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SCUOLA DI INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE

EXECUTIVE SUMMARY OF THE THESIS

Startup-Driven Innovation in the Logistics Industry: A Classification Framework and a Focus on the Technologies Fostering Social Sustainability in the Warehouse

TESI MAGISTRALE IN MANAGEMENT ENGINEERING – INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE

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1. Introduction

Using startups to glimpse innovations is not a new practice. Reports of the most influential consultancy companies such as McKinsey [1], Deloitte [2], and Kearney [3] suggest observing startups to cope with the fast-paced innovation of these years. The Contract Logistics Observatory of Politecnico di Milano conducts these investigations, focusing on the logistics sector. This research is part of its activities and aims to identify how the logistics sector innovates, focusing on the technologies used. The first research question wants to determine the current dimensions of technological innovation in logistics. From here, the second RQ focuses on recognizing the technologies to enable these trends. The third and last objective, still focusing on the technologies, complements the literature on a tendency that emerged during the prior examinations: social sustainability in the warehouse. The first two questions required an analysis of 735 worldwide startups, then classified and analyzed to determine innovative trends and technologies. The third point pursues these findings and enlightens the technology-human relationship in the warehouse, observed through safety and work satisfaction. Indeed, the literature does not comprehensively cover this relationship, even if there are several innovations. In this regard, a framework maps how 20 selected technologies interact with warehouse operators.

2. Research Methodology

As anticipated, this thesis develops around three research questions:

1. **What are the dimensions of technological innovation in logistics today?**
2. **What are the most relevant technologies for each dimension?**
3. **Which technologies could foster the development of social sustainability in warehouses?**

The methodology used was different for each of the three, but it was a preparatory process dependent on a first common step: startups database construction. Here, some passages follow the previous study of 2020 [4]. In detail, the sources considered were Crunchbase and ALBA. The former is an international database, the latter is internal to the university. Data preparation consists of three phases for both databases: setting criteria for extraction, extraction, and review of extracted companies. The criteria include active logistics businesses born in the last five years and funded in the last two. Following extraction, the total data consisted of 1913 startups and 39 columns. Of these, 735 where finally selected as relevant for the study after a analysis of their offers.

Startups Classification and Tags Analysis

To answer RQ1, startups were classified and tagged. The classification is structured on three levels: macro categories (4), level 1 subcategories (24), and level 2 subcategories (32). The four macro categories are New Logistics Players, Hardware, Software, and Platforms. These were essential in identifying trends at a macroscopic level. Then, the tags introduced detail each business and enable a transversal analysis. Tags are 393 and are level 1-specific. It means that the purpose of the tags was to map the elements that differentiate companies within the same level 1 subcategory. This was an addition compared to the previous study.

Identification of Technologies Applied

For RQ2, it was necessary to identify the technologies applied by startups and connect them to the various trends from RQ1. For this, the sources were sections dedicated to technologies on the companies' websites and academic papers. The granularity with which these technologies were identified was kept consistent among them. Technologies are 58 in total. They were listed, described, and analyzed using a network graph to recognize connections.

Literature Review on Social Sustainability in the Warehouse

Ultimately, RQ3 involved an initial literature review of 29 documents, integrated with results obtained from the startup investigations. The selection prioritizes the most recent documents. The topics covered are industry 4.0, logistics, social sustainability in the warehouse, and sustainability. The sources are academic journals, book chapters, papers, and, in a small number, websites. A final note points that the literature covering this topic is still sparse.

3. Startups' Directions of Technological Innovation

This section answers RQ1, analyzing each of the four macro categories on categories numerousness and tags present.

New Logistics Players

New Logistics Players (NLPs) companies offer logistics services and are 27% of the database.

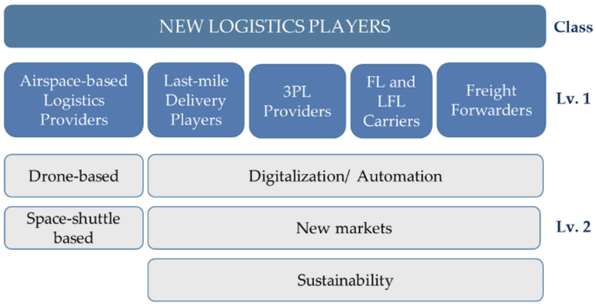

Figure 1: NLPs Classification

Level 1 subcategories follow the range covered by these services. Level 2 highlights the type of innovation. Here, New markets indicate those without particular innovative aspects. About the numerousness, at level 1, Last-mile Delivery Players are distinguished as the largest. At level 2, space logistics emerges as a potential future trend. Also, Digitalization/automation overshadows other categories, occupying 58% of cases compared to 11% of Sustainability. In line with this data, the Sustainability subcategory of Freight Forwarders is empty. The explanation could be that long-range vehicles are those least affected by progress in the environmental field [5]. Last-mile Players, instead, are the ones that most involve Sustainability in innovations (17%). The tags analysis confirms the general focus of NLPs on the digital, with 68% tagged with at least one among *tracking*, *payments management*, *insurance*, *analytics*, and *e-commerce*. However, Last-mile Players are a vector for all types of innovation. In addition to all digital trends, they also report tags of *EVs* (13%), *reverse logistics* (10%), and *remote control* (4%). The latter involves the remote control of *autonomous vehicles* (7%) and, despite being limited in number, can develop in the future from a social sustainability perspective. Indeed, it improves the safety of several logistics activities. On this topic, another tag is *driver-centric* of FL and LFL Carriers.

Hardware

This macro category includes startups developing devices for logistics activities. It occupies 17% of the database.

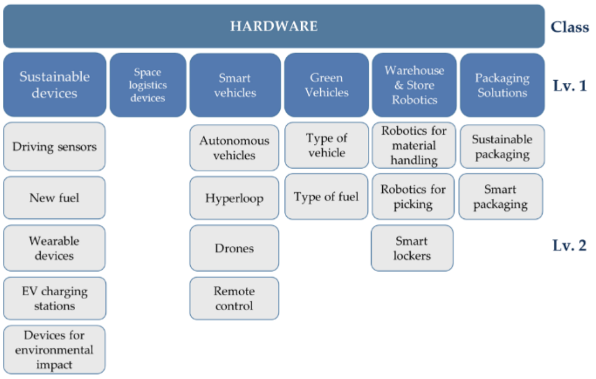

Figure 2: Hardware Classification

Smart Vehicles is the largest subcategory and includes Remote control, already noted previously in terms of social sustainability. Sustainable Devices, the second category for companies included, is connected to this theme. Here, social sustainability emerges with Driving sensors for drivers and Wearable devices for improving work experience in warehousing. This trend unites with environmental sustainability (Green vehicles, Sustainable packaging, New fuels), automation (WH Robotics), and digitalization (Smart packaging). All these tendencies are connected, as proven by the micro-level of details given by tags. Sustainability meets digitalization with the coexistence of *sustainable packaging* embedded with *tracking* sensors. WH & Store Robotics includes *AMRs* that can collaborate *with humans* to support their activities. In Smart vehicles, instead, autonomy meets environmental sustainability with *autonomous electric trucks*, as in green vehicles. Also, automation intersects again with social sustainability with *remote control* of all logistics vehicles. Then, the two declinations of sustainability are recalled in Sustainable Devices with *CO_2 recovery, electrification, drivers' safety, anti-collision, tire monitoring*, and *exoskeletons*. Lastly, startups are exploring new applications with the newborn Hyperloop and Space logistics solutions.

Software

This class involves companies supporting supply chain activities with IT solutions. It composes 39% of the database. Here, no level 2 is present.

Here, trends previously observed are confirmed, but the central role is played by data, aimed at improving flow visibility and supply chain integration. Indeed, Supply Chain Visibility & Integration and Inventory & Flow Management occupy the first two positions. Here, digital connects with sustainability. The most common tags are *analytics, tracking, demand analysis, payments* and *documents management, invoice, audit,*

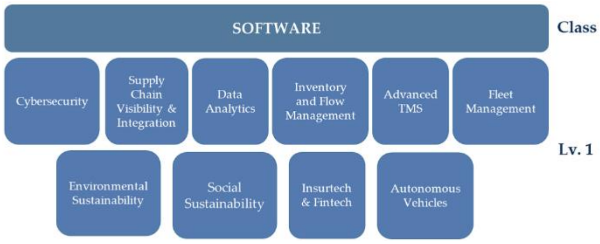

Figure 3: Software Classification

digital twin, driver monitoring, EV charging management, and *fuel optimization*. The common sense is to increase the visibility of operations, from the warehouse to transport, for better *decision-making* and more effective *integration* with partners. This also involves the well-being of employees and the environment. Data Analytics enhances these elements with *AI and Machine Learning*. A widespread feature is *digital twins*, a technology that creates a virtual model of an entity, be it a warehouse or the entire supply chain, enabling *insights* and *scenario analysis*. This technology concerns 13% of companies in Data Analytics and promises to be pivotal for supply chain *resilience*. Advanced TMS links with these subcategories by improving *communication* between SC actors. Cybersecurity connects with these aspects, offering a key ancillary service to protect and foster digital capabilities. Regarding the other subcategories, Fleet management includes attention to *drivers* (social sustainability) and *EVs* (environmental sustainability). These two tendencies emerge also in Social Sustainability and Environmental Sustainability. The former focuses on *accident prediction* in the warehouse and the latter on *carbon accounting*. Finally, Insurtech & Fintech highlights the services dedicated to *trade finance* and *insurance* already noted in other macro categories.

Platforms

These companies "help different customers get together" [6]. They account for 17% of the database. Platform involves businesses while Crowdsourced Platforms target individuals. Indirect Purchases includes workforce and packaging.

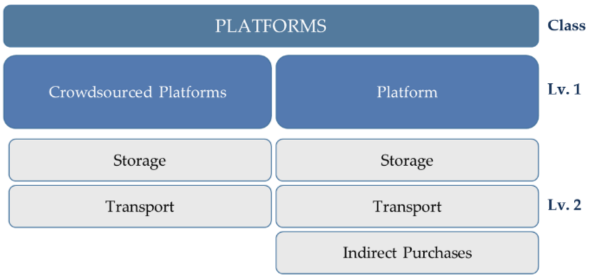

Figure 4: Platforms Classification

The largest subcategory is Platform, which accounts for 91% of level 1. Most of the users need to ship goods. They connect with *carriers* (52% of cases), *freight forwarders* (5%), or truckers (11%). Alongside AI-driven matching, Platforms still embody all the other trends mentioned previously, with *tracking*, *analytics*, *documents management*, *payments management*, *insurance*, *electric fleet*, and *driver-centric*.

Findings from Analysis of Startups

From the examination above, five interconnected trends emerge:

- **I. Digitalization**
- **II. Automation**
- **III. Resilience**
- **IV. Sustainability**
- **V. New Frontiers**

The first trend refers to the digitalization and automation of processes and tasks. This involves the categories of New Logistics Players, Platforms, and Software. Related tags are *payments management*, *documents management*, *invoice*, and *audit*. Trend I promote Social Sustainability by automating repetitive tasks with little decision-making. Furthermore, digitizing supports resilience by increasing efficiency and lowering reaction time to unpredictable events. Trend II includes autonomous vehicles present in NLPs, Hardware, and Software. Here, Environmental Sustainability is in *autonomous electric vehicles*. Also, *remote control* links automation and Social Sustainability, enabling operators to drive vehicles from a safe location. Resilience concerns Supply Chain Visibility & Integration, Data Analytics, and Cybersecurity. These embody companies' need for data to improve visibility and control along supply chains. Connected tags are *digital twin*, *analytics*, *standardized decision-making*, *scenario analysis*, and *insights*. As explained above, this trend relates to Digitalization. In trend IV, Sustainability encloses two declinations: Social and Environmental. The former includes solutions improving the safety and work satisfaction of warehouse operators and drivers. It connects with Digitalization and Automation. Environmental Sustainability deals with EVs and other innovations to reduce the environmental impact of logistics. Some of them are coupled with automation. To conclude, New Frontiers engineer two applications: Hyperloop as a new vehicle, and space as a new context.

4. Technologies Applied by Startups

Linked to the abovementioned trends, a total of 58 technologies were identified. Below are the main ones.

Table 1: Main Technologies

Name	Cluster
Autonomous Vehicles	AV
Computer vision	AV
Sensors LIDAR	AV
Cameras	AV
Drones	AV
New fuel: eFuels	SUS
New fuel: hydrogen	SUS
Electric Vehicles	SUS
Software for social sustainability - operator	SSWH
Exoskeletons for WH operators	SSWH
Devices for let the workers operate hands-free	SSWH
Sensors IoT	SSWH
Robotic arms to grasp objects	SSWH
AMRs/AGVs	SSWH
Software for teleoperation of vehicles	SSWH
Software for tracking	RES
Digital twins	RES
AI and Machine Learning	RES
Algorithms for route optimization	TPA
Algorithms for scheduling and dispatching	TPA
Algorithms for freight auditing and invoicing	TPA
Algorithms for documents management	TPA

Clusters are Autonomous Vehicles (AV, *Automation trend*), Environmental Sustainability (SUS, *Environmental Sustainability trend*), Social Sustainability in the Warehouse (SSWH, *Social Sustainability trend*), Resilience (RES, *Resilience* *trend*), Task and Process automation (TPA, *Digitalization trend*).

Autonomous vehicles include last-mile robots, drones, AGVs/AMRs, trucks, trains, and ships. Their movement relies on cameras, LIDAR sensors, IoT, and computer vision. An increasing number of solutions include remote control, consisting of humans actively supervising the autonomy of the machines. Autonomous electric vehicles are present in the database.

Computer vision enables machines to recognize objects around them. Contexts of applications are warehouse operations and autonomous vehicles. The former involves picking, yard management, workers' safety, and process digitization. In many of these, computer vision supports and simplifies tasks, acting in the view of social sustainability. Concerning autonomous vehicles, computer vision determines the precision of obstacle recognition algorithms. This is a feature on which AV companies compete, and it enables teleoperation software.

LIDAR sensors enable movement of AVs and accident-prediction devices.

Cameras can associate with computer vision or not. In the first case, applications are obstacle recognition for autonomous vehicles and accident prediction in the warehouse. When not coupled with computer vision, cameras accomplish insurance purposes.

Drones deliver cargo but also medical goods, reaching remote areas. Their parameters are payload, speed, and distance. Products of Gadfin [7] arrive at 5kg, 200km, 100km/h or 150kg, 200km, 150km/h.

Infinium [8] develops eFuels, "ultra-low carbon synthetic fuels" to replace petroleum in actual vehicles. Hydrogen, in its most concrete application, is derived from ammonia and targets trucks, ships, trains, and planes.

Electric Vehicles observed are last-mile robots, drones, AMRs/AGVs, trucks, trains, and ships. This testifies how automation and electric proceed together and influence each other.

Software for operators enables all features caring about employees work experience. These include fatigue data analysis, safety monitoring, and informational support.

Exoskeletons reduce the effort to handle packages and prevent operators from making incorrect movements. They improve satisfaction and work quality.

Devices to free hands of operators are heads-up displays, smart watches, and mobile devices. They provide warehouse employees with AI-driven picking, packing, and routing.

IoT sensors enable visibility along the supply chain and in the warehouse, mainly by tracking goods-related information and registering data in the cloud. These real-time updates are also meaningful for autonomous vehicles' performance monitoring.

Robotic arms combine computer vision for product recognition and hardware for optimal picking, sorting, and packing. The outcomes are classifiable as socially sustainable, relieving operators from repetitive tasks.

Warehouse AGVs and AMRs can be *collaborative* or *non-collaborative*. The former involves AI and ML to work with humans and learn from them. This innovation also falls under social sustainability. Non-collaborative robots are instead fully autonomous and, backed by computer vision, replace humans in material handling.

The teleoperation software allows a remote driver to suggest the right corrective actions for an autonomous vehicle. This apply when the vehicle needs support. The technology focuses on suggestions rather than driving.

Tracking the most widespread service. It provides real-time information about position of goods in shipping and warehousing. Other information can be temperature and damage. IoT devices enable this technology.

Digital twins are a virtual representation of a physical system [9]. These are supply chains, warehouses, vehicles, products, and documents. Digital twins foster reliability, visibility, and simulations, thus promoting resiliency.

AI and ML are used in several contexts and differentiated for their output. ML provides forecasts, AI manages risk mitigation and best practice suggestions.

Route optimization algorithms compute the fastest route to follow, whether for warehouse workers or drivers.

Algorithms for scheduling and dispatching optimize task allocation for workers.

Algorithms for freight audit and invoicing automate the examinations performed by auditors.

Documents management scripts generate or read documents, validate, sign, and send them.

Findings from Technologies Analysis

Each of the 58 technologies connects to the others. A network graph maps all these connections. Below is the aggregate graph relating to the connections between the clusters.

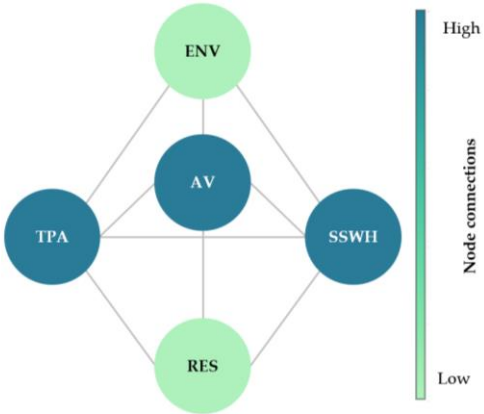

Figure 5: Technologies Cluster Connections

Mostly connected nodes are Autonomous Vehicles, Tasks and Processes Automation, and Social Sustainability in the Warehouse. From these affinities emerges the pivotal role of AVs, which development entails humans. This is the case of teleoperation. On the one hand, it testifies to the need for human supervision of AVs, and, on the other, it enters into the theme of social sustainability by increasing warehouse safety. This introduces the theme of the *AV-humans cooperation*, the pillar of collaborative AMRs. They foster social sustainability in warehouses together with the software for operators' experience. This consists of relieving operators from the mental stress associated with repetitive tasks and guesswork. The same objective is that of algorithms for document management, scheduling, or dispatching. Underlying technologies at the basis of AV, Social Sustainability, and their integration are cameras, computer vision, LIDAR sensors, AI, and ML.

A wording that synthesizes the pivotal role of automation and the increasing focus on social sustainability is that of Ox [10]: *human-centric automation*.

Given the trends observed until now, this document delves into social sustainability in warehouses, intending to contribute to the literature.

5. Social Sustainability in the Warehouse

This chapter starts by reviewing the literature on the topic of SSWH and then develops a framework to merge findings from the papers with those from startups.

Literature Review

Social sustainability is defined by [11] as "the management of practices, capabilities, stakeholders, and resources to address human potential and welfare". This section discusses Social Sustainability in the Warehouse (SSWH) starting from practices and technologies suggested by the literature.

Practices from the Literature

SSWH practices considered in this research are a selection of the ones proposed by [12], [13]. They are:

I. **Safety**
II. **Labor practices**
III. **Health and hygiene**

The first item refers to the probability of incurring accidents or death in the workplace. Labor practices involve workers' satisfaction, positively impacted by job enlargement and/or enrichment. The third item conveys the availability of services and devices to guarantee proper sanitary conditions.

Technologies from the Literature

Considering what reported in [14], [15], [16], and [17], the literature proposes eight technologies connected to SSWH (numeration is to read the classification model):

LT41. Real-time tracking of material flows
LT49. Autonomous order processing
LT47. Product distribution planning
LT35. IoT
LT34. Augmented Reality
LT37. Autonomous Robots
LT9. Drones

From this list clearly emerges the relationship between SSWH and Logistics 4.0, already highlighted in the section 4.

Benefits and Issues

SSWH has both positive and negative impacts on warehouse work experience. The pros are from [18]:

I. **Improved labor practices**
II. **Physical workload and health**

These items see machines taking charge of more repetitive and dangerous tasks, leaving workers free for less repetitive, safer, and more engaging assignments.

Drawbacks linked to technologies introduction, instead, are taken from [14] and [19]:

I. **Job destruction and job insecurity**
II. **Artificial divide**

The first object refers to insecurity due to the fear of having their job replaced by a machine. In the case of job replacement, the fear is being substituted, in the case of job support, the matter is being assigned to trivial tasks. This happens if no job enlargement or enrichment is proposed. Artificial divide is the gap between humans who can successfully interact with smart systems and those who cannot. All of these can demoralize operators and lower productivity.

Framework

The framework classifies SSWH technologies according to two dimensions. The first is the warehouse activity they benefit, the second is the relationship with that operation that can be of support or substitution.

Structure explanation

Rows articulate based on a list of warehouse activities taken from [20].

The second classification criterion differentiates technologies that *support* operators in task execution from technologies that *substitute* workers. Support means simplifying activities, and increasing satisfaction and efficiency by reducing guesswork. Substitution consists of the machine taking full charge of a task previously assigned to operators. This is linked to relieving workers from repetitive or dangerous work.

Classification model

Technologies included are both from the literature and from the startups. Each of the technologies found in the literature matches one identified in startups.

Literature: LT41 (*Software for tracking*), LT49 (*Algorithms for documents management*), LT47 (*Algorithms for scheduling and dispatching*), LT35 (Sensors *IoT*), LT34 (*Heads-up displays*), LT37 (*Non-collaborative AMRs*), LT9 (*Drones*).

Startups: ST5 (*Computer vision*), ST6 (*Sensors LIDAR*), ST7 (*Cameras*), ST32 (*Software for social sustainability - operator*), ST33 (*Exoskeletons*), ST34 (*Devices for let workers operate hands-free*), ST36 (*Robotic arms to grasp objects*), ST37 (*AMRs/AGVs*), ST38 (*Software for teleoperation*), ST42 (*Digital twins*), ST43 (*AI and ML*), ST46 (*Algorithms for route optimization*) ST48 (*Algorithms for freight auditing and invoicing*).

Table 2: Classification Framework of SSWH Technologies

WAREHOUSE ACTIVITY		TECHNOLOGY ROLE	
Macro-activity	Activity	Task support	Task substitution
Receiving	Schedule carrier		LT47
	Unload vehicle	ST33+ST32	LT37+ST6+ST5, LT37+ST38
	Inspect for damage		ST5
	Manage receiving documents		LT49
Put-away	Identify product	LT35+ST34+ST32	LT35+ST5
	Identify storage location		LT41+LT35+ST42, LT9+ST7+LT35
	Job assignment		LT47
	Move products	ST34+ST32+ST43+ST46, T33+ST32, ST37+ST43	LT37+ST6, LT37+ ST38
	Update records	LT35+ST34+ST32	LT35+ST5
Order fulfillment	Identify picking location		LT41+LT35+ST42, LT9+ST7+LT35
	Job assignment		LT47
	Reach picking location	ST34+ST32+ST43+ST46, ST37+ST43	LT37+ST6, LT37+ ST38
	Pick goods	LT34+ST32+ST43, ST33+ST32, ST37+ST43	LT37+ST6, LT37+ ST38, ST36+ST5
	Move goods	ST34+ST32+ST43+ST46, ST33+ST32, ST37+ST43	LT37+ST6, LT37+ ST38
	Sort goods	ST37+ST43	ST36+ST5
	Label package	LT34+ST32+ST43	ST36+ST5
Shipping	Schedule carrier		LT47
	Move goods	ST34+ST32+ST43+ST46, ST33+ST32, ST37+ST43	LT37+ST6, LT37+ ST38
	Load vehicle	ST33+ST32	LT37+ST6+ST5, LT37+ ST38
	Manage shipping documents		LT49, ST48
	Update records		LT35+ST5
All areas	Safety	ST7+ST5+ST42+ST43 +LT41+ST32	

For the *task support* column, the set ST34 + ST32 + ST43 + ST46 assists the worker in routing (ST46) through hands-free devices (ST34) based on dedicated software powered with AI (ST32+ST43). Alternatively, moving but also picking, and sorting can be executed with an ML-based collaborative robot (ST37+ST43). Then, exoskeletons (ST33) guide employees in material handling with connected software for fatigue analysis (ST32). Safety is then monitored through cameras (ST7) embedded with computer vision and ML (ST5+ST43), often paired with a digital twin of the warehouse (ST42), and accident tracking (LT41) enabled by a dedicated software (ST32).

In *task substitution*, instead, algorithms are replacing specific tasks such as those for scheduling and dispatching (LT47), documents management (LT49), and auditing and invoices (LT48). Then, handling and picking can be performed by autonomous robots (LT37) embedded with LIDAR sensors (ST6) or supervised with teleoperation software (ST38). Also, in loading and unloading, they are coupled with computer vision (ST5). This last technology can pair with IoT (LT35) for automatic record updates or robotic arms (ST36) to replace picking operators. Finally, to locate items in the warehouse, two solutions can be adopted. The first bundle digital twin, IoT and tracking (ST42+LT35+LT41), and the second uses drones, IoT, and cameras (LT9+LT35+ST7).

As a general comment on the framework can be highlighted that there are more sets of technologies dedicated to task substitution than task support. However, the situation reverts when considering only technologies coming from startups. Indeed, in this case, there are 9 technologies promoting task support against the 7 dedicated to substitution.

Findings from Literature Review and Framework Development

Considering what emerged from these studies, three key concepts are defined:

I. **Safety is addressed by task substitution technologies**
II. **Labor practices are improved by task support technologies**
III. **Future technological developments depend on how the deriving issues will be managed**

The first point refers to technologies that replace humans. Among the most common, there are non-collaborative AMRs (LT37), robotic arms (ST36), and teleoperation software (ST38). These, from a social sustainability perspective, improve safety by preventing workers from accidents.

Continuing, technologies that improve labor practices are those supporting the operator. These are the collaborative AMRs (ST37), devices providing informational (ST34+T43) or physical (ST33) support. These embody the tendency to build machines around human needs, instead of forcing humans to adapt to machines.

The developments of these two declinations of SSWH depend on solutions proposed to their issues. In particular, task substitution may cause job destruction, task support may lead to job trivialization.

6. Conclusions and future outlooks

This research enlightens the trends of logistics today, discusses the related technologies, and indicates which foster social sustainability in the warehouse.

Section 3 recognizes five trends in logistics. Three emerge as predominant in 4: digitalization, automation, social sustainability. Also, these tendencies influence each other. Digitalization concerns repetitive processes, potentially relieving employees from unsatisfying tasks. Technologies in this regard are algorithms for document management, dispatching, and scheduling. Automation keeps humans in the innovations. Indeed, some startups no longer rely on autonomous vehicles alone but on autonomous vehicles supervised by humans, as in the case of teleoperation. Others do not produce robots to replace employees but to support them in task execution. This is the case of collaborative AMRs. These human-centric innovations also guide the development of exoskeletons, ensuring safety and reducing physical stress for warehouse workers.

This last context, the warehouse, is where all these trends meet. Humans work alongside automation and task digitization. This is why this thesis focuses on SSWH, analyzing the technologies fostering it. As the developed framework emphasized, the human-technology relationship comprehends two types of interactions: task support, improving labor practices, or task substitution, improving safety.

Between these two proposals, it is tough to understand which will prevail. Startups are focusing more on task support. Also, drawbacks deriving from task support technologies seem easier to manage. A pivotal role in this regard can be played by technologies present in both types of solutions, such as computer vision, AI, and Machine Learning.

7. Academic and Managerial Implications

This section covers limitations and academic and managerial implications.
As for limitations, fund data quality affects section 3. These data would have been meaningful in determining the solidity of each business, category, and trend. However, many companies do not have it. Also, no experts contribute to the technologies listing. A more experienced view would have been significant in identifying items and connections. Continuing, the literature on SSWH is sparse, and the information mapped may not be exhaustive. Lastly, this study considers only startups; for a more comprehensive view, traditional companies also could be observed.
From an academic perspective, the implications are two. The first is the confirmed relevance of looking at startups to glimpse innovation. Proof of this are the many promising businesses and technologies at the beginning of their development. Proceeding, this thesis wants to enlighten social sustainability in the warehouse. This aims to set the basis for future studies on this topic. From what emerged, future investigations can focus on the activities on which operators prefer to be replaced rather than supported, and the effects derived from technology introduction. However, these points should be detailed for each technology. Indeed, job enlargement or enrichment may vary for each technology as employees degree of acceptance or work experience.
In conclusion, managers can catch the sector's trends and detail the related technologies to invest in, whether acquiring or integrating it. Considering a startup, instead, trends identified can be the base for adapting its business to the most promising services. Then, visibility is given on what technologies improve the employee experience in the warehouse. Then, this chapter also presents a model to understand which warehouse activities are most affected by social innovation and in which terms. This can be meaningful in understanding what to focus on and what technologies to introduce to enhance labor practices, attract employees, and improve logistics and social responsibility. More comprehensively, all this can make a company able to act before competitors on specific investments and gain a competitive advantage.

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