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STRATEGIES AND CHALLENGES OF BUILDING SPACE CLEANING PROCESSES

Iveta AMOLIŅA, College of Law, Kronvalda Bulv. 1A, Riga, LV-1010, Latvia, amolina@jk.lv (*corresponding author)*
Intra LŪCE, College of Law, Kronvalda Bulv. 1A, Riga, LV-1010, Latvia, intra.luce@jk.lv
Jānis EGLĪTIS, College of Law, Kronvalda Bulv. 1A, Riga, LV-1010, Latvia, janis@unogroup.lv

The field of space cleaning is an important part of any country's economy, as it provides jobs and promotes entrepreneurship. In today's urbanized environment, building space cleaning has become an integral part of daily life and the work environment. A clean and tidy environment not only enhances the aesthetic impression but also significantly affects people's health, work productivity, and overall comfort. Based on the problems affecting the field of space cleaning, it is relevant to study the aspects of organizations engaged in cleaning activities in order to attract cleaners and to ensure that those already employed do not leave their jobs but instead work in safe and healthy workplaces.
Nowadays, "smart" solutions are gaining increasing importance in the field of space cleaning, involving the use of digital technologies and automation. For example, smart monitoring systems, sensors that measure room occupancy, or robotic cleaning tools help organizations reduce costs and increase work efficiency.
At the same time, "start-up" initiatives also play a significant role, operating flexibly and adapting to changing needs, thus creating a dynamic environment for industry development.
The concept of "eco" or environmentally friendly cleaning, based on the sustainable use of resources, waste reduction, and minimizing the impact of chemicals, is also becoming increasingly important. By choosing ecological cleaning agents and water-saving technologies, it is possible to significantly improve employee health protection and reduce the negative impact on the environment. In the context of global climate change and sustainability, the principles of "Zero Carbon Village" are also being increasingly discussed, where the goal is to create inhabited areas with zero carbon emissions. In such settlements, special attention is also paid to cleaning processes—only sustainable materials, renewable energy, and circular economy principles are used to ensure that cleaning work does not leave an unnecessary ecological footprint.
The aim of this research is to analyze building space cleaning processes and their implementation strategies based on efficiency and quality, by examining theoretical aspects and conducting public surveys on the subject. Special attention will also be given to "smart" and "start-up" solutions, ecological aspects, and their alignment with the future Zero Carbon Village concept.
The research employs a combination of methodological approaches to explore future directions in the cleaning sector. A literature review provides a theoretical foundation by analyzing existing studies and concepts. A Sociological method, specifically a survey, is used to gather empirical data on public attitudes and awareness regarding innovations in the industry. The collected data is then examined using an analytical method, enabling the identification of key trends and correlations.

Keywords: *cleaning services, eco – friendly cleaning, strategy, smart technologies.*

INTRODUCTION

Space cleaning is not only a practical but also a strategic process that requires the evaluation of several factors. The efficient execution of cleaning work is influenced by various socioeconomic, technical-technological, and legal factors. Effective organization of building space cleaning requires thoughtful decision-making based on the specifics of the building, usage intensity, and user needs (Muriithi et al., 2016).

The cleaning industry is currently one of the fastest-growing economic sectors worldwide. It is often referred to as a guaranteed sector because there is constant demand regardless of economic conditions. Its potential remains assured as long as the economy grows with new building construction, the opening of new businesses, and consumer preferences favoring cleanliness. The sector will grow even faster due to the introduction of more advanced technologies and service mechanization, ensuring greater efficiency and profitability, supported by fast and effective deliveries. In Latvia, the cleaning industry falls under group 81.2 of the Lursoft NACE Rev. 2 classification—cleaning activities, more specifically, "other building and industrial cleaning activities." This group includes general interior cleaning of all types of buildings, facade cleaning, specialized building cleaning, and other specialized cleaning activities, such as cleaning of industrial equipment, the inside of tank trucks and tankers, building and industrial disinfection, pest extermination, bottle cleaning, street sweeping, as well as snow and ice removal (Lursoft, 2024). The cleaning industry is a sub-sector of construction and landscape architecture services.

Cleaning is an important task, and when done properly, it can reduce risks to both worker safety and health, as well as lower company expenses, for example, by extending the service life of equipment and furniture (European Agency for Safety and health at Work, 2009) and maintaining flooring in good condition. In the cleaning field, workers are exposed to various occupational hazards and chemicals that may affect their general health, particularly eye health (Jiménez Barbosa et al., 2019).

Cleaning may be performed by building owners, tenants, or building managers, but in practice, this service is often outsourced. Outsourcing is the transfer of ongoing management responsibility from the client or service user to a third party, called a vendor or service provider, to deliver cleaning services in accordance with a service level agreement (Khan et al., 2022). The concept of outsourcing originates from the American term "outside resources," which refers to obtaining resources from the outside (Troacă, Bodislav, 2012). Later, this term was adopted in economic terminology to indicate the use of external sources for business development, which previously relied on its internal resources.

Modern cleaning processes are becoming increasingly complex due to growing hygiene requirements, technological development, and sustainability principles. Effective cleaning is no longer just about maintaining cleanliness, but a strategic process that impacts building functionality, user well-being, and operating costs. However, in practice, challenges often arise—insufficient resources, low worker qualifications, and inefficient work organization. Therefore, managers in this sector must be able to choose appropriate strategies, identify key challenges, and find solutions that promote efficiency and quality of cleaning processes in the long term.

In this context, "smart" technologies based on sensors, data analysis, and robotics are gaining more importance. For example, smart vacuum cleaners (Ruan et. al., 2021), floor washing robots, and indoor air quality monitoring devices not only improve cleanliness levels but also optimize labor resources.

Another important development direction is "start-up" companies, which are entering the cleaning market with new business models and solutions—from digital applications for booking cleaning services to the development of environmentally friendly cleaning products and equipment (Troacă, Bodislav, 2012). Start-up approaches foster innovation and flexibility, which is particularly important in a changing economic and social environment.

Increasing attention is also being paid to "eco" or environmentally friendly cleaning, which involves replacing chemicals with biodegradable products, saving water and energy, as well as implementing circular economy principles. Environmentally friendly methods not only protect worker health but also reduce companies' ecological footprint (Fontana, et. al., 2025). From a sustainability perspective, space cleaning is increasingly associated with the "Zero Carbon Village" concept (Zhu, 2014), which envisions creating settlements with zero carbon emissions (Zhu et al., 2022). In such villages or neighborhoods, cleaning processes are implemented using only sustainable materials, renewable energy sources, and fully digitalized, efficient solutions. This means that in the future, the cleaning industry will be closely linked to the green transition and the achievement of climate goals.

The aim of the study is to analyze building space cleaning processes and their implementation strategies based on efficiency and quality, by examining theoretical aspects and conducting public surveys on the subject. The research uses literature analysis (literature review), a sociological method (survey), and an analytical method for examining data obtained through the survey. Special attention is given to "smart" technologies, "start-up" initiatives, ecological aspects, and Zero Carbon Village principles as future directions for the cleaning sector.

LITERATURE REVIEW ON THE ESSENCE OF SPACE CLEANING

Environmental cleaning is one of the most important duties of every individual. The larger the area to be cleaned, the more people are needed. Today, due to surrounding dust, people tend to experience allergies, watery eyes, colds, coughing, rashes, etc. (Muriithi et al., 2016).

Cleaning is an important task, and if performed well, it can reduce risks to both worker safety and health, as well as lower company expenses, for example, by extending the service life of equipment and furniture, and maintaining flooring in good condition. In some industries, such as food production and catering, poor cleaning can even lead to company bankruptcy.

Cleaning is an activity performed to maintain a healthy, safe, and aesthetically pleasing environment. It involves removing dirt from objects and surfaces (Sabharwal, 2015), usually done manually or mechanically, using water with detergents or enzymatic products.

Cleaning means the complete removal of dirt from devices, work surfaces, workstations, and environments, using appropriate cleaning chemicals under recommended conditions (Al-Rub et al., 2020). Dirt is defined as substances that make an object dirty by sticking to it (Turner-Walker, 2012). Dirt includes mud, stains, soil, graffiti, mold, fingerprints, ingrained dirt, and foam (Zainol et al., 2015). Dust, as one type of dirt, includes dust particles, lint, powder, fluff, cobwebs, etc.

Performing cleaning work on certain elements requires strong physical skills. Regular space cleaning helps prevent the accumulation of dirt and microorganisms, reduces the risk of allergies and infections, and extends the service life of interior finishes and equipment.

Cleaning is an essential hygiene aspect, and it also creates a pleasant atmosphere; therefore, every institution must be cleaned and kept tidy. Cleaning is the process of removing stains, dirt, dust, grease, and unwanted impurities, which include wiping, sweeping, scrubbing, and washing (Sivakami). Cleaning prevents infections as well as improves the appearance of the environment, which otherwise could become a breeding ground for pests and insects such as ants, flies, mosquitoes, cockroaches, spiders, etc.

The authors of the article have compiled information from the Latvian standard on types of dirt removed during

cleaning processes (Latvian Standard, 2021) (see Table 1). The table reflects types of dirt, their description or definition, and examples of how they appear.

Table 1. Types of Dirt and Their Examples (Based on Latvian Standard LVS 1051)

Type of Dirt	Description	Example
Waste	Contamination that can be picked up	Pieces of paper, leaves, cigarette butts
Debris	Relatively small particles that cannot be easily lifted into the air	Gravel, sand, soil, ash, fibers, hair, spider webs, insects, crumbs
Dust	Fine, small particles that can form a layer on a surface and can become airborne	
Stains	Dry or wet contamination not caused by damage or improper building maintenance	Any type of spilled liquid residues (blood, secretions, excrement, coffee, foamy drink, oil), condensation rings, chewed gum tracked in, streaks, displaced objects, and fingerprints
Surface Contamination	Dry or wet contamination over an unrestricted surface area not caused by damage or improper maintenance	Persistent contamination spots over a large area, e.g., accumulated or tracked-in dirt, limestone and rust stains, grease film, cleaning agents/water residues, nicotine, large-area traces from moving objects and fingerprints, as well as areas with uneven surface treatment

By examining the collected information, it can be concluded that the essence of space cleaning lies in the removal of dirt from various surfaces. During the cleaning process, disorder and dirt are eliminated, resulting in clean and tidy premises that are also free from infections and microorganisms, which significantly affect employee safety and health. According to the European Commission Decision (EU) 2018/680, which sets out criteria for awarding the EU Ecolabel for indoor cleaning services, the product group "indoor cleaning services" includes regular, professional cleaning of commercial, institutional, and other publicly accessible buildings, as well as private dwellings. Cleaning services may be provided in such areas as office spaces, sanitary facilities, publicly accessible areas (corridors, waiting rooms, lounges), etc. The ecolabel criteria have been developed to promote environmentally friendly cleaning.

When organizing space cleaning, the decision-making process involves several stages—from assessing needs to selecting the most appropriate solutions. First, the frequency and scope of cleaning must be determined: whether cleaning will take place daily, weekly, or as needed. Second, the appropriate type of cleaning must be chosen—manual, mechanical, or automated—as well as the cleaning agents, which should be both effective and environmentally friendly. Third, it must be evaluated whether the work will be carried out with internal resources or by outsourcing (European Union, 2018). These decisions should be based on balancing quality, cost, and time factors. Communication between the building manager, cleaner (or service company), and room users also plays an important role in decision-making, ensuring clear work organization and quick problem-solving.

The field of facility management and cleaning is significant for the economy of any country. By uniting the leading and most progressive companies in the sector and agreeing to comply with professional standards, it is possible to jointly create favorable conditions for the operation and development of honest cleaning and facility management companies, as well as a foundation for fair competition in the market and raising the prestige of the industry.

RESEARCH ON WORK ORGANIZATION IN CLEANING COMPANIES

RESEARCH METHODOLOGY

The research was conducted using the survey method. The survey consists of 15 questions. Any survey is a list of questions to which the respondent must provide written answers. In the survey, respondents were asked closed questions, with given answer options from which the respondent had to choose by marking one or several answers. Some closed-type survey questions were designed as frequency or importance scales, which can be considered Likert-type questions.

The Likert scale consists of a list of statements with predefined evaluative (attitude-describing) responses. Typically, four or five response options are offered on a Likert scale. The Likert scale is convenient because it helps avoid ambiguity in respondents' answers and the associated difficulties in summarizing responses. It is also convenient in survey data processing, as it allows for the use of simple coding systems, such as from one to four or five, which also makes it possible to identify the "direction" of attitudes, from negative to positive or vice versa. Using the Likert scale makes it easy to create indexes for identifying factors influencing the studied characteristics (Geske, Grīnfelds, 2020).

The research results were analyzed using the functions and tools available in Excel, such as COUNTIF, Vlook, Average. The results were described using descriptive statistics.

Descriptive statistics are used to provide quantitative descriptions in a manageable form. Descriptive statistics help to reasonably simplify large amounts of data. Each descriptive statistic reduces a large amount of data into a simpler summary (Kaur et. al, 2018).

The research took place from July 1, 2024, to August 30, 2024. Respondents aged 18 and older who were in any form of employment participated in the study. Since the number of respondents by gender was equal, the survey data were analyzed by comparing responses by gender.

Inclusion criteria: persons over 18 years of age and economically active individuals. Exclusion criteria: persons younger than 18 years of age and inactive individuals. Before the survey was published on social networks, a pilot study

was conducted, which revealed that the survey questions were understandable and relevant to the research topic, as confirmed by several pilot study respondents.

RESEARCH RESULTS AND ANALYSIS

A total of 140 respondents aged 18 to 79 participated in the study 50%555 women and 50% men. The average age of respondents was 41.39 years. The median age was 41 years. The most frequent age of respondents (mode) was 41 years. The standard deviation of respondents' age was 8.445 years, while the variance was 71.319 years.

The authors of the study grouped respondents' ages into four categories in order to observe statistics by age groups. The largest proportion of respondents of both genders was in the age group 31 to 50 years—77.1% (54) of women and 84.3% (59) of men. In the remaining age groups, respondents ranged from 1.4% to 11.4% (see Table 2).

Table 2. Industry contact with dirt, number (created by author based on survey data)

Industry	Trash	Debris	Dust	Stains	Surface Contamination
Unknown	1	1	1	0	0
Construction	24	23	27	18	16
Public administration	9	7	12	5	8
Marketing	2	1	2	0	1
Education and research	4	1	6	1	2
Trade	21	12	20	8	7
Telecommunications	1	0	0	0	0
Finance and insurance	5	3	6	4	3
Health	6	3	7	10	7
Food and catering	0	0	1	0	1
Information technology	2	0	0	0	0
Cleaning and facility management	14	14	15	12	14
Real estate	16	14	17	9	11
Others	12	10	17	6	6
Total	117	89	131	73	76

Analyzing the existence of a cleaning plan/program in workplaces by industry, it can be concluded that such a plan can be observed in the trade sector (15.4% (14)), while the construction industry is the one where the existence of a cleaning plan/program in workplaces is absent (26.5% (13)).

Table 3 shows the frequency of cleaning tasks in respondents' workplaces.

Table 3. Cleaning frequency in the company, % (created by author based on survey data)

Cleaning Tasks	Every Working Day	1 x Week	1 x Month	2 x Year	As Needed	No Opinion
Emptying waste bins and replacing bags	65.7	27.1	1.4	0	2.9	2.9
Wet cleaning of floor coverings	43.6	41.4	4.3	0	5	5.7
Carpet cleaning with vacuum cleaner	30	43.6	7.1	0	7.9	11.4
Wet cleaning of entrance doors	22.9	27.1	22.1	4.3	14.3	9.3
Cleaning of windowsills	20.7	36.4	19.3	3.6	12.1	7.9
Cleaning horizontal surfaces (tables, cabinets)	42.1	35.7	8.6	2.1	5.7	5.7
Cleaning lamps and lighting fixtures	9.3	19.3	32.1	7.1	20.7	11.4
Cleaning towel, toilet paper, and soap holders	42.9	30	12.9	0.7	7.1	6.4
Toilet cleaning	64.3	26.4	1.4	1.4	2.1	4.3
Cleaning of interior elements	15.7	40.7	18.6	2.9	12.1	10
Replenishing hygiene materials (soap, paper)	52.1	22.9	7.1	2.1	10.0	5.7
Cleaning Tasks	100	100	100	100	100	100

The most frequently noted task by respondents was the emptying of waste bins and replacement of bags every day (65.7% (92)). Wet mopping of floor surfaces takes place every working day (43.6% (61)), and similarly, respondents indicated that it also occurs once a month (41.4% (58)). Carpet vacuuming, according to respondents, takes place at least once a week (43.6% (61)). Respondents' answers show that wet cleaning of entrance doors occurs once a week (27.1% (38)), and slightly fewer respondents indicated that it happens daily in their workplace (22.9% (32)). Windowsills are cleaned in respondents' workplaces once a week (36.4% (51)). Respondents' answers indicate that wiping of horizontal surfaces takes place every working day (42.1% (59)) and slightly less often once a week (35.7% (50)). Cleaning of lamps and lighting fixtures in respondents' workplaces takes place once a month (32.1% (45)). Cleaning of towel, toilet paper, and soap dispensers occurs every working day (42.9% (60)). Toilet cleaning in respondents' workplaces takes place every working day (64.3% (90)). Cleaning of interior elements occurs once a week (40.7% (57)). Finally, hygiene materials are replenished every working day (52.1% (73)).

Based on the analysis of respondents' answers, it can be concluded that cleaning tasks in respondents' workplaces take place every working day, while certain tasks (such as cleaning of windowsills, interior elements, etc.) are carried out

once a week, which is understandable given the nature of these cleaning tasks and as the concluding question about the cleaning equipment used in their company. It should be noted that, since room cleaning is mostly carried out outside working hours, many respondents may not be aware of what kind of cleaning equipment is used. It should also be mentioned that respondents could select more than one answer to this question, therefore the number of responses may not coincide with the number of respondents. Observing the results, it can be said that in respondents' workplaces, cleaners use manual labor (115). This means that the premises are cleaned independently with tools such as dusters and cleaning cloths. About 20% fewer responses indicate that a vacuum cleaner is used for cleaning (92) compared to manual labor. Twenty-nine respondents' answers confirm that in their company cleaning is carried out with a floor cleaning machine. However, three respondents indicated that they had not noticed what kind of equipment is used for cleaning their workplace. Based on respondents' answers, it can be concluded that manual labor is irreplaceable and is used by the majority of companies. Nowadays, room cleaning is no longer just a mechanical process, but rather a multilayered activity integrating technological, organizational, and environmental aspects. Comprehensive cleaning solutions involve not only the performance of cleaning tasks but also a strategic approach based on quality standards, sustainability, and efficiency. Modern cleaning companies increasingly use robotic devices, smart planning systems, and environmentally friendly cleaning agents to reduce resource consumption and improve results.

CONCLUSIONS

The cleaning sector in Latvia constitutes one of the cornerstones of the national economy and represents one of its fastest-growing industries. At its core, cleaning is defined as the removal of dirt from various surfaces. Through this process, disorder and impurity are eliminated, resulting in premises that are clean, orderly, and free from infections and microorganisms factors that play a crucial role in ensuring employee health and safety.

Cleaning must therefore be understood not merely as a mechanical task but as a time-consuming, strategic, and multilayered process that influences workforce well-being, organizational efficiency, and the optimal use of company resources. The findings of the study highlight the significance of integrating "smart" technologies such as robotic cleaning tools, sensors, and digital planning systems which substantially enhance efficiency while simultaneously reducing operational costs. Start-up initiatives contribute to innovation and flexibility by introducing new forms of service provision and environmentally sustainable solutions.

An ecological approach emphasizing the use of biodegradable cleaning agents, contributes to a reduced ecological footprint and enhanced protection of employee health. Looking towards the future, the Zero Carbon Village concept illustrates the potential to implement cleaning processes based on sustainable materials, renewable energy, and circular economy principles. This in turn promotes zero-carbon emissions and supports the broader objectives of sustainable urban development.

Taken together, these aspects indicate that the cleaning sector must pursue an integrated trajectory of development, uniting technological progress, innovation, sustainability, and climate objectives. Within such a framework, human resources remain indispensable: professionally trained personnel, proficient in established quality standards, are capable of delivering consistent and measurable cleaning outcomes. The application of such standards enables the objective assessment of cleaning quality by defining permissible levels of contamination and the necessary operational tasks. Furthermore, the outsourcing of cleaning services allows clients to optimize costs while securing a professional, context-specific approach tailored to the requirements of each facility.

To improve cleaning process, the authors offer the following proposals: company managers should pay more attention to cleaning work, as it affects employee safety and health. Allow cleaning staff to have sufficient time to clean the premises when planning their schedule. Implement safer chemical alternatives: replace hazardous cleaning with eco – friendly and non-toxic products to reduce health risks, especially those affecting eye health. Enhance worker training programs – provide regular training on occupational safety, proper equipment uses and handing of chemicals to minimize workplace accidents and exposure.

Need to implement smart cleaning technologies, use automated cleaning systems, sensors, and robotics to improve efficiency, reduce manual labor, and ensure consistent quality. Introducing smart cleaning technologies – utilize automated cleaning systems, sensors, and robots to improve efficiency, reduce manual labor, and ensure consistent quality. Start applying Zero Carbon Village principles to facility cleaning by integrating sustainable practices such as energy – efficient equipment, waste reduction to achieve environmental goals.

This study proposes an integrated approach to building space cleaning that combines smart technologies, ecological sustainability, and organizational innovation to improve efficiency and quality in the cleaning sector. It emphasizes the adoption of digital monitoring systems, robotics, and data – driven planning to optimize resources and enhance productivity.

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