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Improving Digitalisation Projects with the Help of Agile Project Management in Finnish Manufacturing Companies

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ABSTRACT:

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This thesis examines the role of agile project management on the success of digitalisation projects in Finnish manufacturing companies and when hybrid governance is the most effective. The research is driven by the strategic significance of industrial digitalisation and the struggles to deliver operational and business value from digital investments. Although agile project management has been well studied in software and knowledge-intensive industries, there has been a lack of research on the use of agile approaches in manufacturing projects that are affected by socio-technical complexity, technological legacy, cybersecurity concerns, and the need for business continuity.

The thesis follows a pragmatist, qualitative dominant secondary data-based research design. It incorporates a systematic review of the literature on agile project management, hybrid governance, manufacturing digitalisation, benefits realisation, and dynamic capabilities, and policy and statistical data from Finnish and European institutional sources. The analysis is informed by a conceptual model whereby agile and hybrid governance impact project performance via mechanisms such as a faster rate of learning, coordination across functional areas, risk detection and avoidance, and minimisation of rework.

The results show that agile practices in digitalisation projects such as iterative development, customer feedback, dynamic planning, and multi-functional integration, can improve project performance, especially in the components that involve uncertainty and exploratory learning. But their impact is substantially conditioned by manufacturing-specific constraints, such as the complexity of IT/OT integration, cybersecurity and regulatory constraints, procurement rigidity and need for system uptime. These boundaries restrict the use of agile practices in manufacturing operations.

As such, hybrid governance emerges as the most suitable and fit-for-context governance mechanism for Finnish manufacturing digitalisation initiatives. Hybrid governance allows for the use of agile governance mechanisms for innovation-led parts and plan-based governance mechanisms needed for stability, compliance and security. The doctoral thesis helps to understand the interplay between governance mechanisms and structural constraints from the perspective of socio-technical systems theory, dynamic capabilities theory and contingency theory. It offers a governance view to manufacturing organisations strategically aiming to enhance digitalisation outcomes with context-specific project management approaches.

KEYWORDS: agile project management; hybrid governance; digitalisation; digital transformation; Finnish manufacturing; sociotechnical systems; benefits realisation

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Abbreviations

AI = Artificial Intelligence

BI = Business Intelligence

BRM = Benefits Realisation Management

CRM = Customer Relationship Management

ENISA = European Union Agency for Cybersecurity

ERP = Enterprise Resource Planning

EU = European Union

ICT = Information and Communication Technology

IEC = International Electrotechnical Commission

ISA = International Society of Automation

IT = Information Technology

NIS2 = Network and Information Security Directive 2

NIST = National Institute of Standards and Technology

OECD = Organisation for Economic Co-operation and Development

OT = Operational Technology

PMI = Project Management Institute

PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses

1 Introduction

1.1 Study context and motivation

Digitalisation is now a strategic focus of manufacturing businesses looking to achieve greater productivity, better quality, more robust supply chains, and novel services as a source of revenue. At the EU level, the 2025 report, State of the Digital Decade, demonstrates that business digitalisation is still not evenly spread in terms of infrastructure, digital skills, and enterprise adoption, which implies that implementation conditions remain unequal by sector and country (LEGISLATION, 2025). However, it is not only the acquisition of technology that constitutes digitalisation in the manufacturing sector: the overall process usually involves structural reorganisation of business operations, information processing, equipment consolidation, data management, and labour policies. This combination results in structurally complex conditions of delivery: requirements change with a better understanding of technical feasibility; benefits are realised in uneven units; and implementation risks are common at interfaces (IT–OT integration, vendor user coordination, and cross-functional dependencies). These characteristics are in line with the European Union policy framing that business digitalisation advances are still top-sided, and more effort is required to achieve 2030 outcomes in relation to infrastructure, digital skills, enterprise digital adoption, and consumer services (Europa, 2025a).

Finland is a suitable context in which this study can be applied due to its strong digital capabilities despite remaining implementation constraints. In their country report on the Digital Decade, 2025, the European Commission refers to Finland as a technologically advanced nation with agile enterprises, and states further that some of the enabling conditions, such as gigabit infrastructure is yet to be advanced. This makes Finland a relevant context for examining how project governance influences the results of digitalisation projects in manufacturing organisations (Digital-strategy, 2025).

1.2 Digitalisation pressures in manufacturing and the Finnish setting

Cloud services, enterprise platforms, industrial data capture, analytics, and automation are all becoming linked with manufacturing digitalisation. According to Eurostat, in 2025, 52.7% of EU businesses utilised paid cloud computing services, 7.4 percentage points higher than the situation in 2023, signalling that digital infrastructure is turning into a standard organisational capability, rather than a specialised innovation. This applies to manufacturing firms, where digitalisation initiatives are becoming strategic, rather than optional, and may be executed under time and budget pressure (Europa, 2025).

In Finland, there is also an increase in the application of advanced digital technologies at the enterprise level. According to the statistics, the number of enterprises using AI technologies is increasing significantly in the middle of 2020s, and it is a sign of the acceleration of experimentation and implementation beyond pilot cases (stat.fi, 2025). Nonetheless, the level of adoption does not necessarily ensure the success of a project. The manufacturing environments are usually characterised by capital intensity, safety and reliability, legacy equipment restrictions, in addition to the operational continuity expectations, which limit the scope for rapid change. These characteristics generate the necessity to consider delivery strategies that will be able to cope with uncertainty without losing control over operations.

Despite working in a favourable digital environment, the success of a project within the Finnish manufacturing industry depends more on how companies address integration, cross-functional coordination, and continuity of operations. According to the statistics of Finland, 38% of enterprises utilised AI technologies in spring 2025, a figure that reached 68% of enterprises employing at least 100 employees, indicating that the pressures to digitalisation are growing even though the success of implementation is still determined by the quality of governance (Publication, 2025).

1.3 Problem statement

Manufacturing projects of digitalisation tend to fail to provide the intended benefits due to the combination of both technological novelty and organisational change. They also need to have alignment between business objectives and implementation design,

coordination between functions (production, quality, maintenance, IT, procurement, finance) and constant communication with stakeholders that may be disrupted before the benefits are visible. In these kinds of environments, the traditional plan-based project control can end up being ineffective in situations where requirements cannot be fully specified initially, and fully iterative models can also be restricted by physical resources, regulatory requirements and system-integration complexity.

This thesis thus considers project management approach as a credible driver of enhancing digitalisation results: not in the simplified sense of (agile) being more superior, but in the more contingent sense of some agile practices (iteration, cross-functional collaboration, feedback loops, adaptive planning) enhancing learning and removing information delays whilst hybrid governance may be needed to limit safety, procurement discipline, and system integration control. The managerial issue, therefore, lies in the choice and customisation of a governing style that befits manufacturing reality, and not in symbolic use of agile labels.

1.4 Research gap and rationale

Even though there is extensive literature on agile techniques in software development and other knowledge-intensive environments, there exists a limited understanding of how agile practices can enhance the outcomes in manufacturing digitalisation initiatives. It is both conceptual and empirical: agile may be viewed as a collection of governance routines, but the impact of agile on manufacturing is contingent on organisational preparedness, technological structure, and interdependence level among production systems. More recent studies in project management research also suggest that digital transformation would demand greater governance integration and sector-specific understanding, which underlies the importance of a manufacturing-based study (Chen et al., 2025).

Recent academic work has stressed that digital change is redefining project work and that project management is not just a vehicle of delivery but part of an enabling capability for transformation; more crucially, the same literature points out that the results of transformation mainly rely on the sociotechnical and organisational terms and not merely the use of technology (Chen et al., 2025). This drives both the thesis design,

consisting of (i) a structured review of recent literature on agile/hybrid project management in digital transformation and manufacturing, and (ii) secondary statistical indicators to place the Finnish manufacturing environment and the maturity of the corresponding digital capabilities in the context.

The policy and investment environment in Finland and the EU support the rationale. The national-level reports show proactive planning and investment frameworks on the advancement of digital capacity, such as actions and finances that determine the ecosystem within which manufacturing initiatives are being undertaken (Europa, 2025b). Meanwhile, cross-country surveillance and the coordinated working policies concerning AI show that the development of the capabilities (skills, governance, and responsible adoption) is a continuous process, which means that task-specific approaches should be implemented within the institutional background restrictions (Commission & Compass, 2025).

1.5 Aim, research question, and objectives

This thesis attempts to explain with the help of secondary evidence how agile project management may contribute to the better performance of digitalisation projects in Finnish manufacturing companies, and under which circumstances agile or hybrid strategies are most likely to be effective.

1.5.1 Research question

What agile practices can be applied to projects concerning the improvement of digitalisation projects within Finnish manufacturing firms?

1.5.2 Objectives

- To critically analyse the literature on agile and hybrid project management in the context of manufacturing digitalisation projects.
- To determine the processes by which agile practices can enhance project results in Finnish manufacturing digitalisation.
- To investigate the contextual determinants that precondition the appropriateness of agile and hybrid strategies within the manufacturing environment.

- To utilise secondary evidence to make recommendations on how to govern digitalisation projects within Finnish manufacturing firms.

1.6 Theoretical framing

This thesis takes a sociotechnical perspective of the projects of digitalisation, along with the logic of execution-driven agile project management. The sociotechnical view considers the results as jointly produced by technology and organisational adaptation: performance is determined by its configuration of systems and interactions between its users, work teams, routines, and decision rights. This is especially relevant in the case of manufacturing since technologies are integrated into the workflows; the value of digital tools is achieved by the changed practice instead of installation itself (maintenance routines, quality decisions, production planning, operator support).

This thesis considers agile project management not as a universal method, but rather as a collection of practices capable of enhancing responsiveness where uncertainty exists. Information delays can be minimised with iterative delivery, fast feedback, and cross-functional coordination, exposing integration issues at an earlier stage in the project lifecycle. Nevertheless, such practices need to be balanced with manufacturing obligations like safety guarantees, supplier agreements, and unit testing. This is the reason why the thesis considers hybrid governance as a possible model: predictive control is maintained where assurance is required, whereas iterative learning is applied where uncertainty is greatest. This interpretation aligns with the recent focus of PMI on strategic alignment and value creation as wider measures of project success (Project Management Institute, 2025).

This framing is consistent with practitioner evidence that project success is becoming increasingly pegged on wider organisational capacity as opposed to a limited focus on scope, time, and cost measures. The Project Management Institute highlights the value of strategic alignment and value-creating capabilities in current project conditions, implying that execution strategies should link performance to benefits and business results (Pmi, 2025). This helps substantiate the thesis's emphasis on results and conditions of governance, as opposed to the purity of method.

1.7 Methodological overview and secondary data strategy

This thesis adopts a secondary-data design, which will involve both a structured literature review and the examination of official contextual indicators. Mechanisms by which agile and hybrid governance can influence the project outcomes are determined using the literature review in the context of manufacturing digitalisation. This is followed by an examination of Finland within the wider European digital context using official statistics and institutional reports. The research is based on triangulation rather than testing because agile adoption is hardly quantifiable in formal records.

1.8 Significance and expected contribution

The contribution is anticipated to be threefold. Theoretically, the thesis is a synthesis of scattered findings into a more understandable assurance of the processes and contingencies: what agile practices can be predicted to enhance (say, speed of learning, alignment of stakeholders, disclosure of integration issues), and what a restraint can eradicate the gains (say, inflexible contracting, lack of cross-functional capability, inadequate data governance). Methodologically, it shows how even secondary-data design can lead to an analytic benefit on the grounds of integrating structured review with official indicators and benchmarking. In practical terms, it comes up with evidence-based recommendations to Finnish manufacturing companies as to which and how agile or hybrid governance to choose to use in digitalisation projects. This thesis contributes three points. Theoretically, it explains how agile and hybrid governance can impact the results of projects by improving learning, coordination, and detection of risks at earlier stages. In methodology, it demonstrates that even a secondary-data design can provide an analytical insight when literature synthesis is paired with official indicators and documentary evidence. In practice, it offers governance-related advice to Finnish manufacturing firms, which implement digitalisation initiatives.

1.9 Thesis structure

Following this introduction, Chapter 2 discusses the literature on agile and hybrid project management in manufacturing digitalisation, emphasising mechanisms, boundary conditions, and project outcomes. The methodological design, data sources, inclusion

criteria, and analytical strategy are detailed in Chapter 3. Chapter 4 shows the results of the literature synthesis and contextual secondary indicators. Chapter 5 covers the practical and theoretical implications of the findings. Chapter 6 summarises the research thesis by providing an answer to the research question and demonstrating how each of the research objectives has been met.

2 Literature Review

2.1 Purpose, scope, and organising logic of the review

The chapter examines the literature required to respond to the research question: to what extent can agile project management practices improve the performance of digitalisation projects among Finnish manufacturing businesses? The review is structured on four connected aspects: agile practices, the mechanisms that those practices can use to improve project outcomes, the manufacturing context conditions that impose boundaries on the application of agile practices, and the argument that hybrid governance is more appropriate than pure agile in most manufacturing contexts.

2.2 Digital transformation projects in manufacturing as socio-technical reconfiguration

More recent scientific studies on manufacturing have been moving towards using the concept of digital transformation as a reconfiguration of the operational models, decision rights, and routines, instead of considering it a discrete IT implementation. Under such framing, project performance cannot be derived from the fact of deployment completion since it indicates value based on the way technologies will be integrated by production planning, maintenance work, quality decision-making, and cross-site standardisation. The project management conflict suggests structural uncertainty: the requirements and the technical viability are such that they co-evolve; the benefits are realised in an uneven way throughout the processes; integration risks are concentrated between the vendors, data structure, operational teams, and interfaces. Such dynamics are observable in empirical studies that have related digital transformation to performance in manufacturing companies, with returns being linked with complementary changes within the organisation (e.g., in terms of capability, financing, and organisational fit) rather than with technology adoption per se (Wang et al., 2025).

This thesis adopts a sociotechnical approach since digitalisation initiatives in manufacturing transform not technologies alone, but also routines, decision rights, and

cross-functional coordination. The current scholarship on digital transformation in project management prioritises sociotechnical integration, governance, and interface misalignment as the main themes, so this interpretation is not a side effect that is only introduced as a theoretical component. In production, the usefulness of digital tools relies on their use in production planning, maintenance, quality management, and operations decision-making (Chen et al., 2025).

2.3 Finnish and EU digitalisation context as an implementation environment

Finland is an applicable implementation scenario since it is both highly digitally mature and persistently geographically underserved in terms of digital infrastructure and capabilities, and, on an EU-wide reporting, enterprise digitalisation is less an extraordinary innovation stance than a competitive one. This section is thus somewhat restricted: it puts Finnish manufacturing in the context of the greater implementation setting without redirecting the focus from project governance (Europa, 2025b).

The second contextual factor is that AI adoption and experimentation are accelerating. According to Eurostat reporting, there is a factual improvement in the use of enterprise AI, and it explains the differences in AI adoption across firms and sectors, suggesting that manufacturing firms are more challenged with decisions concerning the incorporation of AI into production processes and business processes despite internal imbalanced AI resource and governance maturity. Governance design and learning grip on results become more significant in the context of AI in project terms, where more uncertainty exists (data quality, model drift, expectations on explainability), and lifecycle monitoring (Güray Efes & Topkıran, 2024).

This trend is reflected in national evidence. The use of AI in enterprises, according to Statistics Finland, is increasing rapidly year-on-year, with the adoption being more focused in larger companies, which is quite significant to this thesis since big manufacturing companies are also more predisposed to operate in a complex portfolio of interrelated digitalisation projects. The managerial problem does not revolve around the presence of digital technology but whether delivery governance can position the adoption into a steady operating value (Stat, 2025).

2.4 Manufacturing digitalisation content: enterprise systems, data practices, and AI capability

In addition to such a general concept as the digital adoption, it is proposed by the literature and official statistics that the process of manufacturing digitalisation is becoming more embedded in enterprise systems (ERP/CRM), data infrastructures, and analytics practices that enable the connection of shop-floor signals to planning and decision-making. The enterprise digital economy reporting by Eurostat gives us indicators of the diffusion of ERP and complements indicators of systematically differential gaps by firm size, strengthening the idea of uneven transformation capacity even at an advanced location. The patterns apply to this thesis because agile/hybrid governance is a plausible interplay with system complexity: once ERP, cloud platforms, and AI are coupled along functions, the coordination and interface management have risen to the core drivers of risks, and their possible value of iterative integration, along with cross-functional routines, can be higher (Eurostat, 2025).

Finland-specific data on data-driven practice adds more information to the thesis on the focus on operationalisation and outcomes. As an example, according to the Finnish business intelligence and data practice reporting, variation exists in how companies structure BI leadership, data management practices, and adoption of analytics, which suggests that the way organisations are capable of mobilising cross-functional data capabilities and putting feedback loops on how operations critically influence system design, in turn, shapes the delivery performance. This aids in using both the quality of coordination and learning speed as mediating variables between the governance and the outcomes of the project (Liu, 2024).

On the level of policy analysis in Europe, the reporting on coordinated AI plans provided by the OECD touches upon the growth in adoption and also on the ongoing issue of skill shortage and concentration of AI talent, which is directly applicable to manufacturing organisations that seek to operate several digitalisation projects simultaneously (Oecd, 2026). In the case of a deficit of skills, project governance realises a trade-off: it has to speed up learning (without shifting the quality to the downward side) and keep

operational risk away. This tension further encourages hybrid solutions whereby there is differentiation between the adaptive and assurance-heavy elements of delivery.

2.5 Agile project management mechanisms relevant to manufacturing digitalisation

The agile project management literature on digital transformation is starting to grow beyond an interest in configuring agile as a branded methodology, and instead treats it as a system of routines, where reducing the latency of information and permitting adaptation in the face of uncertainty. Thematic themes that are revealed in a systematic review of digital transformation in project management include socio-technical integration, governance and leadership, and misalignments at interfaces. In the case of manufacturing, it matters since, at the socio-technical edges (adoption of operators, OT constraints, vendor integration, data governance), project issues are likely to be revealed, to precisely where agile routines, such as iteration, frequent stakeholder feedback, incremental integration, etc., should show up problems earlier, compared to linear execution models (Chen et al., 2025).

In this thesis, agile project management can be seen as a form of practice instead of a rigid method. The latest scholarship has stressed that agile need not be outlined by a single procedural template, but by adapting planning, iterative delivery, stakeholder collaboration, and continuous learning. Core practices applicable to manufacturing digitalisation are iterative delivery, incremental implementation, backlog prioritisation, cross-functional collaboration, frequent stakeholder feedback, and regular review or retrospective. The importance of these practices lies in the fact that the requirements change as the implementation process goes on, yet their success relies on the fact whether the organisation can sustain them with suitable structures, skills and management support (Dong et al., 2024).

Another stream also formally combines the interaction of agile project management with digital transformation and outlines a contingent trend such that agile practices seem most useful where the amount of uncertainty is poised, and feedback can be normalised, yet the impact depends upon organisational circumstances and the transformation character. In the case of the thesis, the implication is methodological in that the literature review should find the mechanisms and boundary conditions, as

opposed to generic statements that agile improves performance. This deals directly with the supervisor feedback, by maintaining analysis fixed on the problem of the research, how the practices are converted into outcomes of the project, as opposed to providing loose descriptions of digital trends, which are loosely connected (Zhang et al., 2024).

The framework-oriented agile transformation work is also similar in that agility is regarded as a change of multi-dimensions like culture, competencies, structure and delivery methods. This is important to the manufacturing process since agile routines are project-based and must be supported by organisations (decision rights, cross-functional staffing, product ownership capacity, and escalation paths) to be safely used in operational settings. The governance implication is that the conceptualisation of agile in manufacturing digitalisation must be one of selective use of agile routines in a more controlled delivery system, and not total substitution of plan-based governance (Ndou et al., 2024).

Recent applied research also indicates the possibility of operationalising agile digital transformation in terms of prioritisation and order methods that deal with resource limitation and ability threshold, which is relevant to the manufacturing SMEs and sub-units within large organisations. Although Finland is quite digitalised, the limitations with resources and skills are still evident within particular manufacturing sub-sectors and factories, which means that the concept of agile/hybrid governance can be examined as the means of distributing limited attention of cross-functional types and expediting the process of learning through validated approaches, instead of merely raising the delivery speed (Bayat et al., 2025).

2.6 Hybrid governance as a contingency response to control–learning tensions

Digitalisation project manufacturing has a structural paradox: it needs to support learning (requirement and feasibility changes), yet to maintain control (due to downtimes, safety, and compliance risks that are expensive). Hybrid project management is most appropriately thought of as a contingency design: it is an amalgamation of adaptive routines in circumstances of great uncertainty (e.g., workflow design, analytics use cases, and user-facing decision support) and predictive controls in circumstances where the assurance is compulsory (e.g., safety validation, procurement,

integration testing gates, and cybersecurity acceptance). The critical question of analysis in this perspective is not whether hybrid models exist, but whether they are harmoniously designed, i.e. whether decision rights, artefacts, cadence, and escalation paths are clearly determined in the interface between adaptive and predictive units.

This argument is in line with the evidence of operational excellence in more developed manufacturing ecosystems: lighthouse-factory reporting points out that performance improvement usually ensues as a result of integrating digital technologies with redesigned routines, building capabilities and strict scaling procedures. It can be made relevant to this thesis because it is possible to think of hybrid governance as the project-level implementation of such a combination: agile routines facilitate experimentation and learning, and structured governance facilitates safe replication and scale-out across lines, locations, and supply interfaces (World Economic Forum, 2025a).

More current lighthouse-oriented research expands on the notion of an organised operating system of responsible transformation, with a focus on standardisation of governance routines, ability construction, and discipline scaling. The thesis, it justifies the argument that agile/hybrid delivery value is conditional on the organisational enablement and governance maturity, and it is an evidence-based counterargument to naive assertions that agile is only about speed (World Economic Forum, 2025b).

Transformation excellence has been further supported by the 2026 lighthouse reporting as being connected with enduring capability building and alignment across functional teams instead of solitary pilots. This correlates with the focus of the thesis on the results of performance outside of time and cost, since the manufacturing value is often gained after stabilisation and scaling, but not at the point when they are first deployed (Paper, 2026).

An alternative literature stream on project management suggests that contemporary delivery capabilities are moving out of compliance-focused PMOs to value delivery models. Although not manufacturing-specific, this contributes to the theoretical orientation of the thesis: should the success of the project be increasingly measured through benefits and value, then delivery governance should explicitly link execution

routine (agile/hybrid) to benefits realisation channels as opposed to delivering being seen as a unique and isolated technical practice (Moghaddasi et al., 2025).

2.7 Boundary conditions: IT/OT convergence, cybersecurity risk, and regulation

IT/OT convergence realities limit manufacturing digitalisation: legacy control systems, vendor-specific protocols, fragmented networks, and uptime requirements limit experimentation and make it difficult to implement incremental release strategies. The coverage of IT/OT convergence in industry notes that integration programmes should be coordinated across domains and that the governance should be able to balance between the competing priorities of IT security, operational continuity, and engineering assurance. In this thesis, the limitations support the examination of the concept of hybridisation as an operational imperative instead of an emotive inclination of the managers (Telstra & Omdia, 2022).

This is worsened by cybersecurity risk. OT-based security reporting demonstrates that intrusions and disruptions are material and increasing, and most organisations cannot cope with visibility and patch constraints in operational settings. The governance implication comes out as straightforward: the routines of agile, which raise the rate of changes, should be offset with validation, monitoring, and risk management in line with OT systems; otherwise, the iterative delivery will contribute to the operational risk instead of alleviating it (Fortinet, 2024).

The attempt at assessing cybersecurity in the public sector strengthens this strategic character of the boundary condition. In its reporting on the cybersecurity situation in the Union, ENISA presents cybersecurity as a systemic ability problem linked to regulatory expectations and sector maturity level. In the case of manufacturing companies affected by the EU regulation, this reinforces the thesis that the design of governance cannot be dissolved along with transformation delivery: approaches to project delivery come with the demands of compliance, reporting, and assurance that will have to be surveyed into the definition-of-done-criteria and delivery cadence (ENISA, 2024).

The concept of threat-landscape synthesis is an additional justification that cybersecurity is not a project to be completed but an operation-time constraint. The threat landscape

reporting published by ENISA focuses on dynamic attack trends and the necessity to manage risks continuously, which conceptually corresponds to the iterative delivery, but only in case iteration is supplemented by efficient controls, monitoring and adequate responsibility. In the context of the thesis, it allows outlining cybersecurity and IT/OT preparedness as the moderating factors that influence the circumstances in which agile/hybrid governance can increase performance (for Cybersecurity (ENISA), 2024).

These constraints are also formalised through regulation. The NIS2 Directive provides cybersecurity requirements to the sectors and builds up the expectation related to risk management and dealing with incidents. In project terms, this means that the process of manufacturing digitalisation programmes involves more and more governance and assurance practices that can be audited and not independent agility delivery, but hybrids that are built to provide compliance and security gates without inhibiting learning cycles (Eur, 2022).

Even operational advice provided by NIST confirms the boundary-condition argument further: OT security guidance specifically acknowledges reliability and safety bounds and the concept that security controls should not be incompatible with operational performance requirements (Eur, 2022). Regarding the production of digitalisation projects, this facilitates a governance position where iterative delivery is organised with safe integration, controlled deployment windows, and continuous monitoring, aiming for hybrid governance as a sensible design alternative.

Lastly, the guidelines about the standards of the sector with reference to ISA/IEC 62443 assist in the operationalisation of the term control in the industrial setting by providing a structured perception of the policies, procedures, and lifecycle security expectations. In this thesis, this literature is not utilised to prescribe a technical architecture but rather to explain why project governance should approach cybersecurity assurance and responsibilities as lifecycle concerns in the delivery design, which affect the choice of methodology and the pace (Dolezilek et al., 2020).

2.8 Evaluating performance: benefits realisation, capability building, and dynamic capabilities

One of the primary shortcomings of most of the available discourses on digitalisation is that they use efficiency measures of delivery (time, cost, scope) as proxies to success despite the emerging body of evidence around transformation value relying on adoption, process performance and long-term capability. The benefits realisation management (BRM) offers a suitable evaluative perspective as it expressly relates project outputs to quantifiable consequences and assigns ownership outside of project closure. By practising empirical BRM within the framework of national digital transformation, it has been proven that benefits do not automatically progress; they need to be governed, the stakeholders aligned, and learning ecosystems, which assist in the process of diffusion and maintained adaptation (Cresswell et al., 2022).

It is consistent with practitioner-oriented evidence: the results of the survey based on benefits realisation show that transformation performance is linked to benefits management maturity and change management integration. In the case of the thesis, this justifies the selection of mediators like coordination and alignment and risk discovery/rework reduction, as they are the exact points by which benefits management maturity would be predicted to have an impact in the context of any complex programmes (Implement consulting group, 2024).

The second evaluative dimension is the capability building. The theory of dynamic capabilities has often been applied to explain how companies feel opportunity, capture them by reconfiguring resources and change routine with time. In the case of manufacturing digitalisation, the conceptual relevance is that project governance can help build capability: cross-functional routines, cyclic learning and systematic retrospectives can be institutionalised to stabilise learning and enhance the future performance of transformation. The available open-access studies on dynamic capabilities in projects of digital transformation make it possible to consider change management and organisational routines as a mediating process between digital initiatives and performance over the long term (Al-Moaid & Almarhdi, 2024).

2.9 Conceptual framework for this thesis

Conceptually, the framework used in this thesis is an example of a mechanism-driven contingency model that addresses the ways through which the implementation of agile and hybrid project management governances affects digitalisation project outcomes in manufacturing settings. The chosen independent variables are the governance practices – their effect is mediated by a series of processes rather than being direct. Specifically, these mechanisms involve organisational learning acceleration, enhanced inter-functionality coordination, timely risk detection, and rework minimisation. These mechanisms account for the way through which the governance practices result in better performance of digitalisation projects, especially those associated with uncertainty and technological complexity. Consequently, the impacts in terms of project outcomes include benefit delivery, capability building, integration quality, and value creation.

Nevertheless, the proposed relationships between the three components (governance practices, mechanisms, and project outcomes) do not remain constant and vary depending on certain boundary conditions specific to manufacturing environments. These are the complexity of the IT/OT integration process, cybersecurity and regulation, rigidness in the procurement procedures, and business continuity limitations. Therefore, the framework suggests that agile/hybrid governance performance depends on the environmental and organisational contingencies, and the relationships are further explored in Chapters 4 and 5.

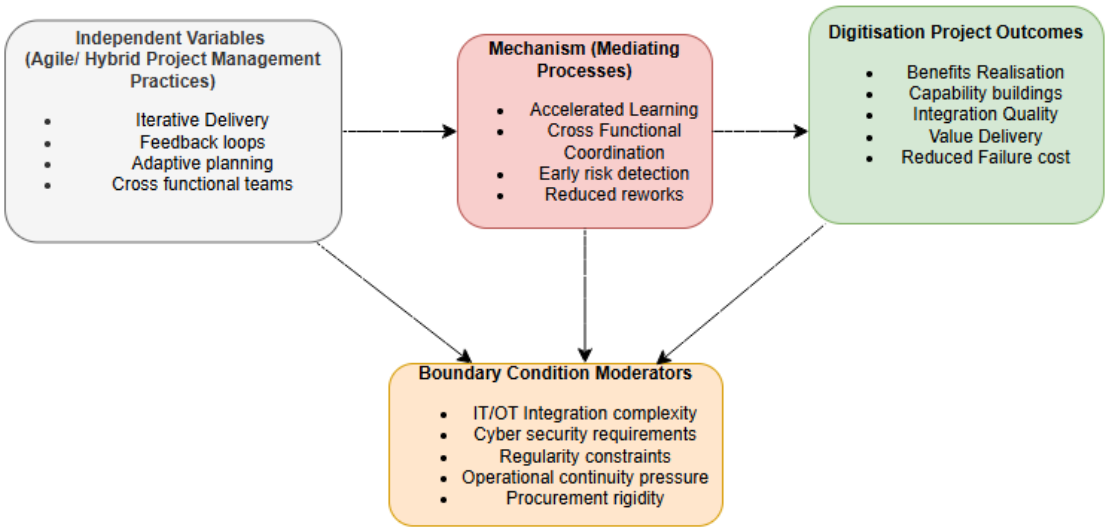

Figure 1 Mechanism-Based Conceptual Framework of Agile and Hybrid Governance in Finnish Manufacturing Digitalisation Projects under Structural Boundary Conditions

2.10 Synthesis of the research gap and implications

The gaps reviewed in the literature seem to merge into several issues, which establish a focused production-relevant research gap. To begin with, digital transformation in manufacturing is socio-technical and interdependent in essence; thus, project performance is related to quality adoption, coordination, and integration, as opposed to deployment completion. Second, the value of agile project management is subject to organisational enablement and dependent on operational constraints; this kind of management should be more thought of as a set of routines that minimise information delays and allow adaptation. Third, hybrid governance does not refer to compromise but is a contingency design in most industrial settings since it balances the learning requirements and uptime, safety, cybersecurity, and compliance requirements. Fourth, the criteria of success are now progressively focusing on benefits realisation and capability building; thus, research and practice must relate governance of delivery pathways to outcome pathways in lieu of internal efficiency metrics. The following conclusions form the thesis focus because what is not needed is to restate that agile outperforms plan-based approaches, but to suggest what agile/hybrid mechanisms are reasonably likely to enhance performance, under what Finnish manufacturing conditions,

and how those conditions can be estimated using secondary indicators and benchmarking evidence. It also means clear writing instructions on the rewritten chapter: the claims should be clearly related to the thesis problem, terms needed to be defined with credible and relevant sources, and technology trends discussions should be provided only to explain the mechanisms, boundary conditions or measure the outcomes, but not to play the role of background information.

3 Methodology

3.1 Introduction

This chapter outlines the research design adopted to study how agile and hybrid practices of project management can enhance the success of digitalisation projects in Finnish manufacturing companies, and in which contexts the success of these forms of governance is conditional. As a continuation of the conceptual and theoretical development of Chapters 1 and 2, the research methodology is not a primary empirical field study, but rather an organised integrative review complemented with contextual documentary evidence. This is because the research question calls for explanation of governance mechanisms, contextual and implementation conditions across multiple levels of analysis, rather than detailed insights into one organisation.

The research therefore utilises two sources of evidence. First, a systematic literature review of the academic and practitioner literature identifies the mechanisms that underpin the effect of agile and hybrid governance on project outcomes. Second, secondary sources including documentary and institutional sources are used to situate these mechanisms in the Finnish manufacturing sector, as well as the European regulatory and digitalisation space. This two-pronged approach enables the thesis to systematically link theory to context when considering the application of governance theory to an industrial context.

The chapter describes the research philosophy, design, development of the research framework, data sources, selection criteria, data collection process, analytical structure and data analysis techniques. It also describes how the reliability, validity and ethics of the study were ensured. Crucially, the methodology explains how the literature-inspired framework was further developed into a Finnish manufacturing-organised contingency model through a thematic analysis and documentary contextualisation.

3.2 Research philosophy and research approach

The research adopts a pragmatist philosophy, which is well-suited to the thesis' focus on a practical and context-dependent governance issue: how to successfully apply agile and

hybrid project management approaches in digitalisation projects in Finnish manufacturing companies. Pragmatism is more focused on the utility of knowledge to address practical problems rather than any methodological dogmatism (Hirose & Creswell, 2023). Because the purpose of the research is not just to explain a phenomenon, but to produce governance insights that are relevant in industry, a pragmatist philosophy is most appropriate.

Pragmatism makes it possible to choose research methods based on their suitability to answer the research question rather than philosophical purity. That is crucial in this thesis because the research includes a range of sources, including scholarly literature, policy documents and reports, institutional indicators and practitioner sources. This helps achieve a broader understanding of the effectiveness of governance across theoretical, organisational and national scales (Molina-Azorin & Fetters, 2022).

This pragmatic approach to research also has an interpretive aspect. While the research is based on documentary and statistical secondary data, these data are not considered as objective representations. They are viewed as expressions of governance frameworks, digitalisation agendas, organisational skills and industrial limitations. This is necessary because terms like agile adoption, organisational maturity and effectiveness of digital transformation are all contextual and cannot be grasped through descriptive measures.

As such, the study follows qualitative dominant structured secondary research, complemented with descriptive analyses. The research is not purely deductive (theory is being tested) or descriptive (information is being summarised). It is an analytical synthesis approach, where theories and evidence are analysed, synthesised and tailored to the Finnish manufacturing environment.

Finally, pragmatism is particularly important because this thesis aims to not only study the theoretical characteristics of agile and hybrid governance but also adapt and enhance governance models for their implementation in manufacturing digitalisation projects.

3.3 Research Design: Structured Integrative Review, Documentary Contextual Analysis, and Framework-Led Analytical Design

This thesis uses secondary research, structured qualitative dominant method which consists of literature review and documentary analysis of context with the conceptual framework developed in Chapter 2 as a guide throughout the research. This design was chosen as it was not just a matter of describing agile or hybrid project management but understanding how the two governance approaches can contribute to the performance of digitalisation projects in certain industrial environments in manufacturing companies in Finland. The study, therefore, aims to be an explanatory synthesis instead of a causal empirical study.

One of the main characteristics of this design is the conceptual framework is used, not only as a theoretical model but also as a methodological model of the study. The first literature-based hypothesis was Agile/Hybrid governance can have an impact on the results of digitalisation projects. But initial synthesis showed that this was too general for manufacturing situations. The framework was therefore refined to a mechanism-based model as agile and hybrid governance practices show up as explanatory variables, project performance as the outcome, four intervening mechanisms—in accelerated learning, cross-functional coordination, early risk identification, and reduced rework—as the pathways to project performance, and manufacturing-related boundary conditions—IT/OT complexity, cybersecurity needs, operational continuity, and procurement rigidity—as moderators of governance effectiveness. This framework had direct influence on the data that was gathered, the coding of data, and the interpretation of the findings.

There are two stages of the research design which are intertwined.

The structured integrative review is the first stage of the process.

This process starts with a systematic and focused review of academic research and good practice literature. This is the foundational stage for analysis in the thesis and consists of the identification, synthesis and interpretation of existing evidence on:

- Agile governance practices
- Hybrid governance principles

- Manufacturing digitalisation characteristics
- Governance–performance mechanisms

The limitations and requirements of implementation in industries:

This process is systematic, moving from identification of sources, screening, thematic coding and synthesis. This is not a narrative review but rather aims to highlight key governance arrangements and theoretical trends for manufacturing digitalisation. In this process, the initial conceptual linkages between governance practices and project outcomes were set.

Documentary Contextual Analysis: Stage Two

The second stage follows the literature synthesis and consists of analysis of institutional, policy and official statistical information that helps to place the governance mechanisms in the context of the manufacturing sector and the EU context. This includes:

- Digital maturity of Finnish manufacturing
- EU digitalisation priorities
- Creating conditions where cybersecurity and compliance are addressed.
- Industrial operational constraints

This stage makes sure that the governance principles that are found in the literature are not applied in an abstract manner but are sharpened based on the actual conditions of implementation. That is, the hypothesis was examined whether theoretically significant governance practices are still viable in the context of Finnish manufacturing.

These two stages form a framework guided analytical design process. The conceptual framework was used to guide selection of the sources as a basis for determining which evidence categories were relevant and to guide them through the process of thematic analysis, in which coding was used to break down the evidence into governance practices, mechanisms, constraints, and outcomes; and to link first-order concepts from secondary sources to second-order themes and accumulate governance dimensions to develop the data structure. This means that the results of Chapter 4 are not presented in the form of a straightforward summary of the literature, but rather as a result of a structured framework-driven thematic synthesis.

Overall, this design is considered as a secondary study that explains a mechanism, incorporates theory and documentation and involves contextual adaptation. It fits well into the pragmatic thinking, as it aims to learn about governance theory and enhance it through use of a context-specific governance model that is applicable to digitalising manufacturing in Finland.

3.4 Framework Development Process

A key research goal of this thesis was not just to apply governance theories, but to develop and adapt them into a context-specific framework to study digitalisation projects in Finnish manufacturing companies. In the initial stages of the literature review, governance literature frequently assumed that agile/hybrid styles of governance simply enhance project performance. This initial framework was based on literature can be described as:

3.4.1 Agile/Hybrid Governance → Project Performance

This provides a good rule-of-thumb but was discovered to be too simplistic for manufacturing digitalisation. The initial synthesis found governance has a non-uniform and indirect effect on outcomes. Rather, its impact is dependent on mechanisms which govern practices and project execution, and the industrial context in which mechanisms operate.

As such, the model was further developed into a more explanatory and contextual framework:

3.4.2 Agile/Hybrid Practices → Performance Mechanisms → Project Outcomes

Moderated by Manufacturing Boundary Conditions

This refinement was a result of thematic analysis of scholarly, practitioner and documentary sources. Four key moderating mechanisms were frequently mentioned as the main ways in which agile and hybrid governance impact digitalisation:

- Accelerated learning
- Cross-functional coordination
- Early risk identification

- Reduced rework

These mechanisms show the process through which project governance has an impact on project performance, rather than making a direct causal claim.

But at the same time this analysis showed that these mechanisms are constrained by manufacturing-specific contexts. The main contextual moderators were:

- IT/OT integration complexity
- Cybersecurity and compliance regulations
- Operational continuity pressures
- Procurement and organisational rigidity

These conditions are especially important as they distinguish manufacturing from software-driven agile development.

The methodological refinement converts the model from a generic governance-performance framework to a manufacturing-related contingency framework. By doing so, this study makes contingency theory more operational by defining which conditions in the industry influence governance success. The framework thus became the framework of analysis for Chapters 4 and 5, to interpret the findings and to provide recommendations.

3.5 Data sources and inclusion criteria

This study relies on three broad bases of secondary sources. The first group is the academic literature, such as peer-reviewed journal articles, review articles, and only a small number of high-quality conference papers, where they can present a strong degree of relevance to the topic. The sources were utilised to investigate agile project management, hybrid project management, digital transformation, manufacturing environments, sociotechnical systems, benefits realisation, dynamic capabilities, and, as required, IT/OT convergence and cybersecurity. Recent review recommenders emphasize that the choice of sources must be transparent, driven by questions, and strongly linked to the conceptual purpose of the study (De Cassai et al., 2025).

The second category is the institutional and policy sources. They are Eurostat, (Eurostat, 2026) Statistics Finland, (Key and Indicators, 2025) European Commission Digital Decade content, (Brussels, 2026) OECD reports (Oecd, 2026) and ENISA reports (Threat, 2025).

The sources have been chosen as they present topical, trackable, and policy-relevant evidence on digitalisation, enterprise capability and cybersecurity situations in Finland and the broader EU. Eurostat and Statistics Finland are both releasing recent enterprise digitalisation indicators, while the European Commission's 2025 Digital Decade reporting provides an updated country-level assessment for Finland.

The third category is high-quality practitioner and industry reports, including PMI, (Pmi, 2026) Business Finland (Technology, 2025) and other regarded industry agencies, (Sadeinnovations, 2026) where they directly provide the governance practice, ability building, or the circumstances of industrial digitalisation. These reports were employed selectively, and their methods and relevance were clear and sufficiently clear. An example of current evaluation material regarding national digitalisation programmes has been published by Business Finland (Trust & Programs, 2025).

The inclusion of sources was determined by the relevance to the research question, relevance to manufacturing digitalisation or agile-hybrid governance, source credibility, recency and clarity of conceptual or empirical utility. The core period of review was 2021-2026, since the digital practices and policy conditions evolve rapidly. Sources that were old were only retained when foundational. Sources were eliminated in case they were loosely favoured, advertorial, old, or too broad to suit the focus of the thesis.

Table 1 : Sources of research summary

Source category	**Main databases/institutions**	**Purpose of this thesis**	**Examples of material used**
Academic literature	Scopus, (Elsevier, 2026) Web of Science, Google Scholar, University of Vaasa Library databases	To find theories, mechanisms and boundary conditions associated with agile, hybrid governance, and manufacturing digitalisation.	Articles on agile project management, digital transformation, benefits realisation, and dynamic capabilities in peer-reviewed journals.

Source category	Main databases/institutions	Purpose of this thesis	Examples of material used
Official statistics and policy reports	Eurostat, (Europa, 2026) Statistics Finland, (Key and Indicators, 2025) European Commission, (Brussels, 2026) OECD (Oecd, 2026), ENISA (Threat, 2025)	In the context of both Finland and the EU digital landscape, and to find applicable limitations of implementation.	Digital Decade country report, enterprise ICT statistics, artificial intelligence adoption statistics, and cybersecurity and regulatory report.
Practitioner and industry sources	PMI, (Pmi, 2026) World Economic Forum, (Technology, 2025) Business Finland (Sadeinnovations, 2026)	To advance the discourse of governance practice, value delivery and industrial transformation.	PMI pulse of the profession, Lighthouse operating system reports, Business Finland programme reports.

3.6 Data collection procedure

This thesis adopted a data collection process that comprises four steps to ensure transparency, relevance and rigour. Given the study's approach to a structured integrative review and documentary contextual analysis (as opposed to primary data collection), the integrity of the findings relies on the rigour and consistency of identification and selection (Pritchard, 2023).

3.6.1 Step 1: Identification

The first step was to identify potential sources of academic, institutional and practitioner information. We searched Google scholar, Scopus, Web of Science, and university libraries, as well as websites of the institutions. The search terms were formulated based on the research question and conceptual framework. Common combinations included:

- Agile project management AND manufacturing
- Hybrid governance AND digital transformation
- Finnish manufacturing digitalisation
- IT/OT convergence AND manufacturing
- Realising benefits AND digital transformation
- Cybersecurity AND manufacturing

The keywords were broad to retrieve evidence from various disciplines but specific to governance and manufacturing.

3.6.2 Step 2: Screening

The second stage involved examining titles, abstracts, executive summaries and authoritativeness. The purpose of this step was to weed out sources that were too broad, poorly conducted, published too long ago, overly promotional, or did not relate to the thesis topic. The emphasis here was on the quality of the publication, authority of the publishing institution and conceptual fit.

3.6.3 Step 3: Full-Text Assessment

Sources successfully screened were then fully evaluated. This involved assessing the contribution of each source to governance theory, digitalisation mechanisms, manufacturing-specific constraints, Finnish and European Union (EU) context. The sources were also analysed for theoretical and analytical credibility.

3.6.4 Step 4: Final Inclusion

The last step was to include only those sources that had a high level of relevance to:

- Governance mechanisms
- Agile/hybrid project management
- Manufacturing boundary conditions
- Finnish/EU digitalisation

This systematic process ensured the evidence base for the thesis was relevant to the research question, and that it was methodologically sound and sufficiently analysed.

3.7 Data Structure and Analytical Coding Framework

Table 2 : Secondary Data Structure

1st Order Concepts (from sources)	2nd Order Themes	Aggregate Dimensions
Iterative delivery	Accelerated learning	Agile performance mechanisms
Stakeholder feedback	Accelerated learning	Agile performance mechanisms
Sprint reviews	Early issue visibility	Agile performance mechanisms
Cross-functional teams	Cross-functional coordination	Agile performance mechanisms
IT and operations collaboration	Cross-functional coordination	Agile performance mechanisms
Incremental testing	Early risk identification	Agile performance mechanisms
Continuous validation	Reduced rework	Agile performance mechanisms
Legacy systems	IT/OT integration complexity	Manufacturing boundary conditions
Real-time production dependency	Operational continuity pressures	Manufacturing boundary conditions
Cybersecurity compliance	Regulatory constraints	Manufacturing boundary conditions
Vendor dependency	Procurement rigidity	Manufacturing boundary conditions

1st Order Concepts (from sources)	2nd Order Themes	Aggregate Dimensions
Predictive governance controls	Hybrid governance structures	Governance adaptation mechanisms
Agile routines in uncertain tasks	Hybrid governance structures	Governance adaptation mechanisms
Stable controls for critical systems	Hybrid governance structures	Governance adaptation mechanisms

3.8 Data analysis strategy

This thesis employed a three-part thematic synthesis approach for data analysis, to translate a variety of secondary data sources into an analytical framework (Braun & Clarke, 2023). This strategy was chosen as the aim of the study is not to test causal relationships, but rather to identify common governance patterns, contextual factors, and performance mechanisms of Finnish manufacturing digitalisation.

3.8.1 Stage 1: Open Coding

In the first stage, the data from journal articles, practitioner reports, policy papers and institutional indicators were open-coded. At this point common concepts, governance practices and explanatory theories were identified without forcing concepts into rigid categories. Key concepts identified were:

- Iteration
- Feedback
- Coordination
- Adaptive planning
- Stakeholder collaboration
- Risk visibility

This led to the identification of broad themes in the discourse on agile and hybrid governance across the different types of evidence.

3.8.2 Stage 2: Axial Coding

In stage 2, these concepts were grouped into broader themes. By comparing concepts, the concepts were grouped under three broad themes:

- Mechanisms
- Constraints
- Outcomes

For instance, iteration and feedback were categorised as performance mechanisms, and regulatory and cybersecurity were categorised as constraints. This involved converting descriptions into explanations.

Our themes or analytical categories were drawn from a conceptual framework outlined in Chapter 2, which was further developed through iterative analysis.

3.8.3 Stage 3: Contextual Refinement

In Stage 3, these themes were refined by incorporating the Finnish manufacturing and EU industrial context. This moderation process added manufacturing-specific moderators, such as:

- IT/OT integration complexity
- Cybersecurity requirements
- Operational continuity pressures
- Governance and procurement inflexibility

This last stage was important because it led to the adaptation of a general governance framework to a contingency model in Finnish manufacturing (Ahmed et al., 2025).

These three stages of analysis provided the basis for Chapter 4 in the form of the organisation of the empirical findings according to governance mechanisms, boundary conditions and governance implications. This ensured a good fit between the methodology, framework building and presentation of findings.

3.9 Reliability, validity, and Trustworthiness

Reliability, validity and trustworthiness was ensured in this study through a transparent approach for secondary-data based studies. As the thesis is not based on primary data

collection, a rigorous approach to methodology is ensured through the selection of sources, transparency in the analytical approach and triangulation of evidence types.

3.9.1 Reliability

This research was improved in reliability in various ways. First, a clear set of criteria were used to select sources, ensuring only relevant, reliable, and quality academic, institutional and practitioner sources were included. Second, the research documented the search terms, screening process and selection criteria used, allowing for the process to be replicated. Third, we used comparison across sources to check for consistency of findings across evidence sources. Lastly, a systematic method of coding and thematic synthesis was used to minimise personal biases and increase stability in the analysis.

3.9.2 Validity

Construct validity was enhanced through data triangulation, whereby various data sources were reviewed and considered, including:

- Academic literature
- Policy and institutional documents
- Key statistical indicators (e.g., Eurostat, Statistics Finland, EU reports)

This allowed triangulation of the concepts of agile governance, digitalisation maturity and manufacturing constraints, to ensure that they were not interpreted unilaterally but verified through multiple sources of information.

3.9.3 Trustworthiness and Internal Validity

Conceptual rigour (internal validity) was taken with caution, as the aim is not to find causal links. Rather, our analysis is inferential, based on convergence of evidence, where our interpretive reasoning is supported by consistency between literature, policy analysis and contextual indicators. This enhances credibility while being cautious in drawing conclusions.

In sum, trustworthiness is achieved through transparency in methods, synthesis and interpretation in line with the exploratory and explanatory approach of the research design.

3.10 Ethical considerations

Only secondary sources that are publicly available in the field are used in this research; there is no human participant involved in the study, no interview, no survey, and no personal data gathering. Consequently, the formality of participant-consent is not essential. Nonetheless, the identification of ethical responsibility is to be emphasised in secondary research. The study abides by the rules of ethical conduct in terms of the accurate representation of sources used, no distortions and selective quotation, consideration of the methodological constraints, and proper referencing of all resources. The criteria of ethical secondary analysis also demand that information should be sourced out of legality, credible, and decent sources of the law, and the interpretation of the data must not be such that it changes the original context of the evidence it is based on (TRIPATHY, 2013).

3.11 Limitations of the methodology

There are some limitations to this study which should be considered when drawing the results. First, the study lacks organisational case studies and primary empirical evidence from Finnish manufacturing companies and so lacks insight into current managerial practices and processes. Second, the study uses proxy measures from institutional data, which may not adequately reflect quality of agile practices and maturity of governance. Third, the use of secondary data limits the causal inferences and conclusions drawn from governance practices and projects. Fourth, the results are mainly applicable to Finland and EU manufacturing and may be less generalisable. However, the design is still fit for purpose in terms of exploratory and explanatory synthesis.

3.12 Chapter summary

This chapter has laid down the systematic approach taken in the thesis. The integration of literature review, documentary contextual analysis and thematic analysis allows for a mechanism-based contingency approach to understanding agile and hybrid governance in Finnish manufacturing digitalisation. This approach means the insights presented in Chapter 4 are supported not just theoretically, but also empirically to provide rigorous and relevant analysis.

4 Findings and Integrated Analysis

4.1 Introduction

This chapter gives the results of the study, as synthesized on two main sources of data: the literature synthesis and the secondary-indicator analysis. This chapter will address the goal of creating a clear understanding of the most important processes in which agile project management impacts the results of digitalisation projects in Finnish manufacturing companies (Enisa, 2024). It also discusses the situational circumstances in which agile practices can be used to improve the performance of a project, and the hybrid governance model as the most appropriate governance model to use in the management of digitalisation projects in this industry (Tuomi et al., 2026).

The results of this paper are founded on secondary data, i.e., they are obtained using the existing academic sources, industry reports, policy reports, and statistical indicators. The findings will help to answer the main research question: How can agile project management practices enhance the results of digitalisation projects in Finnish manufacturing companies? (Yilmaz et al., 2023)

The initial section of this chapter covers the literature synthesis that examines any existing literature on agile project management and its relevance to digitalisation initiatives in manufacturing. In this section, the author will examine the main agile processes of work, including iterative delivery, stakeholder feedback, and cross-functional collaboration, which have been demonstrated to enhance the project results. The second section of the chapter introduces the secondary-indicator analysis that refers to the analysis of official reports and statistics on the Finnish digitalisation landscape. This discussion will put the literature results into context and offer a practical background to the success of agile practices in Finnish manufacturing contexts (Weforum, 2026).

One of the crucial aspects of the findings is an understanding that though agile practices have their unique benefits, manufacturing projects frequently include tasks demanding a higher degree of control, predictability, and compliance with regulations. This is the reason why the hybrid governance approach, i.e., the flexibility of agile with the

conventional project management controls, is revealed to be the most efficient governance model in terms of digitalisation projects in the manufacturing industry (Projectmanagement, 2023). This chapter, however, does not merely discuss the particular advantages of agile but also examines the need to have a hybrid form of governance to achieve the exploratory aspect of digital transformation and the more strict manufacturing operations (Leech & Hanslo, 2026).

4.2 Agile Practices and Performance Mechanisms

4.2.1 Agile as a Mechanism-Based System, Not a Method

The synthesis of the literature suggests that agile project management should not be understood as a standardised process but rather as a mechanism-based system of adaptive practices, which affect the information processing and uncertainty management in projects. This is especially crucial in the context of digitalisation in manufacturing, where projects are characterised by high degrees of interdependence between technologies, processes and organisations.

Rather than emphasising formal structures or steps, agile is based on an underlying set of routines - such as iteration, feedback, and incremental delivery - that influence the way information is processed, and decisions are made in projects. These routines enhance the pace, content and flow of information, enabling project teams to respond in a timely way to changing needs and unexpected events (Romao et al., 2026). In digitalisation projects where the outcome is uncertain, this flexibility plays a key role in project performance.

The mechanism-based approach also helps explain the inconsistencies in the effectiveness of agile practices. They do not only rely on their implementation, but on the mechanisms, they trigger such as learning, coordination and risk awareness. In manufacturing, these mechanisms need to be employed within constraints like system stability, process continuity, and regulatory and safety concerns, which limit flexibility.

Thus, the approach to agile as a mechanism-based system shifts the focus from "doing agile" to assessing how practices create value in specific contexts. This offers a more

sophisticated understanding of agile and hybrid practices in industrial contexts (Romao et al., 2026).

4.2.2 Accelerated Learning and Iterative Feedback

One key theme emerging from the literature is that iterative cycles of delivery are a critical enabler of organisational learning in digitalisation projects. In manufacturing, digital projects often involve novel technologies like artificial intelligence, advanced data platforms and extensions to existing enterprise resource planning (ERP) systems. These projects are characterised by uncertainty, with not all system requirements, interactions and desired outcomes known in advance. In such projects, conventional sequential planning struggles to cope with the changing knowledge, while agile methods enable learning along the way.

Agile practices minimise decision-making delays by providing opportunities for early experimentation and feedback. By focusing on short development iterations, teams can experiment with assumptions in a real or simulated environment, to determine early on what is and isn't working (Esteves, 2026). And ongoing input from project stakeholders enriches this process by keeping solutions in touch with operational and strategic requirements. Furthermore, incremental verification allows project teams to validate partial results before proceeding, thus minimising risks and uncertainties when making subsequent decisions.

This form of learning is especially useful in the exploratory part of digitalisation projects, where innovation and learning is needed. For instance, data analytics or artificial intelligence projects may need to iterate to fine-tune models and systems based on ongoing experimentation and learning. In these projects, agile approaches enable a "try and learn" approach, thereby improving both the technical and organisational aspects of the innovation (Zeng et al., 2025).

But the study also suggests the advantages of fast learning are contingent. In manufacturing, where production systems are designed to prioritise stability, reliability and uptime, too much iteration can lead to conflicts with operational concerns. Increases in change of systems that are closely tied with physical processes can create risks beyond the benefits of learning. As such, although iteration is a powerful learning tool, it needs

to be carefully managed with continuity and control. This highlights the need to restrict the use of agile practices to suitable parts of projects, rather than across the board.

4.2.3 Cross-Functional Coordination in IT/OT Environments

Manufacturing digitalisation is by nature cross-functional, involving the interaction of information technology (IT), operational technology (OT) and business practices. Manufacturing digitalisation, unlike IT-only projects, includes interactions between digital and physical operations, and coordination is a key factor for project success. In this regard, one way agile practices can impact performance is through improved coordination (Leong et al., 2023).

Agile methods encourage the creation of cross-functional teams which include a range of specialists, such as IT experts, production engineers, operational managers and business leaders. This reduces communication bottlenecks, with information being more directly shared between key actors, rather than through bureaucratic or functional channels. This allows for quicker detection and resolution of problems associated with system integration, process fit and operational practicality.

Another benefit of agile is a better integration of technical and operational goals. Digitalisation projects can go wrong when there is a misalignment between systems design and operational requirements. Through iterative involvement of multiple functions in the development process, agile teams keep solutions aligned with operational needs. This ensures more context-aware solutions, especially when dealing with system integration between legacy systems and digital platforms like cloud or data analytics systems (Chen et al., 2025).

Another key advantage is the ability to quickly address problems. Collaboration between different roles and functions allows quicker identification of issues across multiple areas, such as IT/OT connectivity problems or data quality issues. This agility is particularly important in Finnish manufacturing companies, as digitalisation projects often involve retrofitting or integrating existing manufacturing systems (Nam, 2025).

But this coordination mechanism is dependent on organisational factors. Companies with siloed structures, top-down decision-making or extensive outsourcing of IT services may not enjoy the full benefits of coordination. Here, communication and integration

issues can limit the effects of the agile practices. Thus, while cross-functional coordination is a strong mechanism, it requires an organisation that is willing to work in an integrated and collaborative fashion.

4.2.4 Early Risk Identification and Adaptive Planning

Another factor that is widely reported is that agile practices increase the ability to identify risks early and plan accordingly. In manufacturing, digitalisation projects are subject to various risks, such as integration issues, cybersecurity risks and changing technology specifications. The uncertainties are handled by agile practices through project transparency and continuous project and risk monitoring (Khan & Qaiser, 2025). This is done through activities like regular reviews, continuous testing and iterative planning. Periodic reviews offer formal opportunities to evaluate project progress, detect problems and update priorities. Continuous testing helps validate system components in an incremental manner, rather than just at the end of a project, enabling technical and integration issues to be uncovered sooner. Agile planning also enables flexibility by allowing project plans to be updated in response to new facts, rather than being locked into an initial plan (Pasqua, 2025).

Together, these approaches allow integration issues to be detected sooner, particularly in the integrated IT/OT environments where interoperability is important. They also enable quicker reaction to cybersecurity threats, as cyber vulnerabilities can be identified and resolved during the development stage. Finally, agile planning enhances technology uncertainty management, enabling teams to adapt to evolving needs or circumstances.

This mechanism is particularly important in manufacturing because the consequences of cybersecurity risks for digital systems can be operational, such as production delays and revenue losses. So, the early detection and resolution of risks is not only beneficial for project management, but it's essential in ensuring system reliability and operational continuity.

4.2.5 Reduction of Rework and Failure Costs

Another important identified mechanism is the mitigation of rework and failure costs through agile approaches. Through the utilisation of iterative development, feedback and testing, project deliverables are validated in a gradual fashion. Rather than discovering bugs and misfits at the end of the project, they are identified and rectified progressively. This minimises the risk of major rework at the end of the project.

In digitalisation projects for manufacturing, this is especially important because of the significant cost and operational consequences of encountering problems at the end of the development process (Lima et al., 2023). Manufacturing digital systems are often deeply embedded in production processes, so that software, data management and system integration errors can directly impact physical production. Therefore, issues with system integration can affect production continuity, causing delays, revenue loss and decreased productivity.

What's more, problems that arise towards the end of the project lifecycle may require rework, which may involve shutting down or reconfiguring manufacturing systems, a time-consuming and expensive process. Agile practices help to reduce this risk by allowing issues to be detected and addressed early, when modifications are less risky and costly.

As such, the benefits of using agile go beyond reducing delivery times. Rather, it is the reliability and quality of delivery that is critical to ensuring that the product being delivered is aligned to operational needs. This leads to greater stability, minimised cost of failure and increased efficiency of digitalisation projects.

4.3 Boundary Conditions in Finnish Manufacturing

4.3.1 IT/OT Integration as a Structural Constraint

The research suggests that the convergence of IT/OT is a key structural limit to the use of agile project management in manufacturing digitalisation projects. Manufacturing systems are characterised by a close interaction between digital and physical systems (IT/OT) and these systems can be affected by changes in the other.

This setting is constrained by several factors, including legacy systems, which constrain system flexibility; process operations, which call for stability and continuity; and real-time interdependencies, in which small changes can result in production downtime. These constraints all limit the effectiveness of frequent iterations, a fundamental agile practice (Latupeirissa et al., 2024).

Consequently, agile methods need to be adapted to minimise any impact on continuity. Although iterative development and changes facilitate learning and adaptation, they need to be tempered with system stability and change management (Europa, 2025). Thus, IT/OT integration needs a well-orchestrated governance strategy where experimentation takes place within safe bounds and in harmony with operational continuity. This needs to be combined with hybrid project management in manufacturing.

4.3.2 Cybersecurity and Regulatory Requirements

Finnish manufacturing companies comply with stringent European Union (EU) regulations and can be expected to comply with raising cybersecurity risk management regulations. These internal and external factors play an important role in how digitalisation projects are managed and the adoption of agile approaches.

Regulatory and cybersecurity requirements introduce several enforced constraints, such as formal validation procedures, which validate that systems satisfy certain safety, security and operational criteria prior to deployment. Also, there are extensive documentation requirements to ensure traceability, accountability and audit compliance (Jiang, 2023). These are crucial in manufacturing systems where system downtimes can result in cost and productivity impacts. In addition, organisations need to have in place a risk management strategy to recognise, evaluate and control cyber threats during the project development (Vicarius, 2024).

These factors limit agile methods' flexibility. Agile is based on flexibility and iteration, whereas regulatory frameworks demand stability, verification and formal approval processes. This means agile systems may not always have strong governance and control to ensure compliance in manufacturing.

This suggests a need for predictive aspects of governance within agile systems, where more structured controls, documentation and compliance evaluation mechanisms are incorporated with iterative development processes. This blending guarantees that projects are both agile and compliant, by balancing innovation, regulation and cybersecurity considerations.

4.3.3 Operational Continuity and Uptime Pressures

A key difference between the manufacturing and software domains is the need for system uptime and reliability. In manufacturing, digital systems are often integrated with manufacturing processes, so any downtime has direct impacts on manufacturing processes.

Digital system failures may result in disruptions to manufacturing processes, causing downtime and impacting production efficiency and timelines. Moreover, it can cause considerable financial losses, especially in high-volume and just-in-time manufacturing systems where delays can ripple through the supply chain. At the extreme end, system failures can also affect human safety, particularly where systems such as industrial control systems are used (Gökalp & Martinez, 2022).

This places significant limitations on the ability to experiment and quickly iterate in the production environment. Although iterative development is essential for learning and development, it needs to be controlled to prevent disruptions to production. This speaks to the need for managed approaches in manufacturing digitalisation projects.

4.3.4 Procurement and Organisational Rigidities

The analysis also highlights various organisational and structural factors that hinder the use of agile practices in manufacturing digitalisation projects. One key constraint is the existence of fixed procurement processes that often demand fixed project scope, specifications and lengthy approvals. This decreases the flexibility required for iterative development and continuous adaptation, important agile practices.

Another challenge is the vendor-dependency of IT and OT systems in many manufacturing organisations, where many systems are provided and managed by third parties. This reduces the flexibility of the organisation to adapt solutions quickly and

autonomously during project delivery, and hence its ability to respond to changes in project demands.

In addition, bureaucratic decision-making processes can slow down feedback cycles and limit the ability of cross-functional teams to work independently. The need to obtain approvals from several levels of management is at odds with the principles of agility, which relies on decentralised decision-making and fast iteration.

All this adds to the inflexibility of project execution settings. And, in doing so, they argue for hybrid governance approaches, which mix formal control arrangements with targeted agile practices (Europa, 2025a).

4.4 Why Hybrid Governance Emerges as Optimal

4.4.1 Hybrid as a Contingency Design

One of the key outcomes of this research is that hybrid project governance should not be understood as a blend of agile and traditional approaches, but rather as a situational, contingency approach, tailored to the needs of manufacturing digitalisation. Here, different components of the project are subject to varying degrees of uncertainty, risk and criticality.

Hybrid approaches respond to this by blending agile and plan-based approaches for uncertain and exploratory project components, with plan-based controls for stable or risky components. Agile components enable experimentation, feedback and learning in areas like data analytics, AI integration, or process innovation. Plan-based elements provide documentation and predictability to ensure operational reliability, safety or compliance (Bayat et al., 2025).

These complementary elements allow companies to ensure product quality and operational stability and promote innovation and learning. It also enables firms to achieve a balance between flexibility and control to ensure that innovating and experimenting do not interfere with production or compliance. Thus, hybrid governance becomes a vital strategy in Finnish manufacturing firms' digitalisation projects, rather than a stepping-stone or intermediate stage (Khan & Qaiser, 2025).

4.4.2 Matching Governance to Project Components

The effectiveness of hybrid governance depends on **task characteristics**:

Table 3 : Project Component Vs Suitable Approach.

Project Component	Suitable Approach
Exploratory (AI, analytics, innovation)	Agile
Integration-heavy (ERP, OT systems)	Hybrid
Safety-critical systems	Plan-based

5 Discussion and Implications

5.1 Discussion of the main argument

This thesis aimed to explore the contribution of agile project management to the success of digitalisation projects in Finnish manufacturing companies and when hybrid governance is more suitable. Our results reveal a coherent and coherent message: agile project management enhances digitalisation performance only through organisational mechanisms, and its use is constrained by the inherent structural and operational features of manufacturing systems.

Contrary to the view of agile as a universal project management approach, the benefits of agile are driven by mechanisms that affect performance through learning acceleration, coordination, early risk detection and rework reduction. These mechanisms enhance project performance primarily in uncertain and changing requirements environments. But in digitalisation projects such as those in manufacturing, these advantages are not absolute. They are contingent on system constraints such as the complexity of IT/OT system integration, cybersecurity, regulatory compliance, procurement rigidity, and the need for stability.

The key interpretive insight of this thesis is hence that the effectiveness of governance in manufacturing digitalisation does not depend on the choice of governance methods, but on the fit between governance mechanisms and constraints. That is, agile is effective only if the system is not compromised by iterative learning.

From here follows the main argument: hybrid governance is not a trade-off between agile and predictive practices, but a structural design adaptation to socio-technical complexity in manufacturing. Hybrid governance allows companies to selectively use agile mechanisms in components of uncertainty and predictive control in safety-critical and operationally sensitive components.

Therefore, this study seeks to redefine digitalisation project governance not as a dichotomy between agile and plan-driven governance, but as an allocation problem, as different areas of digitalisation projects need different governance approaches.

5.2 Theoretical implications

This study informs three broad theoretical areas: socio-technical systems theory, dynamic capabilities theory and contingency theory. These offer different perspectives to interpret and build upon the results.

5.2.1 Contribution to Socio-Technical Systems Theory

Socio-technical systems theory highlights the inter-relationships between technology and human organisations. Manufacturing digitalisation projects are socio-technical as they involve IT systems, operational technologies (OT) and human decision-making.

The results of this thesis add to this theory by showing that the governance of projects must be considered as part of the socio-technical system. Agile has an impact not just on process efficiency but also on interaction quality between technical and operational system components. But these interactions are contingent on systems' coupling.

Highly coupled manufacturing systems are affected by fast-paced iterative change, altering system stability. Therefore, socio-technical theory needs to consider the dilemma between adaptability and stability in operations - which is key to digitalisation governance (Leech & Hanslo, 2025).

This work therefore extends socio-technical theory by emphasising that digitalisation is not just about system design, but also the ability to adapt within the confines of the system.

5.2.2 Contribution to Dynamic Capabilities Theory

Dynamic capabilities theory describes how firms build the capacity to sense, seize and re-allocate resources. Our analysis shows that agile project management practices match the "sensing" and "learning" capabilities.

The results confirm agile practices increase organisational learning speed, allowing companies to adapt faster to technological uncertainty. Incremental development and feedback loops enhance sensing by offering early returns on system and integration problems.

But the authors also demonstrate that dynamic capabilities are bound by environments. In manufacturing, sensing and adaptation is limited by the production system. This implies a previously overlooked constraint: system tolerance constrains the pace of dynamic capabilities.

As a result, this thesis contributes to dynamic capabilities theory by adding the notion of constrained adaptability, which involves a structural constraint of organisational learning through system criticality and operational risk.

5.2.3 Contribution to Contingency Theory

Contingency theory suggests that there is no one best approach to organising or managing projects; it is dependent on its context. This research supports and enhances this view in the governance of digitalisation in manufacturing. This research demonstrates that agile governance is more effective in conditions of uncertainty and modularity, while planning is still required in high risk, complex and tightly coupled environments. Thus, hybrid governance is the most fitting governance structure. Crucially, this research extends contingency theory by detailing the contingencies in the process of manufacturing digitalisation, such as the complexity of IT/OT integration, cybersecurity and regulatory challenges, operational continuity needs and procurement inflexibility (Bellis et al., 2024). By doing so, it provides a better understanding of how to apply contingency theory in the industrial digital transformation.

5.2.4 Practical implications for Finnish manufacturing companies

The results of this thesis provide practical guidance for Finnish manufacturing companies on how to set up governance structures for digitalisation projects

5.2.5 Governance Design Principle: Hybrid as Default

Most significantly, companies should not assume that all digitalisation projects should be managed using agile project management. Rather, hybrid governance should be the default governance design in manufacturing firms. This is because digitalisation projects typically consist of both exploration-based and stability-critical components (e.g. AI, analytics, new digital services; and production systems, operational technology (OT) infrastructure). These have different levels of uncertainty, risk and impact on operations.

As a result, they cannot be managed using a single governance framework and hybrid governance approaches are needed to balance agility and control (Zhang et al., 2023).

5.2.6 Project Segmentation Strategy

Companies should use a project segmentation strategy where digitalisation projects are broken down into segments based on their characteristics. Exploration modules, such as innovation and analytics, should be governed by using agile approaches to allow flexibility and experimentation. Hybrid approaches are suitable for integration modules, which deal with system integration (Mirzaei et al., 2025). Plan-driven controls should be applied to operational-critical systems, which are related to production stability. This approach ensures that governance structures remain in alignment with task uncertainty, risks and system criticality, as opposed to being blanket applied.

5.2.7 IT/OT-Aware Implementation Strategy

In view of the prominent role of IT/OT integration issues, companies must explicitly consider governance structures that consider system coupling of IT and OT. Agile iteration should be used with care in contexts that impact production operations. This calls for a disciplined approach to implementation, which combines experimentation with stability. Specifically, experimentation should be conducted in a way that it does not interfere with production systems, thereby minimising risks. Development environments need to be as close as possible to the real world to detect integration problems. Finally, deployment cycles should be demarcated by validation checkpoints, to ensure that changes to the system meet safety, reliability and performance standards before they are rolled out (Europa, 2025a).

Procurement and Vendor Governance Reform

Existing procurement practices are often not suited to agile delivery approaches since they are based on fixed scope and rigid contracts. To support digitalisation, companies should change their procurement processes to permit incremental delivery contracts, which enable incremental development and testing. They should also use flexible contracting arrangements to enable vendor collaboration (Sun et al., 2024). Finally,

procurement should support iterative definition of requirements, rather than up-front specifications. This is essential to support the agile and hybrid governance models.

5.2.8 Capability Development Requirement

Hybrid governance is heavily reliant on capabilities. Organisations need to build an ability to collaborate to facilitate coordination across IT, OT and business functions. Further, digital literacy among both IT and business units is crucial for decision-making and execution. Another prerequisite is for firms to have appropriate governance capability to deal with the combination of adaptive and plan-based control systems. So, capability building should be considered not a consequence of digitalisation, but an important prerequisite for governance (Eurostat, 2025).

5.3 Limitations and future research

Although this study offers a refined and theory-based account, it has several limitations.

5.3.1 Secondary Data Study Design

This research uses only secondary data sources such as literature, policy and institutional reports. This means that the study does not include organisational and project case studies. As such, the results rely on analysis and interpretation. This approach enables the integration of the broad conceptual insights but also is limiting in terms of capturing organisational dynamics in practice, decision-making and challenges in implementation. As such, the findings should be considered as theoretically sound but not empirically tested in firm contexts (Weforum, 2026).

5.3.2 Use of Proxy Indicators

Governance effectiveness and digitalisation maturity were measured using proxy indicators, such as enterprise ICT use and policy reports. But these indicators don't directly assess the quality of agile implementation, governance maturity or project performance outcomes. This creates an element of abstraction and limits the precision of causal inference of governance and its results.

5.3.3 Domain Specificity

The study is specifically focused on Finnish manufacturing in the context of EU regulation. This ensures context-relevance but may limit the generalisability of the findings to non-EU, low-regulation or non-industrial digital transformation contexts (Europa, 2025c).

5.3.4 Mechanism-Level Inference Limitation

While mechanisms such as learning, coordination and risk reduction are identified, these are based on literature synthesis. These mechanisms should be tested in future studies.

5.3.5 Future Research Directions

From the limitations, we can suggest some future avenues for research. First, empirical research in Finnish manufacturing companies would help to establish the applicability of hybrid governance in practice. Second, longitudinal analyses of digitalisation projects would help to understand the dynamics of governance changes over the project lifecycle. Third, quantitative models of governance/performance relationships could be created to statistically verify the strength of the mechanisms found in this research. Fourth, governance frameworks specific to IT/OT would help to formalise hybrid governance in complex industrial settings. Lastly, cross-country studies could be used to understand the effects of different regulatory, technological and industrial settings on governance design and the use of agile and hybrid approaches.

5.4 Refinement of the Conceptual Framework Through Secondary Evidence

The original conceptual framework outlined in Chapter 2 was mainly formulated based on literature regarding agile and hybrid project management approaches. The framework posited an inherently linear structure whereby the processes of agile and hybrid governance directly impacted project performance through four mediating factors: accelerated learning, cross-functional collaboration, risk detection at the early stages, and minimized rework.

Nevertheless, a careful examination of the secondary data collected from academic and institutional literature revealed that there was need for a fundamental modification of the original framework when examining the issue of manufacturing digitalization in the

Finnish environment. Specifically, the statistics obtained from Eurostat, Statistics Finland, and the European Commission suggest that the process of manufacturing digitalization in Finland goes beyond considerations of project efficiency and is largely constrained by issues like IT/OT integration, cybersecurity, and operational continuity.

The contextual analysis above showed that an explanation of governance effectiveness could not be derived solely based on agility. On the contrary, the secondary data suggested that agility/hybridity practices only had an influence under certain boundary conditions of the industry – namely as moderating factors.

Consequently, the framework was updated from a simple correlation model to a mechanism-based contingency model:

- Agility/Hybrid practices continue to be the main input
- The proposed mechanisms of learning, coordination, risk detection, and avoidance of rework continue to hold true
- Boundary conditions of the Finnish manufacturing industry become moderating factors such as IT-OT convergence, cybersecurity, procurement difficulties, and uptime necessities

Thus, the secondary analysis provided a better context to the framework and updated it according to the industry characteristics, making it more relevant for practical applications.

In this case, the secondary sources did not negate the original theoretical framework, rather supplemented and improved it.

5.5 Concluding Remarks

This thesis proves that the performance of digitalisation projects in Finnish manufacturing firms is not related to the implementation of agile practices, but to the fit between governance mechanisms and manufacturing constraints. Agile mechanisms enhance performance, but its adoption is constrained by the nature of the manufacturing system.

Therefore, hybrid governance is the most suitable and resilient governance solution to digital transformation in manufacturing. It allows firms to balance flexibility and control and avoid stifling innovation.

The main contribution of this research is therefore a changed outlook: from seeing agile as an isolated approach, to project governance as a socially and technologically constrained context sensitive configuration of mechanisms.

6 Conclusion

This study aims to understand the role of agile project management practices in the success of digitalisation projects in Finnish manufacturing companies, and when hybrid governance practices are more relevant. This research was driven by the growing strategic relevance of digitalisation in manufacturing, and the struggle to translate digital investments into operational and strategic benefits. Although agile project management practices are well researched in software and services industries, their suitability in manufacturing settings, which are characterised by socio-technical complexity, legacy systems, regulatory and other constraints, and the need for continuity of operations, is less well understood.

This study aimed to build a structured framework of agile and hybrid governance models in the context of manufacturing digitalisation projects by mapping out the mechanisms through which they affect project outcomes, and the contextual factors that determine their effectiveness. This has been done by employing a dominant qualitative secondary data analysis, combining academic, policy and institutional publications from Finland and the EU.

6.1 Summary of Key Findings

This thesis shows that agile project management improves the results of manufacturing digitalisation not as a universal approach, but through several mechanisms. These mechanisms are faster organisational learning, enhanced cross-functional aligning, risk mitigation and waste reduction. These mechanisms contribute to improved project performance through better information sharing, enhanced flexibility and improved decision-making in uncertainty.

But the success of these mechanisms is context specific. The constraints of manufacturing environments play a crucial role in determining how agile can be applied. These include the complexity of IT/OT system integration, cybersecurity and regulatory constraints, demands for business continuity and organisational inertia (such as procurement processes and hierarchical decision-making). These constraints restrict

how and to what degree iterative experimentation and change, the hallmarks of agile, can be practised in real production contexts.

One lesson is that manufacturing digitalisation is not just a technological shift but a socio-technical transformation, in which the success of digitalisation is contingent upon the alignment between the technology, human and governance systems. In these types of environments, governance cannot be a one-size-fits-all approach. It must be able to be tailored to the various parts of projects and assessed risks.

6.2 The Role of Hybrid Governance

Perhaps the most important contribution of this thesis is that hybrid governance is a contextually appropriate design, rather than a methodological compromise. Hybrid governance mixes agile and plan-based management methods in uncertain and innovative aspects of digitalisation projects with plan-based controls in stable, high-risk or compliance-driven areas.

This approach allows organisations to combine two seemingly contradictory needs:

- The need for agility and experimentation for innovation in digitalisation
- The need for stability, reliability and compliance in operational systems

In the Finnish manufacturing industry, where digitalisation commonly entails integrating industrial systems with digital technologies, hybrid governance is the most feasible option. It balances the need for operational safety with iterative development, where needed.

As such, the study recasts project governance in manufacturing digitalisation as a contingency-based design issue, in which governance should reflect the task, system and environment that it is set to operate in.

6.3 Theoretical Contributions

This study adds to three important streams of theory: socio-technical systems theory, dynamic capabilities theory and contingency theory.

In terms of socio-technical theory, the research supports the notion that digitalisation is influenced by the interplay of technical systems and organisations. But it adds to this view by showing that project governance mechanisms are themselves an element of the socio-technical system and affect the effectiveness of the interaction between human and technical elements.

As for the dynamic capabilities' theory, this study reinforces the perspective that agile practices boost organisational learning abilities. But it also introduces the notion of bounded adaptability in that the scale and pace of organisational learning is limited by operational and infrastructural constraints in a manufacturing context. This nuance is especially significant in situations where system stability is vital.

The best fit with theory is contingency theory. The results clearly support the contention that there is no one best way for managing projects. Rather, governance success is achieved through fit between approaches and environmental factors. This thesis contributes to contingency theory by identifying the contingencies in manufacturing digitalisation projects, such as IT/OT complexity, cybersecurity needs, operational continuity needs, and organisational governance systems.

6.4 Practical Implications

This research has significant implications for managers, project managers, and decision-makers in Finnish manufacturing companies in the digitalisation process.

First, firms should refrain from using agile as a one-size-fits-all project management approach for all digitalisation projects. They should adopt hybrid governance as their default approach to project management, as different parts of the project need different types of governance.

Second, companies should implement a differentiated governance approach, in which digitalisation projects are broken down into exploratory, integration and operational-critical sub-projects. Agile approaches can be used for exploratory components, while more traditional governance approaches are applied for critical or risky components.

Third, firms need to be wary of IT/OT integration. Agile experimentation should not be done in a free-for-all environment that may have an impact on production. Rather, the use of isolated environments and roll-out plans should be used to maintain stability.

Fourth, organisations may need to adapt procurement and supplier management processes to agile and flexible delivery. Procurement processes that rely on fixed-scope contracts might not align well with the flexibility required for digitalisation projects and hinder agile practices.

The fourth factor is a firm's capabilities. Companies need to focus on collaboration skills, digitalisation and governance maturity to successfully execute hybrid project structures.

6.5 Limitations of the Study

This study has some limitations. The research is based entirely on secondary data, which restrains the possibility of empirically validating results. This means that the findings are inferred and interpreted.

Moreover, the proxy indicators for digitalisation readiness and governance system effectiveness lead to inference. While these indicators offer valuable contextual data, they are not a direct measure of agile adoption quality and project performance.

Geographical scope is also a limiting factor in the form of Finnish manufacturing in the EU. Although the results are highly applicable to comparable industrial and regulatory regimes, they might not entirely fit other geographical regions with different institutional and economic settings.

Lastly, the mechanisms identified in this study are not measured but synthesised from literature. The mechanisms identified need to be verified through empirical studies.

6.6 Future Research Directions

The present study opens several opportunities for future research. First, case studies in Finnish manufacturing companies would help validate the implementation of hybrid governance models and help to understand the real-world challenges.

Second, longitudinal studies of digitalisation projects could help to understand how governance models change, and their efficacy in different stages of the project.

Third, quantitative research could be designed to measure the links between governance models, agility and project success. This would help to establish the causal links of mechanisms identified in this thesis.

Fourth, more research should be conducted to create formalised hybrid governance models that apply to IT/OT environments, where the operational and digital systems are integrated.

Finally, cross-country research could explore the role of regulatory, industrial and digital readiness environments in shaping outcomes for agile and hybrid governance practices.

6.7 Final Conclusion

In summary, this thesis shows that the success of agile project management in the digitalisation of manufacturing is not a matter of adopting a methodology, but of the fit between governance mechanisms and the systems of industrial production. Agile governance improves performance via distinct mechanisms, but is limited by operational, technological and regulatory constraints.

Consequently, hybrid governance is the most suitable and viable governance model for Finnish manufacturing companies in the digital transformation journey. It facilitates the blending of flexibility and control, change and stability, innovation and regulation.

The implication of this research is that the success of the digital transformation of manufacturing firms has less to do with using new methods, and more to do with creating governance systems that are attuned to the complexity, uncertainty, and constraint of operations.

Table 4 : Research Objective Validation

Research objective	**How the objective was achieved**
To critically analyse the literature on agile and hybrid project management in the	Obtained through Chapter 2, which was a synthesis of recent literature on agile practices, hybrid governance, manufacturing constraints and project outcomes.

Research objective	**How the objective was achieved**
context of manufacturing digitalisation projects.	
To determine the processes by which agile practices can enhance project results in Finnish manufacturing digitalisation.	Via Chapters 2 and 4, iterative learning, stakeholder feedback, cross-functional coordination, finding risks earlier, and minimising rework are the primary mechanisms.
To investigate the contextual determinants that precondition the appropriateness of agile and hybrid strategies within the manufacturing environment.	Attained by Chapters 2, 3, and 4, which examined IT/OT complexity, cybersecurity, compliance, operational continuity, and organisational readiness as a primary boundary condition.
To utilise secondary evidence to make recommendations on how to govern digitalisation projects within Finnish manufacturing firms.	Having done so through Chapters 4 and 5, which synthesised the literature with official secondary indicators to create evidence-based implications to govern the project.

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