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Prevention of security threats in public space in the context of urban development

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Abstract. The purpose of this study was to explore effective approaches to ensuring security in public spaces of modern cities through the analysis of international practices and the integration of architectural, technological, and social solutions into urban planning. The methodology of the study was based on the conceptual framework of the smart city theory and the principles of sustainable urban development, using systematic and comparative analysis, as well as the examination of real-life examples. The study analysed a wide range of threats, including criminal, anthropogenic, natural, socio-political, and information. The findings showed that the most effective strategies are integrated strategies that combine architectural solutions, such as the "safe design" concept – prevention through Environmental Design, technological innovations such as video surveillance systems with analytical capabilities, and social initiatives such as community patrol programmes. The analysis of cases such as Amsterdam: The Transformation of Bijlmermeer and Nordic Safe Cities confirmed the significance of integrating security measures into urban planning. The findings showed that such integrated approaches not only reduce crime, but also contribute to the creation of safe and comfortable conditions for social interaction. A major factor in the success of these strategies is their adaptability to the local context and the active engagement of the public in the planning and implementation of security measures. The findings demonstrated that successful strategies must be flexible, adapted to the local context, and involve the community in the planning process. Therewith, a series of challenges were identified, including the necessity of balancing security and openness of urban space, risks of social segregation, and challenges related to privacy. The findings have implications for the development of urban planning practices, as they confirm the effectiveness of comprehensive strategies that ensure safety while maintaining the open nature of public spaces

Keywords: urbanism; social integration; architectural design; preventive measures; video surveillance; technological solutions

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Introduction

The rapid urbanisation and technological advances of the 21st century have created unprecedented challenges in ensuring public safety in urban environments. As cities continue to grow and develop, the need for effective strategies to prevent security threats in public spaces is becoming increasingly urgent. The complexity of modern urban landscapes, coupled with the integration of smart technologies and the Internet of Things (IoT), has created a multifaceted security landscape that requires innovative approaches to address potential vulnerabilities. The convergence of physical and digital infrastructures in urban environments has expanded the range of security challenges, requiring a comprehensive understanding of both conventional and emerging threats. Furthermore, the COVID-19 pandemic has highlighted the significance of incorporating public health considerations into urban security planning, adding another layer of complexity to the already daunting task of protecting urban populations. In this context, the development of robust, adaptive, and integrated security measures has become paramount to ensure the resilience and sustainability of urban communities.

Modern research has contributed greatly to addressing various aspects of urban security and development. M.A. Khaliji and K.J. Ghalehteimouri (2024) explored the impact of rapid urbanisation on social, cultural, and environmental issues in metropolitan cities, highlighting the need for better urban privacy management and collaboration among security experts. Their study highlighted the impact of factors such as diverse political perspectives and legal differences on urban security vulnerabilities. J. Laufs *et al.* (2020) conducted a systematic review of smart city security technologies, proposing a classification system for security measures based on their functions and integration with conventional policing and urban planning. The study underscored the significance of addressing both technological innovations and established security practices when developing comprehensive urban security strategies. J. Chen *et al.* (2024) investigated the relationship between urban form and crime in the United States of America, finding both linear and non-linear associations between various urban characteristics and types of criminal activity. Their findings provide valuable information for long-term urban planning and the development of safer, more sustainable urban environments. K. Kiełek (2022) focused on the determinants of safety in urban public spaces, emphasising the critical role of visibility, design, and citizen behaviour in creating safe environments. The study highlighted the necessity of collaborative efforts between residents, authorities, and urban planners to improve public safety.

P. Piroozfar *et al.* (2019) investigated the effectiveness of Crime Prevention through Environmental Design (CPTED) principles in Brixton town centre, London. Their mixed methodology approach demonstrated a reduction in crime following the implementation of CPTED measures, while also identifying ongoing stakeholder concerns for further safety improvements. L. da Silva Tomadon *et al.* (2024) conducted a bibliometric analysis of smart city and sustainability indicators, stressing the growing interest in integrating technology and sustainability to improve the quality of life in cities. The study underscored the value of developing comprehensive indicators for monitoring and managing sustainable urban development. K. Ahmad *et al.* (2022) explored the ethical and philosophical challenges associated with the introduction of artificial intelligence (AI) in smart cities, emphasising the need for human-centred approaches to technology deployment. Their study highlighted the significance of addressing safety, reliability, interpretability, and ethical issues in the application of AI in the urban environment. N.A. Megahed and E.M. Ghoneim (2021) examined the role of building design strategies in mitigating the spread of airborne diseases, especially in the wake of the COVID-19 pandemic. Their study proposed a conceptual model that combines technical control methods, design approaches, and air purification techniques. The purpose of this model is to improve the cleanliness of air inside buildings and reduce health hazards in urban environments.

P.M. Rao and B.D. Deebak (2023) addressed security and privacy issues in IoT-enabled smart sustainable city environments, focusing on authentication and key management protocols. Their study pointed out the importance of robust security measures to address the challenges posed by interconnected devices and heterogeneous networks in smart cities. Z.A. Baig *et al.* (2020) presented an intelligent system for detecting denial-of-service attacks in wireless sensor networks, demonstrating the criticality of developing advanced security mechanisms for IoT-based urban infrastructure. R. Kitchin and M. Dodge (2017) explored the paradoxical nature of smart city technologies that simultaneously mitigate and create new urban risks and vulnerabilities. Their study proposed a set of systemic interventions to address cybersecurity challenges in smart city initiatives. Finally, C. Ma (2021) provided a comprehensive overview of cybersecurity challenges in smart cities, focusing on four main components: smart grids, smart buildings, smart transport systems, and smart healthcare. The study emphasised the need for flexible systems with strong information security capabilities to prevent major security incidents and maintain public trust.

Although researchers have addressed a wide range of issues – from technological solutions to architectural planning – most studies focus on individual aspects of security, without offering a holistic, integrated approach to addressing security in the urban environment. There is no comprehensive analysis of the relationship between a variety of security measures and their combined effect on the overall level of security in urban space. Furthermore, the balance between implementing security measures and maintaining the comfortable, open nature of public spaces has been understudied; additionally, no systematic approach to assessing the cost-effectiveness of various security measures in the long term has been developed. Considering this, the purpose of this study was to identify key issues and assess the effectiveness of existing approaches to preventing security threats in public space in the context of modern urban development. The study focused on the following tasks:

1) to investigate and classify the major types of security threats in the public space of modern cities;

2) to analyse and compare international practices of applying architectural, technological, and social solutions to improve the security of public spaces;

3) to evaluate the effectiveness of integrating security measures into urban planning and development processes based on case studies.

Materials and methods

The study was based on the conceptual framework of the "smart city" theory and the principles of sustainable urban development, which involve the integration of technological, social, and environmental aspects into urban planning and management processes. The "safe design" and "integrated urban development" concepts contained in the Leipzig Charter on Sustainable European Cities (2007) also served as a theoretical framework. The study employed a combination of general scientific and special methods. The method of system analysis was used to consider the safety of public spaces as a complex system of interconnected elements, which helped to identify key factors of influence and their interaction. The comparative method was applied to compare and contrast various approaches to ensuring safety in the urban environment, which helped to identify the most effective practices and evaluate their potential for adaptation in specific contexts. Real-life projects to improve the safety of public spaces, such as Amsterdam: The Transformation of Bijlmermeer (2009) and Nordic Safe Cities (2020), were thoroughly analysed, which enabled the assessment of the practical effectiveness of diverse approaches and the identification of key success factors. The forecasting method was used to analyse trends in the global market for smart city security solutions.

The study focused on initiatives aimed at improving the security of public spaces. The regulatory framework was based on international regulations, namely European Convention on Human Rights (1950), Directive of the Council of European Union No. 2008/114/EC "On the Identification and Designation of European Critical Infrastructures and the Assessment of the Need to Improve their Protection" (2008), Revised European Social Charter (1996). These regulations considerably contributed to a better understanding of urban security issues and the significance of personal data protection in the implementation of technological innovations. The analysis was based on strategic documents, such as Sustainable Development Strategy of Latvia until 2030 (2010) and A. Morán's (2022) study, which help to integrate security measures into long-term urban planning. Documentation of projects such as Amsterdam: The Transformation of Bijlmermeer (2009) and Greater Manchester Combined Authority (2021) provided valuable insights into the practical implementation of safety measures and their effectiveness in the urban environment.

The study used data from statistical and analytical services, including forecasts for the development of security solutions in smart cities from Global Public Safety Solution for Smart City Market (2023). This enabled the study to consider the possibilities of developing technological solutions to improve security in the urban environment. Valuable information was also provided by the official websites of international organisations and projects, such as Smart Nation Singapore (2024) and the UN-Habitat: United Nations Human Settlements Programme (2024), which offered relevant data on the latest approaches to urban security. The sources used had an interdisciplinary approach, which contributed to a comprehensive analysis of the problems of public space security, combining theoretical concepts with practical experience of their implementation. This enabled a thorough analysis of the problem and the proposal of effective strategies for ensuring security in the urban environment.

Results

Research and classification of the key types of security threats in the public space of modern cities. Guaranteeing safety in the public areas of modern cities is a key challenge for governments and local administrations around the world. A comprehensive understanding and management of the various potential hazards in the urban environment provides the foundation for developing effective protection strategies and implementing adequate protective measures. In the context of rapid technological development and active social transformations inherent in modern urbanised communities, there is a strong call for regular updates and improvements to the methods of categorising security threats. European Convention on Human Rights (1950) in its Articles 2, 3, 5, and 8 sets out the fundamental principles of human security that must be ensured in the urban environment.

Directive of the Council of European Union No. 2008/114/EC (2008) defines critical infrastructure as an essential element of urban security. Specifically, Article 2(a) specifies critical infrastructure as a key part that ensures vital public functions, health, safety, security, and economic or social well-being of people and requires special protection measures. There are the following major categories of security threats in the public space of modern cities, based on the classification of the Department of Homeland Security (2023): criminal threats, which include various forms of criminal activity, from petty offences to organised crime; anthropogenic threats related to the functioning of urban infrastructure and industrial facilities; natural threats arising from natural disasters and extreme weather events; socio-political threats that may manifest themselves in the form of riots, terrorist acts, or other forms of social tension; information and cyber threats that are becoming increasingly relevant in the context of the digitalisation of urban space.

In the context of technological development, new threats associated with the introduction of modern technologies into the urban environment deserve special attention. The development of video surveillance and face recognition systems has a double effect: on the one hand, it increases the level of security, while on the other hand, it creates potential risks to the privacy of citizens. Regulation of the European Parliament and of the Council No. 2016/679 (2016) (GDPR) sets strict requirements for the collection and processing of personal data, which directly affects the use of such systems in urban areas. Specifically, Article 35 of this Regulation requires a data protection impact assessment before implementing technologies that may pose a major risk to the rights and freedoms of individuals. This calls for a balance between security and privacy in the urban environment.

With the development of the smart city concept and the introduction of IoT into urban infrastructure, the vulnerability of critical systems to cyberattacks is increasing. Directive of the of the European Parliament and of the Council No. 2016/1148 (2016) sets out cybersecurity requirements for operators of essential services, including urban utilities and transport systems. According to this Directive, cities must implement adequate technical and organisational measures to manage the risks associated with the security of the network and information systems they use in their operations.

Growing social inequality, increased migration processes, and changes in the demographic structure of urban populations can create the potential for social tensions and conflicts. Revised European Social Charter (1996) defines

standards of social rights of citizens, including the right to housing, healthcare, and social protection, which directly affects the creation of a safe and inclusive urban environment. The practical exercise of these rights requires an integrated approach to urban planning and social policy. To effectively manage risks and plan security measures, it is vital not only to identify the types of threats but also to assess their potential impact and probability of occurrence.

Safe City Index, developed by the Economist Intelligence Unit (2021), assesses the safety of cities in four key categories: digital safety, healthcare, infrastructure safety, and personal safety. Each category includes a set of indicators that enable a comprehensive assessment of the security of the urban environment. For example, the digital security category includes an assessment of the level of cyber defence of critical infrastructure, the availability of personal data protection policies, and the level of digital literacy of the population.

The Urban Resilience Framework methodology, developed under the of UN-Habitat (2024) initiative, aims to increase the ability of urban centres to withstand a variety of challenges, from natural disasters to socio-economic shocks. The approach involves a comprehensive assessment of urban systems across several key dimensions, including social well-being, economic development, infrastructure, and governance. For each dimension, a set of indicators has been developed to assess a city's preparedness for various types of threats and its ability to recover from crises. Not only the conventional aspects of physical security should be considered, but also the emerging challenges of digitalisation, climate change, and social transformation.

In the context of Latvia, which is a member of the EU, the implementation of the above-mentioned international standards and approaches to urban security is particularly relevant. Law on Local Governments (1994) provides local authorities with broad powers in the field of public order and security in the territory of municipalities. Law on Spatial Development Planning (2011) requires the integration of security aspects into the territorial planning and urban development processes.

The urban security assessment system reflects the multidimensional nature of threats and the interconnectedness of various aspects of urban security. The central element of the system is the overall security of the urban environment, which is shaped by five key components: physical security, cybersecurity, environmental security, social security, and economic security. Each of these components has its specific challenges and threats that require dedicated analysis and management. Physical security, which has conventionally been considered the core aspect of urban security, covers a wide range of threats, from petty offences to severe crimes and terrorist acts. International practices show that effective physical security requires a comprehensive approach that combines technological solutions (e.g., video surveillance systems) with social crime prevention programmes (Department of Homeland Security, 2023). The CPTED concept, which is being actively implemented in many European cities, involves the integration of security principles into architectural and urban planning design. This theory assumes that proper planning and rational use of architectural space can reduce both fears of crime and the factual number of offences, which ultimately improves the overall quality of life of residents.

Cybersecurity is becoming an increasingly critical element of urban security in the context of the development of smart cities and the digitalisation of urban services. Directive of the of the European Parliament and of the Council No. 2022/2555 (2022) sets new, stricter cybersecurity requirements for a wide range of organisations, including municipal services. According to this Directive, cities must implement comprehensive cyber threat management mechanisms. These mechanisms should address not only the technological aspects of protecting information systems, but also organisational and personnel issues. Particular emphasis is placed on protecting critical infrastructure, such as water supply, energy and transport systems, from cyberattacks.

The environmental sustainability of cities is becoming increasingly significant in the context of global climate change. Paris Agreement (2015) defines global targets for reducing greenhouse gas emissions and adapting to climate change, which directly affect urban development policies. Cities face the need to adapt to sea level rise, extreme weather events, and other climate-related risks. The programme, initiated by the Rockefeller Foundation (2013), helps cities around the world develop and implement strategies to increase resilience to various environmental and socio-economic challenges.

Social security is a key aspect of sustainable urban development. In the context of social security, special attention is paid to social cohesion, integration of migrants and refugees, and ensuring equal access to urban services and infrastructure. Manifesto For a New Urbanity: European Urban Charter II (2008) emphasises the role of social inclusion and citizen engagement in urban governance as key elements of a safe and sustainable urban environment.

The economic security of cities is intricately linked to their ability to ensure sustainable economic development and create employment opportunities for their residents. The EU's draft action plan (European Council, 2000) concerning Lisbon strategy and its successor, the Europe 2020 strategy (European Commission, 2010), set goals for creating a competitive and innovative economy, which directly affects the economic security of cities. In this context, cities are developing strategies for economic diversification, support for small and medium-sized businesses, development of innovation clusters, and investment attraction.

Integration of all these security aspects calls for a comprehensive approach to urban planning and management. The "integrated urban development" concept, set out in the Leipzig Charter on Sustainable European Cities (2007), emphasises the necessity of harmonising sectoral policies and involving all stakeholders in urban development processes. This concept implies that security issues should not be considered in isolation, but in the context of the overall socio-economic and spatial development of the city. In the Latvian context, the implementation of these international approaches and standards is based on specific national features and priorities. Sustainable Development Strategy of Latvia until 2030 (2010) identifies the creation of a safe and inclusive urban environment as one of the key priorities. The strategy emphasises the significance of integrating security aspects into all areas of urban planning and management, from infrastructure development to social policy. Latvian cities, notably Riga, are actively pursuing innovative approaches to urban security. Therewith, special attention is paid to compliance with the requirements of the GDPR (2016) on the ethical use of augmented reality technologies in public places.

These trends reflect a comprehensive approach to urban security that addresses not only technical aspects but also social, economic, and environmental factors. This approach requires close cooperation between various city services, active community engagement, and ongoing evaluation of the effectiveness of the measures implemented. A crucial element is the adaptation of international practices to local conditions, considering the specific features of a particular city or region. In this context, the exchange of practices between cities, both at the national and international levels, is of particular import. This allows for the effective implementation of innovative solutions and their adaptation to local circumstances.

International practices of applying architectural, technological, and social solutions to improve the safety of public spaces. Provision of security for public spaces in modern cities requires a comprehensive approach that combines architectural, technological, and social solutions. International experience demonstrates a wide spectrum of innovative approaches, the effectiveness of which varies depending on the cultural and socio-economic context. In the field of architectural solutions, the CPTED concept has become the cornerstone of many initiatives to improve the safety of the urban environment. This concept, developed in the US and widely adapted in Europe, is based on the principle that proper design and efficient use of the built environment can lead to a reduction in crime rates and an increased sense of security among the population.

In the Netherlands, for instance, the Police Label Secure Housing programme sets standards for secure housing design that include elements such as natural surveillance, access control, and territorial reinforcement. These principles have been integrated into national building codes, leading to a considerable reduction in crime rates in new housing developments. In the UK, Official Police Security Initiative "Secured by Design" (2024), developed by the police, offers a comprehensive approach to designing safe buildings and spaces. This initiative includes recommendations for lighting, landscaping, and building layout that promote natural surveillance and reduce opportunities for criminal activity. Notably, the effectiveness of these architectural solutions heavily depends on their integration with social programmes and technological security features.

In the area of technological solutions, video surveillance systems are still one of the most prevalent tools for ensuring security in public spaces. However, modern approaches extend far beyond mere surveillance. For example, Smart Nation Singapore (2024) foresees the introduction of an integrated system of sensors and cameras that not only record events but also analyse behavioural patterns to predict potential threats. This system uses artificial intelligence algorithms to detect abnormal behaviour and automatically alert the relevant services. Notably, the implementation of such systems requires a careful balancing act between security and privacy, which is regulated by documents such as the GDPR (2016). Global trends also confirm the rising significance of technological solutions in ensuring the security of public spaces. A vivid example of the forecast for the development of the smart city security solutions market is presented in Figure 1.

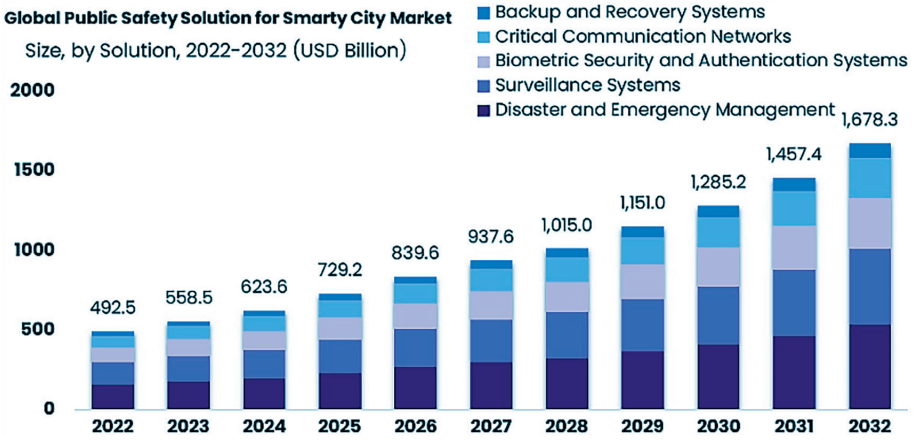

Figure 1. Development forecast for the global market of security solutions in smart cities, 2022-2032
Source: compiled by the authors based on Global Public Safety Solution for Smart City Market (2023)

Figure 1 illustrates the forecast for the global smart city security market for 2022-2032. The graph shows market growth across multiple solution categories, including backup and recovery systems, critical communications networks, biometric security and authentication systems, surveillance systems, and emergency and disaster management systems. The market is forecast to grow significantly from around USD 500 billion in 2022 to over USD 1.5 trillion by 2032. Particularly notable growth is expected in the surveillance and emergency management segment, reflecting the growing demand for integrated security solutions in urban environments. This trend highlights the relevance of investing in technology and infrastructure to improve the security of public spaces in the context of smart cities. Social initiatives play a key role in creating a safe urban environment, complementing architectural and technological solutions. The Community Policing programme (Brown, 1989) is an example of an approach that is being actively introduced in many countries, including the United States, the United Kingdom, and Scandinavian countries. This model of policing is based on active cooperation between the police and local communities to identify and address security issues in their early stages. In Denmark, for example, the State Safety Programme (SSP) (Danish Crime Prevention Council, 1998) creates a platform for cooperation between multiple institutions to prevent youth crime.

A comparative analysis of the effectiveness of diverse approaches to ensuring the safety of public spaces reveals that the most successful strategies are integrated strategies that incorporate elements of architectural design, technological innovation, and social programmes. For instance, the Xinjiang Square redevelopment project in Urumqi, China (State Council Approves Urumqi's City Plan, 2017) demonstrates the effectiveness of such an integrated approach. The project included the redevelopment of the space following the CPTED principles, the installation of a modern video surveillance system with analytical capabilities, and the implementation of public engagement programmes to increase social cohesion and responsibility for the safety of the shared space.

Notably, the effectiveness of certain approaches may vary substantially depending on the cultural and socio-economic context. For example, high-tech solutions that are successfully implemented in Singapore or Dubai may be less effective or even unacceptable in the context of European cities with their strong traditions of privacy protection. Therefore, adapting international practices to local conditions and needs is critical to successfully improving the security of public spaces. In the context of Latvia, as in other Baltic countries, special attention is paid to the balance between technological solutions and social programmes. Sustainable Development Strategy of Latvia until 2030 (2010) underscores the significance of creating inclusive and safe public spaces as a key element of sustainable urban development. This implies not only the introduction of modern security technologies, but also the active involvement of citizens in the planning and management of urban space.

Overall, global experience demonstrates that the most successful methods for enhancing public space safety are those that are integrated, flexible, and adaptable. They build a multi-layered protection system that not only reacts to threats but also actively seeks to create a safer and more inclusive urban environment by combining "hard" measures (technological and architectural solutions) with "soft" measures (social programmes and civic engagement initiatives).

Notable for their long-term effects and capacity to organically incorporate security features into the urban landscape are architectural solutions like the UK's "Secured by Design" initiative and the Netherlands' Police Label Secure Housing (Official Police Security Initiative, 2024). Through environmental design, these methods improve passive security and work especially well in large-scale urban redevelopment projects and new construction. However, they are difficult to integrate into existing infrastructure and may need a large initial expenditure.

Rapid deployment, high adaptability, and the ability to make decisions based on data are some advantages of technological solutions, as demonstrated by initiatives such as Smart Nation Singapore and Smart City Málaga (Smart Nation Singapore, 2024). These solutions work particularly well in high-risk metropolitan areas and smart cities. However, their high maintenance costs, privacy issues, and heavy reliance on dependable technical infrastructure sometimes hinder their effectiveness.

Social initiatives that promote crime prevention by active citizen participation, such Community Policing and Denmark's State Safety Programme (SSP), highlight the value of developing trust between communities and law enforcement (Brown, 1989; Danish Crime Prevention Council, 1998). Although these strategies produce long-lasting social cohesion, they take a long time to produce benefits and rely significantly on public participation. They work best in places with strong community structures or high levels of social friction, especially in small to medium-sized cities.

The benefits of integrating architectural, technological, and social measures are demonstrated by integrated plans, such as the SmartEnCity project in Europe and the rebuilding of Xinjiang Square in China (SmartEnCity, 2016; State Council Approves Urumqi's City Plan, 2017). These methods provide thorough and flexible security solutions appropriate for a variety of intricate metropolitan settings. High costs, complex coordination needs, and the need to efficiently balance multiple components, however, might make its implementation challenging. They are usually used in major metropolitan projects when long-term security planning is essential to more general development objectives. While each of these approaches has unique advantages and works well in certain situations, a comparative study of these approaches shows that integrated tactics are typically the most successful in the long run. Their strength is in integrating the advantages of each approach while addressing specific drawbacks, creating a more secure, resilient, and inclusive urban environment.

Analysis of international practices also reveals a growing trend towards the use of innovative technologies to improve the safety of public spaces. For example, in Spain, the Smart City Málaga project (European Commission, 2016) includes the introduction of smart lighting that not only optimises energy consumption but also improves safety by adaptively controlling brightness depending on the presence of people and environmental conditions. This solution demonstrates how technological innovations can simultaneously address the issues of safety, energy efficiency, and comfort in the urban environment.

Within Latvia and other Baltic states, considerable attention is focused on developing smart security approaches that consider the specifics of the region, including climate factors and historical background. For example, SmartEnCity (2016) is also relevant for Latvia, demonstrates a comprehensive approach to creating a safe and sustainable urban environment. The project includes the renovation of buildings based on energy efficiency and safety principles, the introduction of smart lighting and monitoring systems, and the active engagement of the community in urban planning and management processes. A comparative analysis of the various approaches to securing public spaces indicates that the most effective strategies are integrated strategies that combine architectural, technological, and social solutions. Such strategies enable not only the response to existing threats, but also the creation of an environment that is naturally conducive to security and social interaction. For example, the reconstruction project of the Republic square in Paris (Urban Green-Blue Grids, 2013) demonstrates how the reimagining of urban space with the CPTED principles, the introduction of modern monitoring technologies, and active community engagement can transform a previously problematic area into a safe and attractive public space.

Overall, the analysis of international practices of applying architectural, technological, and social solutions to improve the safety of public spaces highlights the necessity of a flexible and adaptive approach. Successful strategies are characterised by the ability to integrate diverse types of

solutions, consider the local context, and actively involve the community in the planning and implementation of security measures. In this context, the experience of Latvia and other Baltic countries can be particularly valuable for understanding how small and medium-sized cities can effectively adapt and implement best practices for securing public spaces in the face of limited resources and specific regional challenges.

Assessment of the effectiveness of integrating security measures into urban planning and development processes. Amsterdam: The Transformation of Bijlmermeer (2009) is an illustrative example of an integrated approach to the transformation of a problematic urban area using the principles of safe design. The core components of the project included the reorganisation of residential areas following the principles of natural surveillance and access control, the introduction of multifunctional land use, the adoption of the "living streets" concept with active ground floor façades, and the development of a network of safe routes for pedestrians and cyclists. Particular emphasis was placed on incorporating security measures into architectural solutions in a way that did not cause a sense of excessive surveillance or restriction of freedom of movement. An essential element of the project was the active engagement of residents in the planning and decision-making processes, which helped to reinforce social cohesion and responsibility for the shared space. Particular emphasis was placed on incorporating security measures into architectural solutions in a way that did not cause a sense of excessive surveillance or restriction of freedom of movement. An essential element of the project was the active engagement of residents in the planning and decision-making processes, which helped to reinforce social cohesion and responsibility for the shared space. Following the redesign, reported crimes in Bijlmermeer fell by approximately 50% between 1995 and 2005, including significant reductions in violent crime and burglary (Amsterdam: The Transformation of Bijlmermeer, 2009). Additionally, surveys conducted post-renovation showed a marked increase in the perceived safety among residents, with over 70% indicating they felt safer in their neighbourhoods compared to before the transformation. The evaluation of the Bijlmermeer project shows a substantial improvement in objective safety indicators and subjective sense of security among residents, as well as a positive impact on the economic development of the area.

Another noteworthy example in urban development is the strategic planning of Future Melbourne in Melbourne, Australia. According to A. Morán (2022) the Future Melbourne's strategic planning, a comprehensive approach to preventing security threats in public spaces was implemented. One of the key aspects of the strategy was the installation of smart technologies, such as networks of surveillance cameras with analytical capabilities and sensors integrated into the city's infrastructure. This enables not only real-time monitoring but also data analysis to identify risks and optimise the urban environment. Melbourne experienced a 9.8% decrease in crime rates between 2017 and 2021, coinciding with the implementation of these smart technologies (Victoria Police, 2022). Pilot zones equipped with surveillance innovations saw faster police response times and a 15% reduction in theft-related crimes. An integral element of the process was the involvement of an interdisciplinary team consisting of city planners, security experts, IT specialists, and community representatives, which ensured that technology was integrated with ethical and privacy concerns. Pilot projects in selected districts helped to evaluate the effectiveness of the innovative solutions and make the necessary adjustments before scaling them up to the city level.

Another case is the Project Safe Neighbourhoods (Sampson, 2019), which is being implemented in Columbia, South Carolina, within the framework of the national Project Safe Neighbourhoods (PSN) initiative. The project aims to reduce security threats in urban public spaces through the implementation of integrated solutions that address a variety of risks, including criminal, anthropogenic, natural, and cyber threats. Columbia observed a 17% reduction in gun-related crimes between 2017 and 2019 during the rollout of PSN tools such as ShotSpotter, body-worn cameras, and license plate readers (Sampson, 2019). The U.S. Department of Justice reported that the implementation of NIBIN technology helped reduce firearm recidivism and facilitated more successful prosecutions of repeat offenders. The primary goal of the project is to create a safe environment for citizens through modern monitoring technologies, such as video surveillance, analytical software, and tools such as ShotSpotter, which detects gunshots, as well as a network of cameras, including body-worn cameras (BWCs) and automated licence plate readers (LPRs).

Modernisation of the city's infrastructure includes improved lighting, surveillance areas, and safe transport routes, following the principles of projects such as Ceasefire Columbia. Another vital element is the use of personal data protection principles according to European standards, such as the GDPR (2016), which ensures the protection of citizens' privacy in the monitoring and information exchange processes. The project also supports the active engagement of citizens in reporting incidents through mobile platforms, which improves cooperation with law enforcement agencies and increases their efficiency. For example, the use of National Integrated Ballistic Information System (NIBIN) data provides a better insight into the threats posed by firearms. A key aspect is partnerships between local authorities, businesses, and civil society organisations to coordinate efforts and share security data. These partnerships are designed to build trust in the community and ensure that information technology is integrated to fight crime.

Nordic Safe Cities (2020) is an example of a comprehensive approach to preventing security threats in the urban environment, tailored to the specific features of urban development. The project encompasses various aspects of urban security, including combating online hate, countering disinformation, engaging youth in promoting inclusiveness, and expanding local security alliances. According to the Sweden Hate Crime Report 2020 (2020), there has been a 20% drop in youth-involved hate crimes between 2015 and 2020, partly attributed to proactive school programmes and social outreach embedded in this initiative. Key elements of the project include the implementation of a strategy to prevent violent extremism through proactive measures aimed at work with schools and social services, visits to families of new parents, awareness-raising in kindergartens, and cooperation between social services and schools to identify threats. The project pays special attention to the development of urban intervention teams and rehabilitation programmes for individuals seeking to leave extremist environments. Stockholm is also focusing on increasing the

competence of city services, developing individual action plans for each district and implementing special programmes to prevent right-wing extremism, including cooperation with the police and educational activities for strategic units of the city. A balance is also struck between the effectiveness of security measures and the protection of citizens' privacy, which is reflected in the development and implementation of special data processing and storage protocols according to the requirements of the GDPR (2016).

Greater Manchester Combined Authority (2021) is a key element of the city's comprehensive strategy for the development of the city and the safety of public spaces. It aims to reduce crime in high-risk areas, with a particular focus on protecting women and girls in public spaces. According to Greater Manchester (2021), the initiative led to a 12% decline in public space crimes against women within two years of implementation. Areas with enhanced lighting and surveillance saw notable decreases in harassment reports, while community feedback indicated a rise in perceived safety, especially in transit areas and public parks. Under this initiative, a series of measures have been implemented to improve safety on transport routes, including better lighting at bus stops and the introduction of modernised video surveillance systems. This allows for more effective monitoring of traffic, improving the ability of the police and other services to respond quickly to incidents. Specifically, the installation of surveillance cameras with instant image sharing between transport management systems and local authorities is an effective element of the programme, which enables better monitoring of public spaces and prompt intervention. "Safe hubs" are also being created – spaces where people can get help. Furthermore, public education campaigns and staff training are being implemented to raise awareness of harassment and other threats.

The analysis of these cases reveals a series of key factors that influence the effectiveness of integrating security measures into urban planning and development processes. Firstly, it is an integrated approach that considers the relationship between the physical environment, technological solutions, and social programmes. Successful projects, such as Amsterdam: The Transformation of Bijlmermeer (2009) and Future Melbourne (Morán, 2022), demonstrate the synergy between architectural solutions that facilitate natural surveillance and access control, technological systems for monitoring and analysing the situation, and social initiatives aimed at increasing public engagement and responsibility. Secondly, it is critical to actively engage the community at all stages of project planning and implementation, which not only increases the effectiveness of safety measures but also promotes a sense of ownership and responsibility for the shared space among residents, as evidenced by Greater Manchester Combined Authority (2021). Thirdly, successful projects are characterised by flexibility and adaptability, which allows for adjustments to safety measures according to changes in the urban environment and emergent challenges, as is particularly evident in Nordic Safe Cities (2020) approach. An essential aspect is also to ensure the long-term sustainability of security measures, which requires not only adequate funding, but also the development of local capacity to manage and maintain the implemented systems.

At the same time, the analysis also reveals potential obstacles to integrating security measures into urban planning. One of the key challenges is balancing security and openness of urban space, as an overemphasis on security measures can lead to the creation of "fortified" spaces that, although safe, lose their attractiveness and vitality. This issue is particularly relevant for projects that implement large-scale technological solutions, as in the case of Melbourne. Another issue is the risk of social segregation, when security measures are disproportionately applied in certain areas of the city, creating a sense of "safe islands" in a "dangerous sea". Another major challenge is to strike a balance between technological solutions and the protection of citizens' privacy, especially in the context of the use of video surveillance and data analysis. In this context, the development and implementation of clear legal frameworks and ethical standards for the use of technology to ensure urban security.

Based on this analysis, a series of recommendations can be offered regarding best practices for integrating security into urban planning and development. First, it is vital to ensure early integration of security issues into urban planning processes, starting with strategic planning and the development of city master plans, as was the case in Melbourne. This allows considering the security aspects at the systemic level and avoiding the need for expensive and often ineffective "retrofit" solutions. Second, it is recommended to use the Security by Design approach, which involves integrating security elements into architectural and urban planning solutions in a fashion that blends seamlessly into the urban environment and does not create a sense of excessive control, as was implemented in Amsterdam: The Transformation of Bijlmermeer (2009). Third, it is essential to develop mechanisms of public participation and co-design in urban security issues, which allows considering the genuine needs and concerns of residents and increasing the effectiveness of security measures, as evidenced by Greater Manchester Combined Authority (2021). Furthermore, it is recommended to develop cross-sectoral cooperation and exchange of practices, both at the national and international level, which is particularly relevant in the context of emerging challenges such as cybersecurity of urban infrastructure or climate.

Discussion

The study of security in public urban spaces identified key factors that substantially affect urban planning and management. The results suggest the necessity of a comprehensive approach to urban security that is consistent with modern urban concepts. A valuable finding is the need to integrate technological solutions into urban infrastructure to enhance security. This is consistent with the findings of Y. Cai *et al.* (2021), who emphasise the value of smart urban systems in crime prevention and public safety. They found that the introduction of smart surveillance and data analytics systems can significantly reduce crime in urban areas. The current findings extend this understanding by demonstrating how such technologies can be effectively integrated into the existing urban fabric without compromising citizens' privacy. At the same time, a prominent aspect is the emphasis on social cohesion as a key factor in the safety of the urban environment. F.M. Calamunci and F.F. Frattini (2023) support this idea in their study of the impact of social capital on crime in urban areas. The present findings confirm the conclusions of these researchers, showing how targeted measures to increase social cohesion can be integrated into urban development strategies to create safer public spaces.

The data analysis also revealed the significance of adaptive urban design for safety improvement. This is consistent with the findings of K.G.N.U. Rannaweera (2024), who emphasised the role of "flexible" urban spaces in promoting positive social interaction and reducing opportunities for criminal activity. The current study showed how adaptive design can be applied not only to new projects, but also to the renovation of existing urban areas. The issue of lighting as a security factor is echoed in the study by A. Chalfin *et al.* (2022). The researchers found a considerable reduction in crime rates in areas with improved street lighting. The data obtained supports these findings, demonstrating how intelligent lighting systems can be integrated with other security measures to create a comprehensive approach to securing public spaces. An essential aspect is the consideration of the role of public engagement in ensuring the safety of the urban environment. This theme echoes the findings of J.R. Sampson (2019), who emphasised the value of collective efficiency in crime prevention. This is supported by the present findings, which show how active community input into the planning and implementation of security measures can greatly increase their effectiveness.

Equally necessary is the importance of addressing gender-related aspects in the planning of safe urban spaces. This is consistent with the study by C. Listerborn (2020), who examined the issue of urban security from a gender perspective. The obtained results complement his study by presenting concrete strategies for integrating a gender-sensitive approach into the overall structure of urban security. Z.S. Venter *et al.* (2022) confirmed the issue of using green areas to improve the safety of the urban environment. Researchers found a positive impact of urban green spaces on reducing crime and increasing the sense of safety among residents. The current findings demonstrate how strategic planning of green spaces can be integrated into the overall city security strategy. Another major aspect is the consideration of the impact of urban mobility on safety. This theme resonates with the study by M. Chanieabate *et al.* (2023), who investigated the relationship between transport infrastructure and safety in urban areas. The data suggests that integrating safety measures into transport system planning can create safer urban environments.

The significance of cultural and artistic initiatives in creating safe urban spaces was also noted. This is consistent with the study by J. Sharp *et al.* (2005), who examined the role of public art in strengthening social cohesion and increasing community safety. The study showed how cultural projects can be integrated into urban security strategies to create more inclusive and safer public spaces. The issue of economic development as a factor of urban security is echoed in the study by M.K. Anser *et al.* (2020). Their study found a link between economic inequality and crime rates in urban areas. This is supported by data that demonstrates how economic development strategies can be integrated into the overall urban security framework to create more stable and safer communities.

Another aspect is the importance of intersectoral cooperation in ensuring the safety of urban space. This is consistent with the study by C.B. Sanders and D. Langan (2019), who examined the role of partnerships between various city services in improving safety. The findings indicate concrete mechanisms for implementing such cooperation in practice to maximise its effectiveness. The issue of using data and analytics to predict and prevent security threats is confirmed by S. Egbert and S. Krasmann (2019). The researchers showed the potential of predictive analytics to reduce crime rates in urban areas. The current findings illustrate how such technologies can be ethically and effectively integrated into urban security systems. A prominent aspect is the consideration of the impact of architectural design on the safety of the urban environment. This subject resonates with the study by E. Shyshkin and A. Pankeieva (2024), who investigated the "protective space" principles in urban planning. This is supported by the data obtained, which show how modern architectural solutions can be integrated into the existing urban fabric to improve safety without creating a "fortress" atmosphere.

A need has arisen to factor in the psychological aspects of how people perceive security in the urban environment. This is in line with the findings of J. Wang *et al.* (2019), who studied the relationship between the physical environment and subjective sense of security. The current findings expand on this idea by showing ways to create urban spaces that are not only factually safe, but also perceived as such by residents. The study also highlighted the significance of a comprehensive approach to urban safety that accommodates the needs of diverse population groups. This is consistent with the findings of O. Demirbilek (2020) on the impact of inclusive design on safety and quality of life in urban areas. The obtained results suggest concrete methods for integrating inclusive practices into the overall urban security system. Another key aspect is the consideration of the role of artificial intelligence and the IoT in improving the safety of the urban environment, which echoes the study by N.V. Doohan *et al.* (2022), who explored the potential of AI-based systems to prevent and respond to security threats in cities. The data demonstrates how such advanced technologies can be integrated into existing urban systems while respecting citizen privacy and ethical standards.

The study highlighted the importance of a comprehensive, interdisciplinary approach to ensuring security in urban spaces. It showed that effective strategies for preventing security threats should incorporate technological, social, economic, and psychological factors. The findings are consistent with current trends in urban studies, but also offer fresh perspectives and practical recommendations for urban planners and policy makers. Specifically, the study pointed to the value of balancing technological solutions with social initiatives, emphasising the role of public engagement and social cohesion in creating secure urban spaces. The study also found that effective security strategies must be adaptive and accommodate the specifics of each urban area, which is also consistent with the findings of W. Salet and J. de Vries (2019) on the significance of contextualised approaches to urban security.

The study also highlighted the need to integrate security measures into broader urban development strategies, including economic, cultural, and environmental initiatives. This is in line with the "resilient cities" concept developed by F. Aram (2024) and demonstrates how security can form an integral part of the overall sustainable development of urban spaces. Further research could focus on the long-term effects of implementing such integrated strategies and adapting them to various cultural and socio-economic contexts, as well as developing methodologies to evaluate the effectiveness of integrated approaches to urban security at varying scales, from neighbourhoods to entire cities.

Conclusions

The subject of this study was the primary types of security threats in the public space of modern cities and international practices of applying architectural, technological, and social solutions to improve the security of public spaces. The study successfully fulfilled its purpose by conducting a comprehensive analysis of these aspects and evaluating the effectiveness of integrating security measures into urban planning and development processes.

The analysis of legal regulation indicates that ensuring the safety of public spaces in modern cities requires a robust and multi-layered legal framework. Important international and European legal instruments that define the responsibilities of state authorities and private entities involved in urban security include conventions, regulations, and directives. These normative acts establish a balance between security and fundamental rights, particularly regarding freedom of movement, privacy, and personal data protection. At the municipal level, the provisions of these international documents are implemented through national legislation, such as laws on local self-government and spatial planning, which promote the integration of security aspects into urban and territorial development programmes. Furthermore, the legal framework mandates conducting risk assessments when implementing video surveillance systems and other technologies that handle large volumes of data, as well as supports the application of "safe design" approaches in planning processes. However, the study identified issues related to inconsistent application of norms, fragmentation of legislation, and insufficient regulation of the integration of advanced technologies such as artificial intelligence and the IoT into existing legal frameworks.

The study findings showed that integrated strategies that combine architectural, technological, and social solutions are most effective. Such an integrated approach allows not only responding to existing threats, but also creating an environment that naturally promotes security and social interaction. A prominent aspect of successful strategies is their flexibility and adaptability to the local context, as well as the active engagement of the community in the planning and implementation of security measures. The study also identified potential challenges in integrating security measures into urban planning, including the need to balance security and openness of urban space, the risks of social segregation, and challenges related to the protection of citizens' privacy.

The findings obtained substantially influence the development of the theory and practice of urban planning and security management in public spaces. They emphasise the necessity of applying an interdisciplinary approach to solving urban security problems and the significance of considering the local context when adapting international practices. Promising areas for further research in this area include investigating the long-term effects of integrated security strategies on the socio-economic development of cities, studying the impact of the latest technologies (such as AI and the IoT) on urban security, and developing methodologies for assessing the effectiveness of security measures that consider both objective and subjective indicators.

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Попередження загроз безпеці в публічному просторі в контексті розвитку міст

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Анотація. Метою цього дослідження було вивчення ефективних підходів до забезпечення безпеки в громадських просторах сучасних міст через аналіз міжнародних практик та інтеграцію архітектурних, технологічних і соціальних рішень у міське планування. Методологія дослідження ґрунтувалася на концептуальних засадах теорії «розумного міста» та принципах сталого розвитку міст, із застосуванням системного та порівняльного аналізу, а також вивченням прикладів з реального життя. У дослідженні проаналізовано широкий спектр загроз, включаючи кримінальні, техногенні, природні, соціально-політичні та інформаційні. Результати показали, що найбільш ефективними є комплексні стратегії, які поєднують архітектурні рішення, такі як концепція «безпечного дизайну» – запобігання через екологічний дизайн, технологічні інновації, такі як системи відеоспостереження з аналітичними можливостями, та соціальні ініціативи, такі як програми громадського патрулювання. Аналіз таких випадків, як Амстердам: трансформація Бейлмермеєра та Північні безпечні міста, підтвердив важливість інтеграції заходів безпеки у міське планування. Результати показали, що такі комплексні підходи не лише зменшують рівень злочинності, а й сприяють створенню безпечних і комфортних умов для соціальної взаємодії. Важливим фактором успіху цих стратегій є їх адаптивність до місцевого контексту та активна участь громадськості у плануванні й впровадженні заходів безпеки. Дослідження продемонструвало, що ефективні стратегії повинні бути гнучкими, враховувати локальні особливості і залучати спільноту до процесу планування. Водночас було визначено низку викликів, серед яких необхідність балансування безпеки та відкритості міського простору, ризики соціальної сегрегації та проблеми, пов'язані з приватністю. Отримані результати мають важливе значення для розвитку практик міського планування, оскільки підтверджують ефективність комплексних стратегій, які забезпечують безпеку, зберігаючи відкритий характер публічних просторів

Ключові слова: урбанізм; соціальна інтеграція; архітектурне проектування; превентивні заходи; відеоспостереження; технологічні рішення