SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2026
ORGANIZATION AND MANAGEMENT SERIES NO. 250

CONCEPTUAL APPROACH TO INFORMATION WASTE IN LEAN MANAGEMENT

Pamela OMIOTEK

University of Gdansk; pamela.omiotek@ug.edu.pl, ORCID: 0000-0003-0128-4503

Purpose: This paper presents and extends the classical concept of waste (muda) in Lean Management by introducing an informational perspective. It proposes a conceptual framework that systematises and explains inefficiencies in information flows.
Design/methodology/approach: The article draws on a critical review of the literature in Lean Management, information theory, knowledge management, and organisational communication. The analysis identifies underlying mechanisms responsible for the emergence of informational inefficiencies. It also develops theoretical analogies between material waste in production systems and information waste.
Findings: The paper formulates a novel definition of information waste, understood as any process or action that causes information to lose its function of reducing uncertainty. It proposes a typology of sixteen categories of informational waste. The model integrates reinterpretations of classical muda with newly conceptualised categories specific to information processes.
Research limitations/implications: The typology provides a conceptual and theoretical foundation for future empirical research. Future studies should quantify the costs of information waste. They should also examine its impact across different organisational contexts and sectors.
Originality/value: The paper contributes to Lean Management theory by offering an integrated perspective on informational waste. It integrates fragmented views on informational inefficiency into a coherent framework. By introducing clearly defined categories, it adapts Lean principles to digital work environments and intellectual labour.
Keywords: Lean Management, information waste, muda, knowledge management, information flow.
Category of the paper: Conceptual paper.

Introduction

The concept of Lean Management emerged at Toyota in the 1950s and 1960s (Walentynowicz, 2013). Many related practices had already appeared in the United States. Most scientists regard Lean as one of the most effective approaches to improving processes and eliminating waste (Walentynowicz, 2013; Al-Aomar, 2012). Interest in Lean production in

Japan led to the publication of The Machine That Changed the World. The book by Womack, Jones, and Roos gave the concept global visibility (Womack et al., 2007).

Practitioners first focused on Lean Manufacturing. Later, the concept expanded into services, healthcare, and construction. Lean Management now covers the whole enterprise, not only production (Walentynowicz, 2013). Nogalski and Walentynowicz describe Lean as a way of thinking and acting rooted in Toyota practice. The approach seeks the best results with the smallest possible resources under given conditions. Lean relies on eliminating waste (muda). It also aims to reduce unevenness (mura) and overburden (muri). Another definition is presented by E. Pawłowski, K. Pawłowski and Trzcieliński. Authors define Lean Management as "a management methodology that fosters a work culture within an organization in which all members are committed to continuously reducing costs, improving quality, and shortening delivery cycles. All of this is done to maximize customer satisfaction […]" (Pawłowski, Pawłowski, Trzcieliński, 2010). The authors of the book "The Lean Strategy: Using Lean to Create Competitive Advantage, Unleash Innovation, and Deliver Sustainable Growth" offer yet another definition. For them Lean is a learning system that any leader can develop within their organization. All they need to do is find a way to use the Toyota Production System framework to identify their own North Star-that is, the ideal balance of customer satisfaction and profitability (Balle, Jones, Chiaze, Fiume, 2019).

Most studies still analyse waste in material, production, or logistics processes. Classical views of muda emerged from physical flows of work and products. Modern organisations now depend mostly on information processes. Data, knowledge, and messages shape daily work. Researchers still define information waste in narrow and fragmented ways. Existing studies usually focus on single problems, such as information overload or communication errors. To date, no coherent and integrative theoretical model has systematically adapted the concept of waste to information flows. To date, no study has explicitly linked Lean process logic with the concept of information entropy.

These gaps indicate a significant theoretical and conceptual limitation in existing research, justifying the need for a new perspective on waste. The present article aims to develop an integrative conceptual framework for analysing information waste in organisations. It adapts classical muda categories. It also extends them to phenomena specific to information processes.

The study adopts a conceptual–theoretical research design grounded in interdisciplinary literature synthesis. It does not test hypotheses. It builds an integrative analytical model based on the synthesis of multiple theoretical perspectives. The presented typology connects material and informational waste within a single analytical framework. It also supports future operationalisation and empirical research. The proposed framework organises dispersed theoretical insights. It also points to practical applications in knowledge-intensive and digitally mediated organisations.

The method consists of four sequential steps:

1. formulation of a definition of information waste,
2. identification of classical muda categories,
3. development of corresponding categories of information waste,
4. analytical discussion of information waste in organisations.

This approach was chosen to ensure systematic conceptualisation and theoretical consistency across the analysed domains.

The first step introduced the author's definition of information waste. The definition draws on Lean Management, waste theory, and information theory. The second step adopted the Lean Management canonical set of waste categories. This set includes the seven forms of waste identified by Taichi Ohno and the later extension concerning the underutilisation of human potential. These categories formed the analytical baseline for the study.

The third step translated the logic of classical waste into the context of information-based work. The analysis focused on mechanisms rather than surface examples. It examined how disruptions to flow, unnecessary resource use, and loss of value appear in information processes. For each classical category, the study identified an equivalent mechanism in the information domain.

The fourth step presented an analytical discussion of information waste in organisations. This discussion linked the proposed categories with existing research and practical examples. It also examined their implications for organisational efficiency and decision-making.

Informational waste

In the classical understanding of Lean Management, waste (muda) refers to all activities that consume organisational resources without creating added value (Ohno, 1988; Womack, Jones, 2001; Liker, 2021). Taichi Ohno stressed that waste includes not only unnecessary activities but also those performed in excess, because both delay or destabilise the flow of work. The literature consistently identifies muda as the main enemy of organisational efficiency. It increases costs, slows processes, and places additional burdens on employees (Nogalski, Walentynowicz, 2009; Walentynowicz, 2013). The logic of waste, therefore, has a universal character. It expresses the mismatch between action and the value created in a process.

Although Taichi Ohno developed the seven types of waste for production systems, their logic applies to all flow-based systems. This includes systems based on materials, energy, and labour. Contemporary organisations now operate in conditions far more complex than those for which the Toyota Production System was designed. Digitalisation, project-based work, multichannel communication, advanced information systems, and the growth of knowledge work have transformed information into a key operational resource.

To analyse information waste, one must first clarify what "information" means. In Shannon's theory (1948), information reduces uncertainty in a system. Davenport and Prusak (1998) describe information as data that people organise and contextualise to make it meaningful. Ackoff (1989) adds that relevance, timeliness, completeness, accessibility, and clarity directly shape decision quality. From this perspective, information resembles a stream. It moves between people, systems, and processes. It undergoes interpretation and supports action. At every stage, information may become distorted, delayed, overloaded, fragmented, or devalued.

Waste, therefore, no longer concerns only material resources, product defects, or excessive transport. Its modern sources increasingly include data overproduction, information overload, communication errors, redundant processing, decision delays caused by data deficits or excess, and dispersed organisational knowledge. Information flows exhibit structural and dynamic properties analogous to material flows. They may become constrained, unstable, excessively expanded, incomplete, or degraded in quality.

If customer value arises through appropriate information processing, then information - like material can carry both value and loss. Applying classical muda categories to information processes, therefore, extends Lean Management into the domains of knowledge and communication. This perspective allows scholars and practitioners to treat information as part of the value stream that may be disrupted, overloaded, or disorganised.

This reasoning raises a fundamental question: which forms of waste occur in information processes, and how do they correspond to Ohno's seven classical losses. To answer this question, one must define information waste with precision, drawing on Lean theory and information theory.

Information waste can be defined as all processes, actions, or omissions that cause information to lose its function of reducing uncertainty and supporting decisions. This occurs when individuals or organisations produce, process, transmit, or store information in excessive, delayed, erroneous, inadequate, or unclear ways. This definition includes data excess, information overload, access delays, quality errors, knowledge dispersion, timeliness problems, and the need to search for or reinterpret information. Information waste, therefore, includes all practices that prevent information from supporting decisions.

From a Lean perspective, information functions like material in the value stream. Its flow may experience bottlenecks, instability, quality loss, and overproduction. Information waste therefore increases organisational entropy, understood as the level of disorder and uncertainty within organisational systems, weakening decision quality, prolonging lead times, and intensifying cognitive burden. Although entropy is not formally operationalised in this study, it is treated as a conceptual lens that helps explain the emergence of disorder and inefficiencies in information processes. Its identification and elimination remain as critical for knowledge-based processes as the elimination of muda remains for classical production systems.

Types of informational waste

Taichi Ohno created the Toyota Production System and defined seven types of waste that disrupt workflow, raise costs, and increase process complexity (Liker, 2021). Although Ohno developed these categories for production systems, their logic also applies to information processes, which now shape most work in contemporary organisations.

The classical types of waste include (Walentynowicz, 2013; Liker, 2021; Marchwiński, Shook, Schroeder, 2018):

- Overproduction – producing without demand or "for stock", including the delivery of excessive information, which generates overvalue and stimulates other losses.
- Defects and production errors – outputs that require repair or scrapping due to failures to follow standards, material defects, insufficient training, late quality control, or equipment failures.
- Unnecessary inventory – excess physical or informational stock that occupies space, generates costs, and freezes financial resources, including outdated documents and unused solutions.
- Waiting – downtime caused by failures, poor organisation, missing tools or information, transport delays, or bottlenecks in the process.
- Unnecessary processing – repeated activities, unsuitable tools, procedures, and excessive information processing, as well as quality levels beyond customer expectations.
- Excessive transport – unnecessary movement of parts, products, documents, or work-in-progress between processes and locations.
- Unnecessary motion – avoidable employee movements, such as searching for information or tools, bending, or handling materials, caused by poor workplace organisation.
- Underutilisation of human potential – low engagement, lack of improvement initiatives, and limited development opportunities for employees.

Contemporary literature emphasises that the list of waste types is not closed and evolves with changes in the business environment. In digital contexts, particular importance attaches to information-related waste, such as losses caused by data dispersion, wishful thinking, excessive complexity of information processes, or low information quality (Lisiecka, Burka, 2015; Al-Aomar, 2012). Waste therefore no longer concerns only physical resources but increasingly affects information resources that underpin modern organisations.

Lean literature and practice also indicate additional forms of muda (Omiotek, 2026; Lisiecka, Burka, 2015; Nogalski, Walentynowicz, 2011):

- Lost time – time that could create value but is lost due to waiting, searching for information, repeating activities, or lacking standardisation.
- Unnecessary processes – activities that do not create customer value, including excessive formalisation, duplicated procedures, or overly detailed documentation.
- High costs – costs resulting from errors, surplus storage, low-quality products or information, and repeated corrections.
- Designing products that do not meet customer needs (overvalue) – products and services with unnecessary or unwanted elements due to incorrect or misinterpreted information.
- Wishful thinking – decisions based on unrealistic or unverified assumptions that generate strategic and operational errors.
- Dispersed information – knowledge that remains inaccessible, unstructured, hidden, or scattered across systems and teams.
- Environmental waste – uneconomical use of energy, water, raw materials, or packaging, reflecting Lean's extension toward sustainability.

In literature not specifically devoted to lean management, one can find many aspects related to information waste. Eppler and Mengis (2004) show that information excess may cause disorientation, cognitive overload, and declining decision quality. Alavi and Leidner (2001) similarly argue that knowledge management fails not only due to poor information quality but also due to excess, which hinders interpretation and use. Connelly et al. (2012) demonstrate that knowledge hiding leads to duplication, delays, and weakened collaboration. Jackson (2007) shows that information overload increases errors and task completion time. Hislop (2013) further links poorly designed information flows with knowledge loss and reduced work effectiveness.

Knowledge-based work continues to expand, and organisations intensify digital and multichannel communication. Classical interpretations of muda no longer capture contemporary inefficiencies. Waste increasingly takes intangible forms linked to information quality, flow, availability, and interpretation. These developments justify a typology that captures waste specific to information processes. As presented in Table 1, the proposed typology organises the main categories of informational waste and their underlying mechanisms. Unlike existing approaches, which typically address isolated dimensions such as information overload (Eppler, Mengis, 2004) or knowledge management processes (Alavi, Leidner, 2001), the proposed typology provides a more integrative and process-oriented classification of informational waste. The following table presents an original, conceptually grounded classification developed through the synthesis of Lean theory and information process analysis. The typology builds upon classical Lean categories and extends them based on insights from information theory and knowledge management literature.

Table 1.
Type of informational waste

Type of information waste	Characteristics	
	Mechanism of emergence	**Examples in the organization**
Information overproduction	Lack of relevance criteria; "just in case" reporting; culture of excessive documentation.	Unread reports, copying entire departments in emails, overly verbose messages.
Defective information	Time pressure, lack of responsibility for data, weak information standards.	Two different versions of the same table, outdated procedures, incorrect figures, misleading messages.
Information inventories	Lack of archiving policy; defensive behaviors; chaotic repositories.	Duplicate files, overloaded drives, unused project folders.
Waiting for information	Unclear communication roles; overloaded managers.	Waiting for emails, lack of decisions blocking projects, delays in document approvals.
Overprocessing of information	Perfectionism; lack of standards; multiple revisions; unclear expectations.	Ten versions of a presentation, a forty-page analysis for a simple problem, unnecessary data "polishing."
Unnecessary information transport	Duplicated channels; lack of a single source of truth; too many intermediaries.	Endless forwards, copying files between systems, the same messages in several tools.
Cognitive motion	Dispersed repositories; lack of metadata; poor searchability.	Twenty open windows, searching for a file in multiple folders, manual data merging.
Lack of feedback / underutilization of knowledge	Organizational silence; lack of feedback culture; hierarchical barriers.	No information about work quality, knowledge hidden in silos, lack of mentoring.
Narrative waste (complaining, destructive communication)	Entrenched complaining norms; lack of communication moderation; low trust.	Gossip, blame without facts, emotional escalations, negative emails.
Lost informational time	Lack of standardization; insufficient automation; lack of information source mapping.	Repeating the same analysis, searching for data, repeated requests for the same information.
Unnecessary informational processes	Excessive formalization; bureaucracy; overregulation.	Forms for the sake of forms, redundant approval steps, documents nobody reads.
Excessive informational costs	Informational chaos; repeated mistakes; lack of data policies.	Financial losses due to incorrect data, storage costs of duplicate files.
Informational over-quality	Perfectionism; poor understanding of the audience; lack of quality criteria.	Presentations overloaded with irrelevant details, analyses with unnecessary precision.
Wishful thinking	Cognitive bias; lack of analytics; avoidance of uncomfortable facts.	"Gut feeling" declarations, unrealistic schedules, planning without reliable data.
Dispersed information	Organizational silos; lack of shared repository; missing naming standards	Critical knowledge held by one employee, files on private drives, information scattered across tools.
Environmental informational waste	Lack of optimization; absence of environmental policies; low IT energy awareness.	Servers storing unused data, unnecessary printing of documents.

Source: own study.

The presented typology demonstrates that information waste constitutes a complex and multidimensional organisational phenomenon whose complexity goes beyond classical interpretations of muda. Losses no longer concern only physical processes but materialize primarily in the quality of information, its flow, accessibility, usability, and interpretation. Information, as a dynamic, stream-based resource, is subject to the same disturbances as

material in production systems: it may be excessively generated, distorted, stored without purpose, delayed, incorrectly processed, or unavailable at the moment of decision-making.

The typology extends the analytical scope of Lean Management by allowing for the identification of previously underexplored forms of waste that have so far remained outside the direct focus of the Lean literature, such as destructive communication patterns, wishful thinking, a lack of feedback, or the underutilization of tacit knowledge. These phenomena have a crucial impact on decision quality, organisational communication efficiency, and the organisation's capacity for learning. Their inclusion extends the classical understanding of muda by adding cognitive, emotional, and cultural dimensions, making the approach more adequate to the realities of contemporary knowledge-intensive organizations.

The proposed original typology may serve as a starting point for further research on the nature of information losses, including their measurement, sources, consequences, and methods of reduction. From a managerial practice perspective, it serves as a diagnostic tool for identifying key areas of informational inefficiency and for designing interventions to improve information flows, communication quality, and decision-making processes. Incorporating information-related categories into waste analysis thus opens the way toward a more holistic and contemporary Lean approach, encompassing both operational processes and the cognitive-communicative aspects of organizational work.

Conclusion

The study contributes to theory by extending the Lean Management framework to the domain of information processes and by introducing a structured conceptualisation of information waste. It reflects the conditions of contemporary organisations, where information has become the primary resource. Information flow, processing, and use now form key organisational processes. A review of the literature and organisational practice shows that traditional waste concepts derived from the Toyota Production System no longer capture many phenomena typical of knowledge-intensive environments. These limitations are most evident in communication and information systems.

The article presents an original and extended typology of information waste. The model integrates classical muda categories with contemporary Lean extensions and newly identified phenomena. These include destructive communication patterns, wishful thinking, lack of feedback, cognitive motion, and the underutilisation of tacit knowledge. The typology allows a more precise identification of inefficiencies in information and communication processes. It also supports the systematic diagnosis of these problems and the design of targeted interventions.

The analysis demonstrates that information waste is inherently complex and multidimensional. It includes technical imperfections such as data errors, outdated information, and dispersed repositories. It also includes socio-cultural factors such as organisational silence, lack of feedback, and destructive narratives. These findings suggest that organisations should address information waste through an explicitly interdisciplinary approach. Effective solutions should combine Lean Management, information theory, knowledge management, organisational communication, and work psychology.

The conceptual nature of the study constitutes its main limitation, as the proposed framework has not yet been empirically validated. The typology has a strong conceptual character and provides a structured foundation for future empirical research. Future studies should focus on several key areas. Researchers should identify dominant forms of information waste across different organisational contexts. They should measure the intensity and costs of information waste. They should also examine links between information quality, organisational culture, and process effectiveness. Further work should develop diagnostic tools to detect and classify information losses. Researchers should also design Lean methods and tools to reduce information waste. These tools may include information standards, visualisation systems, feedback rules, information flow mapping, and methods to reduce cognitive load.

The proposed approach can support the development of practical training, auditing, and implementation tools. These tools may help organisations manage information as a strategic resource, reduce losses, and increase the value of decision-making processes. In the long term, such solutions may contribute to the emergence of a distinct research stream focused on Lean Information Management. In this perspective, eliminating information waste is as important as eliminating waste in material flows.

References

1. Ackoff, R.L. (1989). From data to wisdom. *Journal of Applied Systems Analysis*, *Vol. 16,* pp. 3-9.
2. Al-Aomar, R. (2012). Analysis of Lean Construction practices at Abu Dhabi construction industry. *Lean Construction Journal*, *Iss. 1*, pp. 105-121.
3. Alavi, M., Leidner, D.E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, *Vol. 25, Iss. 1*, pp. 107-136.
4. Balle, M., Jones, D., Chaize, J., Fiume, O. (2019). *Strategia Lean. Kultura uczenia się kluczem do budowania przewagi konkurencyjnej.* Warszawa: MT Biznes.
5. Davenport, T.H., Prusak, L. (1998). *Working knowledge: How organizations manage what they know*. Boston: Harvard Business School Press.

6. Eppler, M.J., Mengis, J. (2004). The concept of information overload: A review of literature from organization science, accounting, marketing, MIS, and related disciplines. *Journal of Knowledge Management*, *Vol. 8, Iss. 5*, pp. 325-344.
7. Hislop, D. (2013). *Knowledge management in organizations: A critical introduction*. Oxford: Oxford University Press.
8. Jackson, T.W. (2007). Email overload: Exploring the moderating role of personality. *Journal of Knowledge Management*, *Vol. 11, Iss. 1*, pp. 81-97.
9. Liker, J.K. (2021). *The Toyota Way: 14 management principles from the world's greatest manufacturer*. New York: McGraw-Hill Education.
10. Lisiecka, K., Burka, I. (2015). Źródła powstawania marnotrawstwa w organizacjach na przykładzie usługowych przedsiębiorstw ciepłowniczych. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, *Vol. 233*, pp. 65-78.
11. Marchwiński, C., Shook, J., Schroeder, A. (2018). *Leksykon Lean. Ilustrowany słownik pojęć z zakresu Lean Management*. Wrocław: Lean Enterprise Institute Polska.
12. Nogalski, B., Walentynowicz, P. (2009). Lean Management – koncepcja zarządzania przedsiębiorstwem. *Przegląd Organizacji*, *Vol. 10*, pp. 3-8.
13. Ohno, T. (1988). *Toyota Production System: Beyond large-scale production*. New York: Productivity Press.
14. Omiotek, P. (2026). *Model procesu kreowania kultury Lean w przedsiębiorstwach produkcyjnych w Polsce.* Warszawa: Difin.
15. Pawłowski, E., Pawłowski, K., Trzcieliński, S. (2010). *Metody i narzędzia Lean Manufacturing.* Poznań: Wydawnictwo Politechniki Poznańskiej.
16. Shannon, C.E. (1948). A mathematical theory of communication. *Bell System Technical Journal*, *Vol. 27*, pp. 379-423, 623-656.
17. Walentynowicz, P. (2013). *Uwarunkowania skuteczności wdrażania Lean Management w przedsiębiorstwach produkcyjnych w Polsce*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.
18. Womack, J.P., Jones, D.T. (2001). *Lean Thinking: Banish waste and create wealth in your corporation*. New York: Simon & Schuster.
19. Womack, J.P., Jones, D.T., Roos, D. (2007). *The Machine That Changed the World: The Story of Lean Production*. New York: Simon & Schuster.