standardize, and Sustain
A3	A problem-solving approach in Lean
CI	Continuous Improvement
CV	Continue Verbetering
DC	Dynamic Capability
DCs	Dynamic Capabilities
DNA	Deoxyribonucleic acid
FTE	Full-Time Equivalent
KPI	Key Performance Indicator
PDCA	Plan-Do-Check-Act
RC	Relational Coordination
T	Time (e.g., T1, T2, referring to time points in the study)
VSM	Value Stream Mapping

LIST OF PUBLICATIONS AND PRESENTATIONS

Journal publications

Van Beers, J. C. A. M., Van Dun, D. H., & Wilderom, C. P. M. (2022). Effective hospital-wide lean implementation: top-down, bottom-up or through co-creative role modeling? *International Journal of Lean Six Sigma*, *13*(1), 46-66. https://doi.org/10.1108/IJLSS-02-2021-0024

Conference presentations

Van Beers, J. C. A. M., & Van Dun, D. H. (2024). The relationship between lean hospital adoption, learning, and relational coordination: an embedded multiple-case process study. *31st International Annual EurOMA Conference 2024, Barcelona.* https://euroma2024.org/

Van Beers, J. C. A. M., Van Dun, D. H., & Wilderom, C. P. M. (2020). Lean strategy implementation in two Dutch university hospitals. *27th EurOMA Conference 2020, Warwick*. https://warwick.ac.uk/fac/sci/wmg/mediacentre/wmgevents/euroma2020/

Doctoral seminars

Van Beers, J. C. A. M. (2020). Dynamic capabilities development through lean strategy implementation: a process study comparing two Dutch hospitals. *13th EurOMA Workshop on Journal Publishing in Operations Management*.

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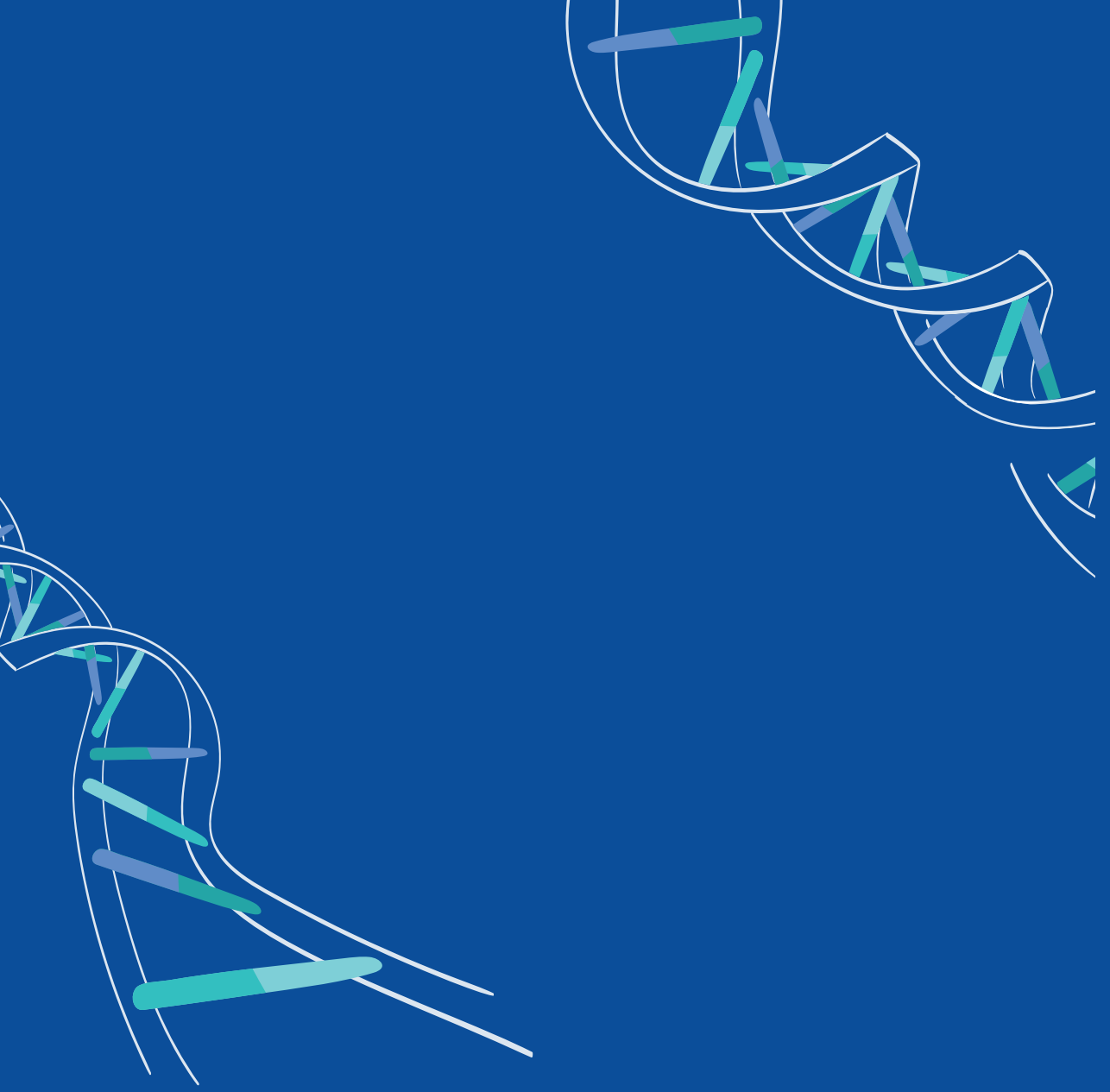

Improvement system

Collaborative synergy

Integrated accountability

Learning-to-learn

▶ How to develop Continuous Improvement as a Dynamic Capability