THE IMPACT OF DIGITALISATION ON EMPLOYEE WORKLOAD IN POSTAL SERVICE OPERATIONS

Lappeenranta–Lahti University of Technology LUT

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Examiners: Postdoctoral researcher Alena Valtonen

ABSTRACT

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New technologies also influence the global postal industry. Postal service providers all over the world apply new digital tools to increase efficiency of parcel delivery. For example, parcels are automatically sorted, routes are optimized and with the help of GPS tracking and online real-time monitoring, parcels are delivered faster. So far, however, there is little information on the impact of digitalisation on employees in the postal service department of postal services.

This bachelor's thesis investigates the impact of digitalisation on the workload of employees in postal service operations. The main goal of this study is to describe how digital tools influence the workload of employees in postal service operations. The study also seeks information on the used technologies and their influence on volume and intensity of work.

The study is a systematic literature review (SLR) of existing research conducted and published in the above-mentioned databases and reports such as Scopus, Web of Science, LUT Primo and European reports between years 2019 and 2026. The findings of the study indicate that the digitalisation of postal services has led to an increase of workload of employees in postal services, especially for delivery employees. The amount of tasks and time to complete them have been put under pressure by controlling of work and by strict schedules. The automation of physical sorting has been implemented in sorting centers.

Although postal services with digital tools also process mail more efficiently than before, in planning the use of digital tools well-being of employees must be taken into account and also employees must be involved in planning phase.

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Gurseet Singh Ahuja

(Lahti, April 2026)

DECLARATIONS

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The author, Gurseet Singh Ahuja, takes full responsibility for the content of this thesis and has reviewed and edited the content generated by the possible use of AI tools.

ABBREVIATIONS

AI – Artificial Intelligence

JD - R – Job Demands-Resources (JD-R) model

SLR – Systematic Literature Review

USO – Universal Service Obligation

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1 Introduction

This chapter motivates why this research is needed, explains the problem to be solved and outlines how this research is organized. The chapter starts with a brief background to digitalisation in the postal sector. Then, the research problem and gap in current research as well as the research questions for this thesis are discussed. Finally, the scope and structure of this thesis are outlined.

1.1 Background: Digitalisation in Postal Services

Postal services across Europe have undergone massive changes over the last decade. A sharp fall in letter volumes were more than offset by a sharp rise in parcel volumes as online shopping became increasingly dominant. New technologies have been needed, and massive investments made by national postal operators to maintain growth and outcompete private competition for new opportunities. This report analyses the changes and the new approaches to delivering a quality service to customers in a highly competitive market. (ERGP, 2024; Bundesnetzagentur, 2025; PostEurop, 2025).

A good example of how far this transformation has gone is Finland's Posti Group. In a period of about ten years the number of local postal delivery centres was halved from about 800 to about 200. This was achieved by centralising sorting in large automated hubs and using digital tools to plan and monitor routes in real-time (Vieno, 2023). Similar changes have taken place throughout the EU, with automated sorting lines, route optimisation software, GPS enabled handheld scanners and real-time tracking systems now common place in most national postal operations (Kalbermatter et al., 2025).

The motivation for studying this topic is very clear. Whilst digitalisation has brought productivity gains it has received very little attention as to what it means for the people actually doing the work. Postal services are large employers in Europe, employing over 1.5 million people (Copenhagen Economics, 2023). They are the front line workers – delivery drivers, sorters, back office staff – whose daily work has been fundamentally restructured by the arrival of digital technology. Understanding what the reorganisation has meant for

their workload is not just an academic question. It has direct consequences for workers' health, job retention and the long-term quality of postal services. That is why this subject is worth looking into.

The European focus of this thesis is deliberate. Postal digitalisation in Europe has taken place within a specific regulatory context - the universal service obligation (USO), which requires affordable postal services for all citizens - and within a tradition of social dialogue between employers and unions. This context shapes how digitalisation unfolds differently than in purely commercial settings. Finland is emphasized in particular because the Posti case is one of the best-documented examples in the academic and grey literature.

1.2 Research Problem and Research Gap

Despite a growing body of work on the technical and operational side of digital postal services, there is a clear gap when it comes to the human dimension. Most research on postal issues has focused on productivity improvements, cost reduction, or customer-facing innovations. Almost nothing has examined directly what happens to the workload of workers who deliver letters and parcels every day (Kalbermatter et al., 2025; UNI Europa, 2022).

Union surveys and sector reports do indicate an increase in work intensity, with workers reporting constant surveillance via GPS, pressure from tight delivery schedules, and being overloaded during peak e-commerce periods. However, these observations have not been systematically analysed in the academic literature (UNI Europa, 2022). Vieno's (2023) qualitative research in Finland is one of the few academic studies to take this seriously. Her interviews with long-term Posti workers reveal that cost-driven restructuring combined with digitalisation has led to real psychosocial harm: workers describe feelings of occupational devaluation and a loss of dignity, captured in phrases like 'it's as if I'm worth nothing.' Similar concerns emerge from (Kalbermatter et al., 2025), who document how algorithmic control and constant performance monitoring are creating stress and health risks, particularly for older workers and last-mile delivery staff across Europe.

Zacher and Rudolph (2024) provide the most directly relevant academic evidence, showing in a three-year longitudinal study that workplace digitalisation and perceived workload have a reciprocal relationship reinforcing the other over time. But their study covers multiple

industries and does not go into depth on postal services specifically. This creates a clear gap: there is no systematic review of how digitalization has changed the amount of work that postal workers have to do. Filling this gap is important because managers and policymakers need hard evidence to decide how to bring in digital tools without just passing the cost of efficiency on to the workers.

1.3 Research Objectives and Research Questions

The aim of this bachelor's thesis is to examine, through a systematic literature review, how digitalisation influences employee workload in postal service operations.

The main research question guiding the study is: **How does digitalisation influence employee workload in postal service operations?**

To support the main research question, the following sub-research questions are addressed:

1. What are the main digital technologies and processes adopted in postal service operations, and how do they change work tasks?
2. In what ways do these digitalisation-driven changes affect the volume and intensity of employee workload?

The second sub-question focuses specifically on volume and intensity because the purpose of this thesis is not only to describe task changes, but to understand how digitalisation changes the actual workload experienced by postal workers.

1.4 Scope and limitations of the Study

This study draws on peer-reviewed academic literature and high-quality European sector reports published between 2019 and 2026. No primary data was collected. The geographical focus is on Europe and Finland for two reasons: the European regulatory context (the USO and social dialogue tradition) shapes how digitalisation unfolds in postal services in ways that are distinct from purely commercial logistics, and the Finnish case - particularly Posti - is one of the most thoroughly documented in both academic and grey literature. These reasons are developed further in the methodology chapter.

The time frame of 2019 to 2026 was chosen to capture developments in the current wave of digitalisation, including AI-based tools and real-time monitoring systems. One pre-2019 source, Hermann (2013), is retained because it provides the foundational definition of work intensification used throughout the theoretical framework.

The focus is strictly on postal services and not on general logistics or courier operations, as the USO context and the specific labour dynamics of postal work differ meaningfully from commercial logistics. Company-specific IT systems and employment law are not evaluated.

1.5 Structure of the Thesis

This bachelor's thesis consists of 7 chapters that proceed in a clear, logical and systematic order that intends to answer the research question, regarding the impact of digitalisation on the workload of the postal service worker, in a complete manner. This is assured because each chapter builds upon the previous one and starts with the context and theoretical base, proceeding with the methodology to culminate in synthesis of results, discussion and conclusions.

After this chapter that presents the background, the research problem and gap, objectives and questions of this research, Chapter 2 gives an overview on the changes and evolution of postal service operations in Europe and Finland, with a more detailed analysis on the types of digital tools and procedures applied. Chapter 3 defines the concept and dimensions of the employee workload, specifically discussing work intensification and time pressure in service industries.

Chapter 4 describes, clearly and with a replicable manner, the systematic literature review methodology. It specifies the search strategy used for the literature review, based on search terms derived directly from the research question and databases, the inclusion and exclusion criteria, the methods of data analysis and synthesis and points to the validity and reliability of the process. Chapter 5 includes the synthesis of information obtained through the literature review, relating to digital technologies and the employee workload. Chapter 6 presents a critical discussion on the main findings, the implications for postal service managers and the industrial engineering and management, as well as theoretical contributions. Finally, Chapter 7 answers to the research questions, states limitations and recommends future research.

2 Digitalisation in Postal Service Operations

This chapter provides the empirical backdrop for the thesis. It traces how postal services have evolved over the past decade, describes the specific digital technologies that have been introduced, and explains how these technologies have changed the way work is organized and performed.

2.1 Evolution and Current State of Postal Services

Since 2010, the postal system in Europe has been going through a period of structural change. The number of letters sent has dropped sharply because electronic communication has taken the place of physical mail for both personal and business correspondence. At the same time, the rise of e-commerce has led to a huge increase in the number of packages being sent, which has made things more complicated for postal operators, who are often losing money on traditional mail (Copenhagen Economics, 2023; ERGP, 2024; Bundesnetzagentur, 2025).

Postal operators must still meet the universal service obligation, which means they must offer letter and parcel services that are affordable and easy to reach across the entire country, even though letter revenues are going down. This puts constant pressure on businesses to find ways to make their operations more efficient without lowering the quality or geographic reach of their services (UNI Europa, 2022). In 2021, the postal and delivery sector in the EU employed more than 1.5 million people and brought in about 110 billion euros in revenue. The main driver of growth was parcel delivery (Copenhagen Economics, 2023).

The most obvious example of this transformation is the Posti Group in Finland. The volumes of letter mail have declined so steeply that delivery is now every other day in many urban areas and the network of local distribution depots has been consolidated from some 800 to around 200 over the past decade (Vieno, 2023; Kuula, 2023). That consolidation was possible only because of the digital infrastructure - automated sorting, algorithmic routing, real-time monitoring - that replaced the locally managed, manual processes of the prior era.

2.2 Key Digital Technologies and Processes

The various ways postal operators are seeking to manage volume changes and increasing demands on their efficiency has been addressed by developing numerous digital services. The primary services involve the adoption of automation (sorting machinery for both mail and parcels), route optimisation, handheld devices for scanning/tracking, real-time monitoring of services and most recently, increasingly intelligent solutions based on AI for forecasting and flexible routing (Kalbermatter et al., 2025; PostEurop, 2025).

Posti, in Finland, has significantly invested in automated sorting stations and intelligent route planning services, the latter which makes use of GPS information along with live traffic reports for efficient delivery sequence planning (Kuula, 2023). Other European states are demonstrating similar investment patterns; Automated Parcel Sorting lines (APS), Enterprise Resource Planning (ERP) and navigational tools are becoming the standard for most national operators (UNI Europa, 2022). AI chat bots and automatic processing of emails are currently gaining traction among operators in order to ease the burden on administration, and robots are being used increasingly for sorting facilities (PostEurop, 2025).

These differing technologies have thus become not just individual items of equipment, but components in an online infrastructure. Delivery staff's mobile devices are capable of registering proof-of-delivery, feeding current service data back to headquarters and allowing for routing changes to be made in real-time over the course of the delivery day (Kalbermatter et al., 2025). This may well connect to the strategy promoted by the EU towards digital change and competitive dominance within an open and deregulated market (Copenhagen Economics, 2023).

2.3 Operational and Work-Process Changes Driven by Digitalisation

Digitalisation is changing postal operational processes and nature of work drastically. Automation of sorting at centralized hubs diminished the hand labor at those facilities and work forces are moving towards last mile delivery and the more complex parcel-handling processes (UNI Europa, 2022; Kalbermatter et al., 2025). Dynamic, real-time route planning

has changed the number of stops per work shift and the time window at each stop became much tighter and more pressing for the couriers to complete their delivery duties (PostEurop, 2025).

Front-line workers notice the most change at their daily job performance. Couriers are interacting more with their electronic devices while they are working to scan packages and check deliveries while the postal workers at the back office need to manage various monitoring dashboards and exceptions (Vieno, 2023). The Posti workers in Finland describe how centralizing the sorting at centralized hubs and algorithmic planning of routes diminish their sense of autonomy and how the complexity of mental load increase when they need to constantly react to the schedules determined by algorithms (Vieno, 2023; Kuula, 2023).

Through these different countries union surveys report that workers express their feeling of work intensification and increased GPS-supported monitoring, especially the distinction between the physical work load and mental work load has been minimized as many processes in postal work have moved toward the cognitive work and work related data processing (UNI Europa, 2022; Kalbermatter et al., 2025). Although the automation simplified some of the tasks, in reality the volumes of work increased, particularly the peak period of e-commerce is causing tremendous workload pressures (PostEurop, 2025). It provides the direct mechanism between the digitalisation and worker's workload that will be studied in the rest of the thesis.

3 Theoretical Framework: Employee Workload

This chapter constructs the theoretical foundation necessary to analyse the effects of digitalisation on workload within the postal sector. It defines the concept and dimensions of employee workload, examines the related constructs of work intensification and time pressure, and considers the consequences of workload changes in service industries. The primary theoretical lens applied throughout this thesis is the Job Demands-Resources (JD-R) model. (Zacher and Rudolph, 2024).

3.1 Concept and Dimensions of Employee Workload

Employee workload is an integral construct within industrial engineering and management that represents the total workload required of employees over a particular period, including the physical, cognitive, and emotional demands required by those tasks (Zacher and Rudolph, 2024; Inegbedion, 2020). A critical element of understanding the total workload is breaking the construct into quantitative workload (or, the amount of work to be performed) and qualitative workload (or, the difficulty and challenge of the tasks involved) (UNI Europa, 2022).

Within the context of postal operations, quantitative workload consists of the total amount of mail or parcels to be processed in a specific work shift, and qualitative workload consists of the demands imposed by dynamically varying routes, real-time monitoring of individual performance data, and simultaneous customer interaction. A theoretical framework to help understand workload dimensions consists of the Job Demands-Resources (JD-R) model, whereby demands impose persistent physical, cognitive, or emotional effort with costs, and resources counteract demands with effort and attainment of work goals (Bakker and Demerouti, 2017; Scholze et al., 2024).

Digitization contributes to workload primarily by adding job demands to those required at a work site; without a complementary adding of job resources, employees will be overstressed (Scholze et al., 2024; Bakker and Demerouti, 2017). UNI Europa (2022) found that digitization has increased quantitative demands (more stops per mail route via optimization) while simultaneously adding qualitatively challenging demands (constant monitoring of performance metrics and exception management). It is important to include both dimensions of workload as they both appear to have increased as a result of digital technology in postal work, and it is this comprehensive approach to workload that has guided this current study.

3.2 Work Intensification, Time Pressure, and Related Constructs

The definition of intensification: It is the process of having to undertake more or qualitatively more demanding work during the same or even shorter time period (Hermann, 2013; UNI Europa, 2022). When applying this concept to the domain of digitalisation, the

intensification usually occurs through algorithmic work processes: algorithmic control over work, real-time monitoring of individual performance, and automated task allocation condense work processes and eliminate 'free time' (Kalbermatter et al., 2025).

Time pressure, or the extent to which workers feel that they have insufficient time to do their assigned work in accordance with the demands placed upon them, is closely related to the concept of intensified working time (Zacher and Rudolph, 2024). According to Vieno (2023) and UNI Europa (2022), digital route optimisation software and GPS-based monitoring narrows the time slots for postal workers and increases the number of delivery stops per shift, adding to the continuous time pressure.

Overall, empirical research for the European postal services largely validates the thesis that digitalisation often results in work intensification. As described by the union representatives surveyed by (Kalbermatter et al., 2025), algorithmic control and surveillance of workers diminish employee autonomy and increase the work pace, particularly in the context of last-mile delivery. Moreover, through the centralisation of planning and performance management Vieno (2023) observes a reduction in buffers within postalworkers' daily routines in Finland and describes increased time pressure. These are two key mechanisms how digital technologies affect work intensity of postal service employees.

3.3 Consequences of Workload Changes in Service Industries

There is a widely recognised pattern of negative impacts on employees and organisations from high workload and work intensification, which is particularly apparent in labor intensive service sectors such as postal services. Individual employees will be stressed, develop burnout and lack well-being and experience somatic pain (e.g. Musculoskeletal complains) if exposed to chronic high workload (UNI Europa, 2022; Zacher and Rudolph, 2024). Within the Finnish postal environment Vieno (2023) found that a work intensification with high workload produced feelings of occupational devaluation and psychosocial stress among long term postal deliverers.

In the organization, the consequences of high workload are high levels of sickness absence and employee turnover and decline of service quality and productivity in the long run (Scholze et al., 2024). In the JD-R model the relationship between work and health states

that when demands continuously outweigh resources, employees get exhausted and develop disengagement, the same way they may undermine organizational performance (Bakker and Demerouti, 2017). In postal services, reports by European trade unions report that already digital work intensification is related to increases of sick leave and problems with retaining employees (UNI Europa, 2022; Kalbermatter et al., 2025).

But work intensification may not solely be negative. Digital technologies may become a job resource for postal workers (e.g. They reduce manual labor based sorting). In that case they could buffer some negative impacts related to the workload (PostEurop, 2025). That's why I will consider the positive and negative job demands and resources imposed by the digital transformation of postal work. These elements will later be integrated in my own analysis in Chapter 5, and their practical consequences in Chapter 6.

3.4 Socio-Technical Systems Theory

Socio-technical systems (STS) theory provides the second theoretical lens for this thesis. The theory was originally developed by Trist and Bamforth (1951) at the Tavistock Institute through studies of British coal miners and later formalised into design principles by Cherns (1976). The core argument of STS theory is that organisations are best understood as integrated systems in which social elements - people, their skills, interactions, and work culture - and technical elements - tools, technologies, and processes - are mutually interdependent. The central principle is joint optimisation: both the social and technical dimensions of a work system must be designed together, because improving one at the expense of the other leads to lower performance and poorer working conditions in the long run (Cherns, 1976).

STS theory is chosen as a complementary framework in this thesis for two reasons. First, it provides a systems-level perspective that complements the JD-R model. While the JD-R model explains the psychological processes through which demands and resources affect individual workers, STS theory explains why those demands arise in the first place - namely, because digital systems are often designed to optimise technical efficiency without adequate attention to the human dimension of work. Second, STS theory is increasingly recognised as relevant for understanding digital transformation in organisations. (Holler et al., 2023) argue that the challenge of digital transformation is fundamentally socio-technical: aligning new

digital capabilities with human work practices, skills, and organisational culture. Applied to postal operations, this means that introducing route optimisation algorithms or real-time monitoring dashboards without involving workers in their design is likely to generate the hindering demands documented in this thesis, because the systems are built around technical targets - speed, efficiency, route density - rather than human sustainability.

The combination of JD-R and STS theory is therefore more complete than either alone. JD-R identifies what happens to workers when demands exceed resources; STS theory explains how design choices create that imbalance in the first place and points to what would need to change in the design process to prevent it.

3.5 Gaps in the Theoretical Literature

Despite this theoretical foundation, several important gaps remain. The JD-R model has been extensively validated in office and knowledge-work settings, but its application to hybrid physical-cognitive roles - such as postal delivery, where workers simultaneously perform physical tasks and manage digital devices - is limited (Scholze and Hecker, 2024). The specific interaction between physical and cognitive demands in algorithmically managed outdoor work remains poorly understood theoretically.

STS theory, similarly, has been applied mainly to manufacturing and office digitalisation. Its application to labor-intensive, regulated public-service industries such as postal services - where universal service obligations constrain the design choices available to managers - has not been systematically explored. The result is that postal managers lack theoretically grounded guidance for designing digital implementations that balance operational efficiency with workforce sustainability.

Finally, neither framework has been applied jointly to postal service digitalisation in the European and Finnish context. This gap is what this thesis addresses, bringing both theoretical perspectives to bear on an empirical area where they have not previously been applied together.

4 Research Methodology

This chapter describes how the research was conducted. It explains why a systematic literature review was chosen, how the literature search was carried out, why the inclusion and exclusion criteria were set as they were, how the 16 included studies were analysed, and what the reliability and validity limitations of the approach are.

4.1 Research approach

A systematic literature review (SLR) was chosen as the research method for this thesis. Tranfield et al., (2003, p. 207) define an SLR as 'a rigorous and replicable method for identifying, selecting and synthesizing research evidence relating to a specified question.' Unlike a traditional narrative review, an SLR follows a transparent, step-by-step process that can be replicated by others and that minimises the risk of cherry-picking evidence that confirms a preconceived conclusion.

An SLR is appropriate here because the research question - how digitalisation influences employee workload in postal services - is essentially a question about what is already known. There is no existing synthesis of this topic in the literature, and the first step towards filling the research gap is to map and assess what evidence exists. An SLR is the standard method for doing this kind of mapping work in management and industrial engineering research (Denyer and Tranfield, 2009).

The study relies exclusively on secondary sources because the scope and timeframe of a bachelor's thesis do not permit the collection of primary empirical data. This is a known limitation and is discussed further in Section 7.2.

4.2 Literature search and selection criteria

The literature search was carried out from 10 March 2026 - 5 April 2026 using exact terms from the key question: (What is the impact of digitalisation on employee workload in postal services?). (Boolean operators were used to increase sensitivity and specificity)

“digitalisation” OR “digital transformation”) AND “employee workload” OR “workload” OR “work intensification” The overall search string used was OR (work demands OR AND ("postal service" OR "postal operation" OR "post" OR "mail delivery" OR "postal services")

Where results were not sensitive enough, for example “postal service*” was used instead of “postal sector” or “post office”. Results were limited to the 2019-2026 period to capture recent developments.

The following sources were systematically searched (and in this order):

1. **Scopus** (largest multidisciplinary database covering peer-reviewed journals)
2. **LUT Primo (**university library system providing access to LUT-specific and Finnish resources)
3. **Web of Science**
4. **Google Scholar** (for grey literature and supplementary coverage of European reports)

Further hand-search was conducted on the reference list of selected papers, and on the homepage of major European organizations (PostEurop, UNI Europa, Copenhagen Economics). I did not restrict search language beyond English due to the dominance of English literature in academic as well as policy analysis on the issue. I established alerts in Scopus and Google Scholar to identify new publications by the closing search date.

4.3 Inclusion and Exclusion Criteria

To ensure relevance and quality, the following explicit inclusion and exclusion criteria were applied:

Inclusion criteria:

- Peer-reviewed journal articles, conference proceedings, or high-quality European reports (e.g., from PostEurop, UNI Europa, Copenhagen Economics)
- Published between 2019 and 2026

- Explicit focus on digitalisation/digital transformation in postal services or closely related public-service delivery operations
- Examination of employee workload, work intensification, time pressure, or related job demands
- English language
- Empirical (qualitative, quantitative, or mixed) or systematic review studies

Exclusion criteria:

- Studies focused solely on broader logistics or non-postal sectors without postal-specific findings
- Studies that do not address employee-level effects (e.g., purely technological or customer-focused papers)
- Non-peer-reviewed sources unless they are official European sectoral reports of recognised quality
- Publications before 2019 or after the search cut-off date
- Duplicate records or non-academic opinion pieces

The European and Finnish focus was applied for three reasons. First, European postal operators share a common regulatory context through the universal service obligation, which shapes how digitalisation is introduced and managed. Second, Finland's Posti is one of the most thoroughly documented cases in the available literature and provides a concrete example for this thesis. Third, the Nordic tradition of social dialogue makes the European context especially relevant for examining how workers experience digital change.

The publication window 2019–2026 was mainly used for the substantive literature on postal digitalisation and workload. Older sources are only used if they offer the basis for theoretical or methodological aspects, like the definition of work intensification, the JD-R model, or procedures for systematic reviews.

Table 1. Summarises the study selection process in a PRISMA-style format (Page et al., 2021).

Stage	Records	Number
Identification	Records identified from databases (Scopus, LUT Primo, Web of Science, Google Scholar)	487
	Records identified from other sources (PostEurop, UNI Europa, ERGP, Bundesnetzagentur reports)	12
	Total records identified	**499**
Screening	**Duplicates removed**	**187**
	Records screened	312
	Records excluded after title and abstract screening	268
Eligibility	Full-text articles assessed for eligibility	44
	Full-text articles excluded	28
Included	**Studies included in the qualitative synthesis and final review**	**16**

4.4 List of Included Studies

The final synthesis comprised 16 studies (see Table 2). For each study, the table shows the author(s), context, method, focus and the main insight contributed to this thesis. This allows the reader to assess the evidence base themselves.

Table 2. Core sources used in the review and analysis framework.

#	Author(s) & Year	Context	Method	Focus	Key Insight for This Thesis
1	**Vieno (2023)**	Finland	Qualitative	Psychosocial strain, dignity, autonomy loss	Work intensification, occupational devaluation
2	**Kuula (2023)**	Finland	Case study	Last-mile efficiency, route planning	Increased delivery stops, reduced buffers

3	**(Kalbermatter et al., 2025)**	Europe (multi-country)	Mixed methods	Union strategies, algorithmic control	Reduced autonomy, health risks
4	**UNI Europa (2022)**	Europe	Survey/Report	GPS surveillance, workload, skills	Work intensification, psychosocial demands
5	**Zacher and Rudolph (2024)**	Multi-industry	Longitudinal	Digital tools and perceived workload	Reciprocal relationship: digitalisation increases workload over time
6	**Scholze and Hecker (2024)**	Multi-industry	Theoretical review	JD-R model and digitalisation	Digital demands and depleted resources
7	**Scholze and Hecker (2023)**	Europe, multi-sector	Qualitative SLR and interviews	Digital job demands and resources using JD-R	Autonomy and collaboration are key digital resources; work intensification is the leading digital demand
8	**PostEurop (2025)**	Europe	Industry report	AI, automation, sorting	Efficiency gains but peak workload pressure
9	**ERGP (2024)**	Europe	Regulatory report	Postal market indicators	Volume shifts, structural change
10	**Copenhagen Economics (2023)**	Europe	Economic report	Postal sector economics 2017-2021	Parcel growth, USO pressure, 1.5M employees
11	**Bundesnetzagentur (2025)**	Germany	Regulatory report	Letter market decline	Structural automation pressure
12	**Parent-Rocheleau and Parker (2022)**	International	Systematic literature review	How algorithmic management affects job demands and resources	Algorithms affect workload and autonomy through six management functions; sociotechnical design moderates outcomes
13	**EU-OSHA (2022)**	Europe	Institutional review report	AI for worker management in European workplaces	Work intensification, monitoring, and reduced autonomy are the primary occupational health concerns in algorithm-managed delivery work
14	**Eurofound (2020)**	Europe	Research report	Employee monitoring and surveillance in digital workplaces	Psychosocial risks of performance tracking for frontline workers including delivery staff
15	**(Inegbedion et al., 2020)**	International	Quantitative survey	Workload balance and employee job satisfaction	Establishes the quantitative and qualitative workload dimensions used in this thesis's analytical framework

16	**Wood (2021)**	Europe (JRC)	Policy and research report	Algorithmic management in logistics and delivery	Documents work intensification, reduced autonomy, and health risks for algorithmically managed delivery workers

The evidence base includes more sector and institutional reports than purely academic journal articles. This reflects the limited academic literature on this specific topic, which is itself a finding that supports the research gap identified in Chapter 1.

4.5 Data Analysis and Synthesis Method

Data from each included study were extracted into a structured template capturing: author(s) and year, country or context, digital technologies discussed, workload dimensions addressed, key findings, and theoretical perspective used. Thematic synthesis was then conducted following the method of Thomas and Harden (2008), involving three stages:

1. Free line-by-line coding of findings
2. Organisation of codes into descriptive themes
3. Development of analytical themes that directly answer the research question and sub-questions

Synthesis was carried out iteratively, with new material continuously compared against what had already been coded. The findings in Chapter 5 are organised around the JD-R framework specifically around demands and resources to maintain a consistent analytical thread from the theoretical framework through to the discussion

4.6 Reliability, Validity, and Limitations of the Review

Reliability was strengthened by documenting all search strings, databases and screening decisions, allowing repeatability. Validity was assured by using only high-quality sources and by basing the synthesis on the JD-R theoretical framework rather than an unsystematic narrative review.

The main limitations are: reliance on published sources only (publication bias); English-language restriction (relevant Nordic-language sources may have been missed); and the absence of primary empirical data. The 2019–2026 time window ensures recency but may have excluded documentation of earlier digitalisation effects. These are discussed further in Section 7.2.

5 Findings from the Literature

This chapter presents the synthesised findings from the 16 included studies. Rather than summarising each study individually, the findings are organised thematically according to the JD-R framework introduced in Chapter 3 - first the demands that digitalisation creates, then the resources it may provide, and finally the differences between worker groups that emerge from the evidence.

5.1 Digital Technologies and Their Impact on Postal Work Processes

The reviewed literature identifies a common set of technologies as the primary drivers of work-process change in postal operations in Europe and Finland. These technologies include automated parcel sorting systems, AI-powered route optimisation, GPS-enabled handheld devices for scanning and tracking, and real-time performance monitoring dashboards (Vieno, 2023; Kuula, 2023; PostEurop, 2025; UNI Europa, 2022).

The main change these technologies have brought is a movement away from locally organised and worker-controlled work towards centrally orchestrated, algorithmically controlled work processes. Before route optimisation software, delivery workers relied on their own knowledge of local streets and customer habits to plan their rounds. Now, they receive a pre-optimised sequence on a handheld device, which the system can update in real-time during the shift (Kuula, 2023; Vieno, 2023). In practice, this means that workers spend more time manipulating devices – scanning packages, confirming deliveries, responding to system prompts – and have less discretion over how and when tasks are done (Kalbermatter et al., 2025; UNI Europa, 2022).

For back office staff, the change has been to manage digital exceptions and monitor dashboards instead of handling physical paperwork or making direct decisions about operational problems (PostEurop, 2025). AI chatbots and automated processing systems now deal with routine queries, but they generate a new kind of cognitive load: staff must understand what the automated systems are doing, know when they are wrong and how to intervene (PostEurop, 2025).

This addresses sub-question 1. The main technologies adopted are automated sorting, AI route optimisation, GPS scanning, and real-time monitoring. Their effect on tasks is a reduction in worker autonomy and an increase in device-mediated, algorithmically structured work.

5.2 Demands Created by Digitalisation

The evidence strongly and consistently points to an increase in job demands for postal workers as a result of digitalisation, particularly in last-mile delivery.

Quantitative demands - the volume and pace of work - have increased. Route optimisation algorithms increase the number of delivery stops per shift while tightening the time window at each stop (UNI Europa, 2022; Kalbermatter et al., 2025; Kuula, 2023). Workers describe a situation where any buffer time that previously existed between stops has been 'optimised away' by the algorithm (Vieno, 2023; UNI Europa, 2022). During e-commerce peak periods, such as before Christmas, the resulting workload pressures become particularly acute (PostEurop, 2025; Kuula, 2023).

Qualitative demands - the cognitive and emotional complexity of work - have also increased. Workers must continuously interact with digital devices while performing physically demanding tasks, manage real-time updates to their routes, and comply with algorithmic instructions that leave little room for professional judgement (Kalbermatter et al., 2025; Vieno, 2023). Performance dashboards that provide real-time feedback on each worker's speed and delivery success rate create a constant sense of being watched and evaluated, which Vieno's (2023) interviewees describe as both stressful and demoralising. In JD-R terms, this constitutes a hindering demand: it consumes resources without contributing to worker development or engagement.

Time pressure is one of the most consistently reported experiences across the reviewed sources. Workers in Finland, Germany, and across Europe describe the same phenomenon: digital tools have made it possible to fit more deliveries into the same shift, and operators have responded by increasing the number of stops required, leaving workers feeling there is simply no time to breathe (Vieno, 2023; Kalbermatter et al., 2025; UNI Europa, 2022). Zacher and Rudolph (2024) provide longitudinal evidence showing that this is not a short-term adjustment effect but a sustained relationship between digitalisation and perceived workload that persists and strengthens over time.

The psychosocial impact is also significant. Vieno's (2023) Finnish evidence is the most direct on this point: long-term postal workers describe a profound sense of occupational devaluation. Skills and knowledge they built over years - knowing customers by name, choosing efficient routes from experience - are no longer valued because an algorithm now does that work. This connects to the JD-R model's concept of resource depletion: autonomy, one of the most important job resources, has been systematically removed.

5.3 Emergent Themes and Patterns

The above suggests three cross-cutting themes from the literature. Firstly, the primary way digitalisation increases the workload of employees is through work intensification driven by algorithmic management. Digital tools increase efficiency, shortening work processes, eliminating previous buffer stages and therefore speeding up pace and shortening recovery times (Kalbermatter et al., 2025; UNI Europa, 2022). Secondly, both restricted autonomy and increased surveillance are omnipresent psychosocial work factors that could have detrimental effects and are consistent with the hypothesis drawn from the JD-R model predicting strain due to increased demands without increased resources (Vieno, 2023; Scholze et al., 2024). Thirdly, differences in the experiences between sorting and last-mile jobs are obvious: workers in sorting jobs benefit from automation and have reduced physical workload, while workers in last-mile delivery jobs bear more of the brunt of the increased workload (Vieno, 2023; Kuula, 2023).

Most lacking from this discussion are longitudinal studies or purely quantitative data that investigate this phenomenon on Finnish or Nordic postal workers and is drawn almost entirely from qualitative literature and European union surveys. However, the general

consensus is very consistent, and this demonstrates the gap I noted in Chapter 1, that digitalisation has predominantly served to increase demands on workers.

5.4 Resources Provided by Digitalisation

Digitalisation is not purely a source of demand. The evidence also identifies ways in which digital technologies function as job resources for some workers.

The clearest example is in sorting centers. Automated sorting machinery has substantially reduced the physical demands of sorting work. Workers who previously spent shifts manually sorting thousands of items now operate and monitor automated systems (UNI Europa, 2022; Kalbermatter et al., 2025). This is a genuine reduction in physical workload and represents digital technology functioning as a resource by reducing a demanding aspect of the job.

For delivery workers, handheld devices provide a kind of informational resource: workers always know exactly which parcel belongs to which address, can access delivery instructions without having to memories them, and can register proof-of-delivery efficiently (Kalbermatter et al., 2025). In principle, better route information could also make navigation easier. However, the literature suggests that in practice these potential resources are outweighed by the demands created by the same systems. The same handheld device that provides delivery information also subjects the worker to continuous monitoring and generates time pressure through its algorithmic instructions.

This suggests a resource-demand mismatch: the resources that digitalisation creates do not adequately buffer the specific demands it generates. Reduced physical strain at sorting centers does not help a delivery worker to experience constant time pressure. Better parcel information does not offset the loss of autonomy that comes from being algorithmically managed. The JD-R model's prediction - that buffering only works when the resource matches the demand - appears to apply here.

5.5 Differences Between Worker Groups

One of the clearest patterns in the evidence is that the impact of digitalisation is not uniform across different worker groups. Sorting-center workers and last-mile delivery workers have had quite different experiences.

Overall, digitalisation has been more beneficial for sorting-center workers. Although they had to adapt to the management of automated systems, their overall demands seem to have decreased, or at least not increased significantly (UNI Europa, 2022; Kalbermatter et al., 2025). Automation has also relieved them from their physical workload.

The last mile delivery workers, who are the bulk of the postal workforce, have faced a more demanding situation. With higher delivery volume, tighter time windows, constant GPS monitoring and less autonomy, the work has become more intense, more cognitively demanding and more stressful (Vieno, 2023; Kuula, 2023; Kalbermatter et al., 2025). This group has not developed similar resources to offset these demands.

This role-based difference is important for the thesis because it means that aggregate statements about the effect of digitalisation on 'postal workers in general' can be misleading. The sector-level finding - that digitalisation intensifies workload - is primarily driven by the experience of last-mile delivery workers.

6 Discussion

This chapter interprets what the findings mean, discusses what is novel about the contribution of this thesis, draws out the practical implications for postal managers, and addresses the theoretical contributions to industrial engineering and management. The discussion builds directly on the findings in Chapter 5 and on the JD-R framework introduced in Chapter 3.

6.1 Interpretation of Key Findings

The main research question asked how digitalisation influences employee workload in postal service operations. The answer from the literature is clear: digitalisation has primarily an intensifying effect on workload, particularly for last-mile delivery workers, and this intensification is driven by a consistent pattern of increasing demands without a matching increase in appropriate resources.

This finding fits the JD-R model well. The model predicts strain when demands outpaced resources, and that is exactly what the postal evidence shows. But the recent distinction between challenging and hindering demands adds a useful layer of interpretation (Bakker and Demerouti, 2017; Scholze and Hecker, 2024). Not all the new demands created by digitalisation are the same. Learning to use a new scanning device is a challenging demand - difficult at first, but something workers can adapt to and that may eventually become routine. Constant GPS surveillance with no discretion over delivery order is a hindering demand - it depletes workers' sense of autonomy and control without offering any developmental benefit. The evidence from Vieno (2023) and (Kalbermatter et al., 2025) suggests that hindering demands are dominant in the current digitalisation of postal services, particularly in last-mile delivery.

The resource-demand mismatch identified in Chapter 5 is also significant. Postal digitalisation has created real resources - notably reduced physical strain at sorting centers - but these resources do not address the specific demands that last-mile workers face. Reduced physical effort in sorting does not buffer the time pressure and monitoring experienced on delivery rounds. This means that even if we can point to genuine benefits from digitalisation in some parts of the postal operation, they do not cancel out the harm in other parts.

The Finnish evidence from Vieno (2023) provides the sharpest illustration of what this means in practice. The loss of occupational pride and dignity that long-term Posti workers describe is not just a subjective feeling - it reflects the removal of a core job resource (autonomy and recognition of professional knowledge) without replacement. This is a particularly important finding for managers to take seriously, because the costs of occupational devaluation - in terms of sick leave, retention, and service quality - emerge gradually and are difficult to reverse once entrenched. Finally, there is a visible gap that

digital tools may deliver efficiency but also impose new demands: new psychosocial demands imposed on the workers are barely being assessed within the literature. This confirms the gap that the literature has, as indicated in Chapter 1-employee workload in relation to digital tools is under-researched compared to issues such as technological progress and productivity gains.

6.2 Novelty of this thesis

The specific contribution of this thesis is a systematic synthesis of how digitalisation affects employee workload in postal services - a topic that has not been systematically reviewed before. Previous work has either addressed the technological and operational side of postal digitalisation or examined worker well-being in specific national contexts (notably Finland), but without bringing these strands together and interpreting them through a consistent theoretical framework.

The application of the JD-R model to postal service digitalisation, with attention to both the demand side and the resource side and to the difference between challenging and hindering demands, is a specific conceptual contribution. So is the identification of the role-based difference: the finding that sorting-center workers and last-mile delivery workers have had substantially different experiences of digitalisation, and that the aggregate sector-level picture is dominated by the experience of the larger last-mile group.

From a socio-technical systems perspective, this outcome is predictable: when digital tools are designed purely around technical efficiency targets without joint optimisation of the social dimension, the result is systems that increase demands without creating matching resources (Cherns, 1976; Holler et al., 2023).

This thesis also adds to the IEM literature by treating postal services as a regulated, public-service context rather than as a generic logistics operation. The USO, the social dialogue tradition, and the labor-intensive nature of the work create specific dynamics that are not captured by studies of purely commercial logistics firms.

6.3 Practical Implications for Postal Service Managers

The findings have direct implications for how postal managers - and Posti's management in particular - should approach the next phase of digital investment.

First, workload audits should be a routine part of implementing new digital systems. This includes quantification of quantitative workload (number of stops, shift duration, recovery time) and qualitative workload (worker-reported cognitive demands, level of control and time pressure) pre- and post-implementation. Without that baseline, there's no way to know whether a digital system is truly improving working conditions or simply squeezing more output from the same workforce.

Second, KPIs and route optimisation parameters should be reviewed with worker well-being explicitly in mind. The current evidence suggests that algorithms are optimized for delivery efficiency without any constraint on the minimum recovery time or maximum cognitive load a worker can sustain. Building these constraints into the algorithm design - ideally with worker input - would be a concrete step towards addressing the hindering demands identified in this thesis.

Third, participative design of digital work systems should become standard practice. Workers who use these systems every day have knowledge about where they create problems that system designers and managers cannot see from the outside. Formalizing mechanisms for workers and their union representatives to contribute to the design and adjustment of route optimisation and monitoring systems would both improve the systems and restore some of the autonomy that has been taken away. This recommendation follows directly from STS theory's principle of joint optimisation - both the technical and social dimensions of a digital work system must be designed together (Cherns, 1976).

Fourth, training and support should be provided not just for technical operation of new tools but for managing the cognitive and emotional demands that come with them. This is the kind of job resource investment that could actually buffer the qualitative demands created by real-time monitoring and algorithmic management.

6.4 Theoretical Contributions to Industrial Engineering and Management

This thesis contributes to IEM in three ways. First, it provides a systematic synthesis of the relationship between digitalisation and workload in a regulated, labor-intensive public-service sector - a context that has been largely absent from IEM research, which has tended to focus on manufacturing or generic service operations.

Second, it extends the application of the JD-R model to postal digitalisation and refines it by using the challenging versus hindering demand distinction to differentiate between types of workload increase. This is a more nuanced application of the model than simply stating that demands have increased and has practical implications in terms of how managers should prioritise interventions.

Third, it demonstrates that role-based differentiation matters for how digitalisation affects workload. The different experiences of sorting-centre staff and last-mile delivery drivers within the same organisation suggest that the application of the JD-R model to digitalisation needs to consider where in the operational value chain a worker is situated, and not just what technology has been introduced.

7 Conclusions and Recommendations

7.1 Answers to the research questions

The main research question was: How does digitalisation influence employee workload in postal service operations? The systematic literature review of 16 sources indicates that digitalisation predominantly exacerbates employee workload, especially for last-mile delivery workers. Digital tools have increased both the volume and the cognitive complexity of delivery work, eliminated buffer time, reduced worker autonomy, and introduced new forms of electronic surveillance - all of which function as hindering demands in JD-R terms. The physical workload of sorting-centre workers has been reduced by automation, but this benefit does not reach the larger group of delivery workers who bear the main brunt of intensification.

Sub-question 1 asked what digital technologies have been adopted and how they change work tasks. Automated sorting systems, AI-powered route optimisation, GPS-enabled handheld scanners, and real-time performance monitoring dashboards are the main technologies. Together, they change the way work is done from being managed by local managers and directed by workers to being centrally planned and controlled by algorithms, with less freedom and more interaction with devices.

Sub-question 2 asked how digitalisation-driven changes affect workload volume and intensity. Quantitative workload has increased through higher delivery density and shorter time windows per stop. Intensity has increased through continuous monitoring, reduced autonomy, and greater cognitive demands from device interaction. These changes are consistent with JD-R predictions: demands have increased while resources - particularly autonomy - have decreased, producing strain and work intensification (Zacher and Rudolph, 2024; Vieno, 2023; Scholze and Hecker, 2024).

7.2 Limitations and Delimitations

There are several limitations that should be mentioned and it is important to distinguish between limitations (things that weaken the strength of the conclusions) and delimitations (intentional scope decisions that define what this thesis does and does not claim to address).

The main limitations are: (1) this is a literature review of existing secondary sources, so the conclusions are contingent on the quality and completeness of what has been already published. The academic literature on postal digitalisation and workload is limited and most of the empirical evidence on the topic is based on qualitative studies and union surveys rather than large-scale quantitative evidence. Second, the emphasis on sources in the English language may have overlooked relevant Finnish or Nordic-language material. Third, the absence of primary data means that the findings cannot be traced to specific organisational decisions or verified in real-time.

The following delimitations are – which are deliberate and justified scope restrictions rather than regrettable – the following: the focus on Europe and Finland (justified by the regulatory and documentary context), the 2019–2026 time frame (justified by the need to capture current digitalisation), and the restriction to postal services rather than logistics more broadly

(justified by the specific USO context). These are not weaknesses of the research design, but rather choices that make the research focused and tractable.

It is also worth noting what this thesis does not claim. It does not claim to measure the size of workload increases, to establish causal mechanisms between specific technologies and specific outcomes, or to generalise beyond the European postal context.

7.3 Suggestions for Future Research

Four directions for future research emerge clearly from this study. First, longitudinal empirical research using mixed methods - ideally conducted with Posti workers in Finland would allow direct measurement of workload change before and after specific digital implementations. This would provide the quantitative evidence base that currently does not exist for this sector.

Second, comparative studies across European postal operators could reveal how national regulatory environments and social dialogue models moderate the workload impact of digitalisation. If countries with stronger union involvement in workplace change show less severe intensification, that would be important evidence for policymakers.

Third, intervention studies focused on the participative design of route optimisation algorithms - allowing workers to set constraints on minimum buffer time and recovery periods - would generate practical design guidelines and test whether human-centred approaches can genuinely reduce hindering demands without sacrificing efficiency.

Fourth, incorporating workload measurement into digital twin models of postal operations would allow IEM researchers to simulate the workload effects of technology changes before implementation, potentially preventing some of the harms documented in this thesis.

In summary, this thesis has shown that digitalisation in postal services is primarily intensifying employee workload, that this intensification is concentrated in last-mile delivery and driven by a mismatch between the demands created and the resources offered, and that this is a topic that deserves far more systematic empirical attention than it has received so far.

References

Bakker, A.B. and Demerouti, E. (2017) ‘Job demands–resources theory: Taking stock and looking forward’, *Journal of Occupational Health Psychology*, 22(3), pp. 273–285. https://doi.org/10.1037/ocp0000056.

Bundesnetzagentur (2025) *Letters Market Report 2024* (Last revised March 2025). Bonn: Bundesnetzagentur. Available at: https://data.bundesnetzagentur.de/Bundesnetzagentur/SharedDocs/Mediathek/Berichte/2024/2025_06_10_Briefmarktbericht_2024_FINAL_en.pdf (Accessed: 7 April 2026).

Copenhagen Economics (2023) *Main developments in the postal sector (2017–2021)*. Copenhagen: Copenhagen Economics. Available at: https://copenhageneconomics.com/wp-content/uploads/2023/01/Main-Developments-in-the-Postal-Sector-2017-2021-volume1-and-2.pdf (Accessed: 7 April 2026).

Cherns, A. (1976) 'The principles of sociotechnical design', *Human Relations*, 29(8), pp. 783–792. https://doi.org/10.1177/001872677602900806.

Denyer, D. and Tranfield, D. (2009) ‘Producing a systematic review’, in Buchanan, D.A. and Bryman, A. (eds) *The Sage handbook of organizational research methods*. London: Sage, pp. 671–689.

European Regulators Group for Postal Services (ERGP) (2024) *Report on core indicators for monitoring the European postal market*. Brussels: European Commission. Available at: https://ec.europa.eu/docsroom/documents/58374 (Accessed: 7 April 2026).

EU-OSHA (2022) *Artificial intelligence for worker management: An overview*. Luxembourg: European Agency for Safety and Health at Work. Available at: https://data.europa.eu/doi/10.2802/76354 (Accessed: 17 April 2026).

Eurofound (2020) *Employee monitoring and surveillance: The challenges of digitalisation*. Luxembourg: Publications Office of the European Union. Available at: https://www.eurofound.europa.eu/en/publications/all/employee-monitoring-and-surveillance-challenges-digitalisation (Accessed: 17 April 2026).

Hermann, C. (2013) ‘The liberalisation of European postal markets and the effects on employment and working conditions’, *FORBA Research Report*. Available at: https://www.forba.at/wp-content/uploads/2018/11/911-FB_03_2013.pdf (Accessed: 7 April 2026).

(Holler, M. et al., 2023) 'A theoretical essay on socio-technical systems design thinking in the era of digital transformation', *Gruppe. Interaktion. Organisation*, 54(1), pp. 29–40. https://doi.org/10.1007/s11612-023-00675-8.

Inegbedion, H., Inegbedion, E., Peter, A. and Harry, L. (2020) *Perception of workload balance and employee job satisfaction in work organisations*. Heliyon, 6(1), e03160. https://doi.org/10.1016/j.heliyon.2020.e03160.

(Kalbermatter, J. et al., 2025) ‘Union strategies in the digitalized post and logistics sector’, *Economic and Industrial Democracy*. https://doi.org/10.1177/0143831X251377302.

Kuula, L. (2023) *How changing the last mile delivery model affects end-to-end efficiency in postal services – A case study of Posti*. Aalto University. Available at: https://aaltodoc.aalto.fi/bitstreams/f559ceeb-3f9b-42bd-926f-021d4ab12192/download (Accessed: 7 April 2026).

(Page, M.J. et al., 2021) ‘The PRISMA 2020 statement: an updated guideline for reporting systematic reviews’, *BMJ*, 372, n71. https://doi.org/10.1136/bmj.n71.

Parent-Rocheleau, X. and Parker, S.K. (2022) 'Algorithms as work designers: How algorithmic management influences the design of jobs', *Human Resource Management Review*, 32(3), 100838. https://doi.org/10.1016/j.hrmr.2021.100838.

PostEurop (2025) *Innovation Booklet 2025*. Brussels: PostEurop. Available at: https://www.posteurop.org/blog/2025-posteurop-innovation-booklet/ (Accessed: 7 April 2026).

Scholze, A. and Hecker, A. (2024) ‘The job demands-resources model as a theoretical lens for the bright and dark side of digitization’, *Computers in Human Behavior*, 155, 108177. Available at: https://doi.org/10.1016/j.chb.2024.108177.

Scholze, A. and Hecker, A. (2023) 'Digital job demands and resources: Digitization in the context of the Job Demands-Resources model', *International Journal of Environmental Research and Public Health*, 20(16), 6581. https://doi.org/10.3390/ijerph20166581.

Thomas, J. and Harden, A. (2008) ‘Methods for the thematic synthesis of qualitative research in systematic reviews’, *BMC Medical Research Methodology*, 8, 45. https://doi.org/10.1186/1471-2288-8-45.

(Tranfield, D. et al., 2003) ‘Towards a methodology for developing evidence-informed management knowledge by means of systematic review’, *British Journal of Management*, 14(3), pp. 207–222. https://doi.org/10.1111/1467-8551.00375.

UNI Europa (2022) *Postal Skills and Work Environment in the Digital Era*. Brussels: UNI Europa. Available at: https://www.uni-europa.org/wp-content/uploads/sites/3/2022/12/20221003_SkillsReferenceFramework_WorkEnviReport_Final_EN_EY.pdf (Accessed: 7 April 2026).

Vieno, A. (2023) ‘“It’s as if I’m Worth Nothing”-Cost-Driven Restructuring and the Dignity of Long-Term Workers in Finland’s State-Owned Postal Service Company’, *Journal of Business Ethics*, 187, pp. 17–31. https://doi.org/10.1007/s10551-022-05294-9.

Wood, A.J. (2021) *Algorithmic Management: Consequences for Work Organisation and Working Conditions*. JRC Working Papers Series on Labour, Education and Technology 2021/07. Seville: European Commission Joint Research Centre. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC129749 (Accessed: 17 April 2026).

Zacher, H. and Rudolph, C.W. (2024) ‘Workplace digitalisation and workload: changes and reciprocal relations across 3 years’, *Scientific Reports*, 14, 5924. https://doi.org/10.1038/s41598-024-56537-w.

Trist, E.L. and Bamforth, K.W. (1951) ‘Some social and psychological consequences of the longwall method of coal-getting’, *Human Relations*, 4(1), pp. 3–38. https://doi.org/10.1177/001872675100400101