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Urban nightscapes and lighting master plans. Case study of Liepāja

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Abstract. Development of modern technologies and urbanisation enable cities to provide a broad range of services even at night, which means that the nightscape is becoming more used. The goal of the study is to develop recommendations for planning the night-time outdoor space and its elements in an urban environment, with a view to improve the functional and aesthetic quality of the city, and to reduce light pollution. To achieve this goal, the authors studied theoretical materials, analysed the experience of three cities in developing lighting plans, conducted field research and made photographic records to assess various areas, compiling and creating a visual representation of the results. The city-level focus in solving night-time cityscape problems is on the drafting of lighting master plans. Using such plans, one can spur tourism and economic growth, and improve the quality of life among the locals. On the level of the city, elements such as edges, neighbourhoods, roads, landmarks, viewpoints and nodes play an important role at night. One has to identify these elements and highlight them based on the recommendations developed. The proposed development of a Liepāja city lighting plan would strengthen the city's identity, improve the safety of the night-time use of outdoor spaces, facilitate navigation, and create aesthetically pleasing views. Furthermore, this is an opportunity to reduce light pollution and transition to sustainable solutions through the use of various smart technologies associated with lighting.

Key words: nightscape, urban landscape, lighting master plan, artificial lighting, light pollution

Introduction

Night-time landscape (nightscape), just like day-time landscape, can be considered a part of urban landscape as a whole. The difference between them is in the transition from natural lighting to artificial lighting [23]. Just like people, cities function in day and night modes. Over time, urban environments have developed to have a 24-hour cycle of activity, which also affects local residents. Advances in technology, travel between different time zones, availability of services and entertainment: all of this and more have extended the time of human activity beyond the usual constraints [5; 10]. With the increasing duration of night-time use of urban spaces, and the number of the users, the issue of the aesthetic and functional qualities of these outdoor spaces is becoming ever more relevant. Studies of night-time cityscapes and lighting only became common with the invention of electricity in the second half of the 19th century [23]. Today, we can observe a lack of balance in the studies that look at daytime and night-time subjects. While day-time cityscapes are well-studied, nightscapes enjoy little attention [5; 10].

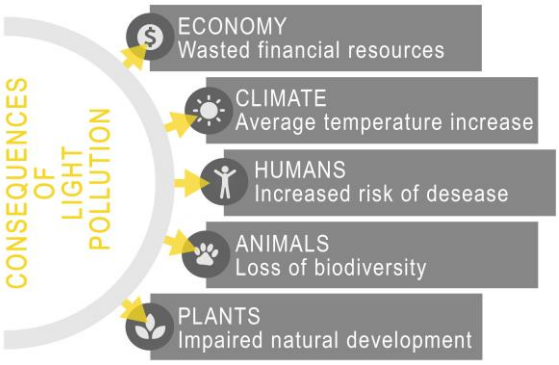

Fig. 1. Consequences of light pollution [8]

With the spread of lighting technology, people have developed positive associations with light, as a representation of the growth and economic well-being of humanity. Various religions and philosophic frameworks view light as standing for everything that is good and proper, for God, while darkness is a manifestation of evil, sin, and the Devil. Light means safety, comfort, and beauty. Darkness means fear, uncertainty, and ugliness. The compulsion to fight darkness is almost a subconscious need among humans, which has been around since the discovery of fire. These factors are often the cause of inefficient use of artificial lighting in outdoor spaces, leading to a new environmental problem: light pollution [1; 18]. According to a "World Atlas of Artificial Night Sky Brightness" created in 2016, some 80% of the Earth's population lives under a light-polluted sky [6]. Figure 1 shows the fields, in which light pollution creates undesirable effects, including the economy, climate, and living organisms (humans, animals, plants).

The behaviour of almost all living organisms depends on the rotation of our planet, and the corresponding night-and-day cycle. Thousands of years ago, our ancestors realised how important the celestial bodies were, and began worshipping them.

To this day, the ancient role of these celestial bodies echoes in the lives of humans, for example the seven days of the week representing the seven brightest objects in the sky (the sun, the moon, and the five planets visible with an untrained eye). The starry sky has served as an inspiration and foundation for mythology, religion, navigation, and scientific discoveries. In its own way, the night sky is a museum of nature and culture, where one can see planets and constellations, enjoyed before by countless generations. Even though the symbols may differ, the sky is a uniting element for various cultures and people [4; 19; 20].

The ability to observe the night sky and see an infinity of stars and galaxies above us: these are the dimensions of space and time that we can only comprehend in an abstract way. This view does not leave anyone indifferent; it inspires and elicits a feeling of awe. The night sky is a requirement for the development of human consciousness. Without the starry sky visible, one cannot realise that humans are a part of the cosmos [18; 20]. Today, we associate sights of the true night sky with being in nature, something only accessible outside the urban environment. Even though this is a good thing for developing reserves with an unpolluted dark sky, it is worth remembering that this way, we unconsciously lay a strict boundary between nature and the urban environment. Returning the night sky to the city can be viewed as a form of urban renewal. It is a process, as part of which one can synchronise the city's appearance with the night-and-day cycle and bring nature back to the city [20].

The recommendations for preserving biodiversity, reducing negative effects on human health, and preventing rapid climate change can be divided into three categories:

Elements of lighting. Elements with direct diffusion of light are recommended. Elements that insects cannot get into must be preferred. Lighting must only be used where it is really necessary, and one must confirm that the emitted light achieves its intended goal. The possibility of light reflecting from various surfaces (roads, walls, windows) must be reduced.

Planning of lighting. It is recommended to develop guidelines for the maximum permitted level of brightness, in order to set areas where lighting is a priority at night, as well as areas where preserving views of the starry sky is important. Development of lighting master plans in urban planning and establishing partnerships with the private sector are recommended. Smart lighting systems must be used wherever possible.

Society. It is necessary to inform the public of the problem of light pollution and remind it of the significance of the starry sky at night, for example, by setting up night sky observation parks and promoting astronomy [1; 18; 19].

A lighting master plan is a basis for the strategy and development of urban lighting. It is a comprehensive, high-level planning document that consists of a review of the current situation, as well as creative and technical sections. It could also be referred to as a darkness plan. The plan takes into account the geographic, environmental, historical, cultural, and social contexts, as well as the needs of people. The creative section of the plan is there to cover the visual part, offering lighting solutions that would be a good fit with the cityscape. The technical section sets the lighting standards and criteria, as well as recommendations and guidelines for technical solutions. Plans do not always encompass the entirety of the city, instead sometimes focusing on the most important areas [2; 16].

Professionals in three fields are responsible for developing outdoor lighting scenarios: urban lighting designers, architectural lighting designers, and urban lighting planners. However, specialists in other fields participate in the development of the lighting master plan, to achieve a better result, and one of these is the landscape architect [2]. Given the current situation in Latvia where the profession of lighting designers and planners is not particularly well-developed, it is the architect or landscape architect working in conjunction with the engineer designing the electric lines who usually plans the layout of outdoor lights [3].

A good lighting plan is adapted to the individual nature of the environment, creating harmony in the nightscape and providing a link with the dayscape. The architecture and urban planning of the location should function as the foundation of the lighting concept [15]. The approaches and interpretations in the development of the plans are different, but in most cases, the goal is the same: to revitalise the areas and create accents in the urban environment through the use of artificial lighting [16].

The goal of this study was to develop recommendations for planning the night-time outdoor space and its elements in Liepāja, with a view to improve the functional and aesthetic quality of the city, and to reduce the light pollution in it.

Methodology

The theoretical part of this study contains information about the lighting master plans adopted in European cities. The experience of three cities—Jyväskylä, Ghent, and Strasbourg—in developing lighting plans was analysed.

The empirical part includes a review of the current situation with the night-time cityscape in Liepāja. The city-level study was based on determining the elements forming the image of a city defined by Lynch [17]. First, the objects marking the city edges were identified, as they matter not only in setting the boundaries of the city as a whole, but also in defining its individual neighbourhoods. Second, the neighbourhoods to be considered, and their special features, were defined. Third, key access routes for

the city, transport-related access points, and links between neighbourhoods were determined. Fourth, the points of night-time activity were identified. Finally,
a summary was prepared of the principal landmarks and viewpoints that help with navigating the outdoors. In addition to the identification of the elements, the authors offer recommendations for developing them in the context of the night-time cityscape. A Liepāja lighting master plan proposal was submitted.

Results and Discussion

Case study analyses

Jyväskylä, Finland. Jyväskylä is the seventh largest city in Finland with 142 thousand residents. The first lighting master plan there was developed in 2000, based on an in-depth study of the city. Currently, the city has more than 100 objects with individual lighting [15; 22].

The lighting solutions are largely focussed on the city centre, encouraging people to go there, although attention is also paid to central parts of neighbourhoods. Lit viaducts and bridges stand out against the background of the city, and at night, they function as gates and landmarks for it. Lit high-rise buildings also offer much help navigating the city, and so do the city theatre, church and council buildings provided with more discreet lighting. Attention is paid to the green zone arranged in a circle around the centre of Jyväskylä, consisting of parks and nature areas. The city's residents use the green belt for outdoor activities at night. The "City of Light" urban lighting development project is ongoing in the city, involving various events with light installations [15].

The city works on communicating with private owners of buildings in requiring them to obtain approvals for changes in the lighting of the buildings, so that the overall appearance of the city at night is uniform and achieves the goals of the lighting master plan. Information materials have been made, and a new lighting plan is currently in the works: visually simpler, it should be clear to anyone interested in the topic. A study of the public's attitude towards the lighting solutions conducted by the local government in 2009 resulted in 90 % positive reactions, supporting the lighting plan, while 83 % of the respondents pointed out that the lighting improved the visual image of Jyväskylä, presenting it as a modern city [15; 22].

Ghent, Belgium. Ghent is known as a city of knowledge and culture. Its population reaches 260 thousand. Ghent's first lighting plan was developed in late 1990, with a focus on the city centre. The second lighting plan came in 2006, with attention aimed at neighbourhoods and emphasising their identities. It was found that neighbourhoods did not need new night-time landmarks, because those already existed, just on a smaller scale, and the only task remaining was to provide them with proper lighting [15].

Ghent's artificial lighting elements can be divided into three categories: functional street lighting, mood lighting for building facades and pedestrian streets, and monument lighting. Only the functional lighting works continuously, while decorative lights stay on between twilight and midnight, not including certain monuments that emphasise the city's identity. These categories interact with one another, creating a single, balanced image of the night-time cityscape. Mood lighting acts as a link between functional and monument lighting [15].

The development of lighting master plans has brought additional benefits to the city. Stronger identity, incentives for night-time business activities and tourism, as well as better safety. However, rapid advances in new technologies, which can be used by private businesses, are noted as a threat to the night-time cityscape. The lighting plan and the overall uniform image of the city that takes years of work can easily unravel. One must strike a balance between the big (overall lighting plan) and the small (local businesses) [15; 21].

Strasbourg, France. Strasbourg is a city in northern France, with a population of 281 thousand. The first lighting master plan there saw development in 1990. Strasbourg's nightscape creates a sense of belonging among its citizens and attracts tourists. The main focus is aimed at architecture and creating transition areas, as well as nodes. The strategy rests on six principles: environmentally friendly lighting in terms of energy consumption and light intensity; emphasising the historic heritage of the city; highlighting its modern identity and being a part of Europe; bringing out different neighbourhoods, with particular attention paid to special outdoor areas; creating connections between neighbourhoods to foster mobility and unity; protecting natural areas, by reducing light pollution [15].

Warm white lighting, combined with more traditional elements, is used in the central part of the city. Attention is paid to historic flavour, with restrictions in place limiting advertising signs with lighting in the centre of Strasbourg. More modern amenities can be found in the European district, which houses the European Council and Parliament. Everyday and seasonal lighting sees use during various celebrations. Connections between neighbourhoods are a particular focus of the city's lighting master plan. Interactive, original, and integrated lighting solutions have been created, improving the sense of security among locals, and creating points of attraction [15].

The examples of good practice reviewed make it possible to identify four common items used in the development of night-time cityscapes, see Figure 2. First, it is the lighting of the objects significant and

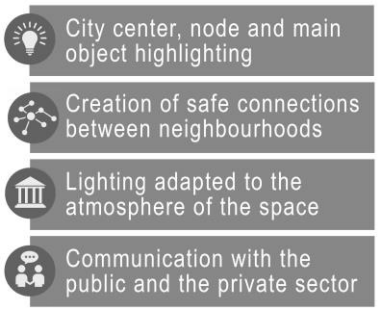

Fig. 2. Main elements of city nightscape planning

[created by the author, 2021]

recognisable in the city. Emphasising such objects at night makes it easier to navigate through the city and strengthens its perceived identity. Second, it is the creating of safe mobility connections between neighbourhoods, and the emphasising of neighbourhood centres and nodes, in order to cultivate a sense of belonging among the city's residents. Third, it is the use of custom lighting elements in historic locations, and locations with a special and different atmosphere. Fourth, it is communication with the private sector and the public. All parties involved in the life of the outdoor spaces in the city must participate in creating its common night-time cityscape image.

Liepāja case study

Liepāja, referred to as the city of winds, is Latvia's third largest city, with almost 68 thousand residents in 2021. The total area of the city is 68.0 square kilometres, of which 16.7 are covered by bodies of water. Across the year, daytime takes up ~51.4 % of the 24 hours, twilight ~22.6 %, and night-time ~26.0%. Given that artificial lighting normally turns on during twilight, one can essentially view the ratio between daytime and night-time cityscapes across a 24-hour period as 1:1.

Between 2011 and 2014, the local government in Liepāja conducted a major lighting project, 'Modernisation and reconstruction of the street lighting system in Liepāja'. As part of the project, lighting was improved in 366 streets in Liepāja, with a total length of 168 kilometres. 4738 new lights were installed, 5.5 kilometres of streets were reconstructed, 2.4 kilometres of bicycle paths were built, and 140 trees were planted. The new lighting system provides data about individual lights and makes it possible to adjust their intensity. 'Round 2 of Liepāja lighting system modernisation' took place in 2014 and 2015. In 2020, the total number of lights in the city was 7600, of which 800 were still old. LED technologies have been used installing new lights in recent years [7; 12; 14].

In regulatory terms, the requirements set for the lighting are minimal. In the Liepāja municipal plan developed in 2012, lighting is mentioned in only two items of the Land Use and Development Regulations (TIAN) [13]. In 2015, as part of the 'Development of Liepāja beach and coastline' thematic planning, a lighting concept was prepared for the north and south beach zones. Lighting serves as a connection between the beach exits and the city streets. The use of both functional and decorative lighting was proposed, depending on the features of the surrounding landscape [11]. Another notable special occurrence associated with lighting is the 'Izgaismotā Liepāja' ('Lit Liepāja') event that took place in 2020. A city-wide recreational walking route with more than 20 light objects was an appropriate solution in a time when pandemic restrictions defined how people were allowed to use outdoor spaces. The event received an excellence award by Latvijas Pasākumu Forums. It attracted considerable interest, and plans are in place to hold another 'Izgaismotā Liepāja'.

In recent years, the interest in night-time urban spaces and lighting solutions has been notably rising in the city. There is awareness of the economic benefit of using smart technologies, as well as the cultural aspect of night-time activities and their potential to promote tourism. The pertinent regulatory requirements are general in nature. According to these, lighting must be adapted to the existing urban space. However, no specific types of urban spaces are defined, offering no guidelines for lighting them (this does not include the beaches and the coastline, for which a lighting concept has been developed).

The following elements defining the image of Liepāja were determined as part of the research:

Edges. Water elements expressed in a linear fashion are used to set the boundaries of Liepāja. To the West, it is the Baltic Sea, and to the East, Lake Liepājas. In the North, the boundary is formed by the Tosmare nature reserve, and Lake Tosmares within it, while in the South, by Pērkones Canal.Three additional edge-forming elements can be found within the city, namely Tirdzniecības Canal, Karostas Canal, and the railway line. The internal elements are decisive in the division of neighbourhoods discussed below. In the context of night-time urban spaces, particular attention should be paid to Tirdzniecības Canal and Lake Liepāja, as locations, from which the lit skyline of Liepāja is visible. Even though the linear-shaped water elements form physical barriers between different areas, such open views can create mental connections. An inspection of the Liepāja skyline visible from the northern bank of Tirdzniecības Canal during the day and at night shows that at night, the top of the steeple of the Holy Trinity Cathedral blends in with the sky at night, and so does the 'Lielais dzintars' concert hall. In contrast, the facades of flat blocks are brightly lit. In developing the night-time skyline of the city, one should strive to achieve an opposite effect, emphasising public buildings and their elements, and not residential buildings. Given that the work to improve Kārļa Zāles Square has begun, it is possible to provide lighting to its elements in the future, to move attention away from the residential buildings, see Figure 3.

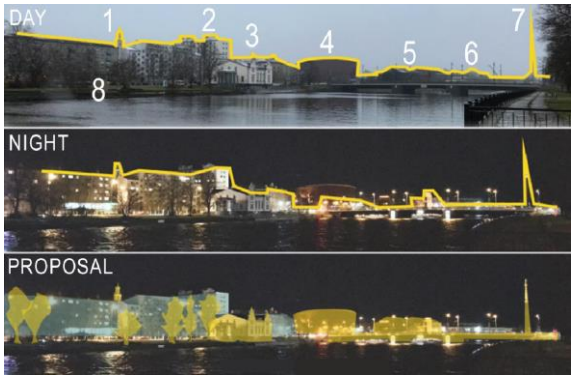

Fig. 3. City skyline view from the northern bank of Tirdzniecības Canal: 1 – Holy Trinity Cathedral; 2 – Flat blocks; 3 – Libava Hotel, 4 – 'Lielais dzintars' concert hall, 5 – Promenade Hotel, 6 – Tramvaja Bridge, 7 – Radio and television tower; 8 – Kārļa Zāles Square [8]

Recommendations for developing edge-forming elements in the city in the context of night-time cityscape:

- Create dark zones in the elements forming the outer edge of the city;
- The Tosmare nature reserve, located further away from the city centre, has the biggest potential for watching the starry sky. The reserve currently does not have a properly set up entrance. In developing night-time outdoor spaces, one can possibly create fenced-off zones for stargazing and educating the public about the problems of light pollution. These need safe and visible access routes, with municipal elements like information signs, deck chairs, waste bins;
- Boundaries inside the city must be reduced physically. The ability to cross them safely at night must be provided for cars, pedestrians and cyclists;
- Internal borders must be reduced visually, lighting larger objects on both the sides of the edge elements, ensuring connections between city neighbourhoods, and creating a sense of belonging among residents;
- In locations where one can view the skyline, the view must not be obstructed. The level of foreground lighting should be reduced as much as possible, to improve the visual quality. The skyline should be enhanced by lighting larger landmarks and other buildings forming it.

Neighbourhoods. One can distinguish nine different neighbourhoods in Liepāja: Karosta, Tosmare, Zaļā Birze, Ziemeļu Priekšpilsēta, Jaunā Pasaule, Jaunliepāja, Vecliepāja, Dienvidrietumu Rajons, and Ezerkrasts [13].

Karosta is notable as a neighbourhood with one of the strongest identities in Liepāja. The neighbourhood used to be a closed military base, strictly separated from the rest of the city. Karostas Canal still functions as a clear boundary between this neighbourhood and the rest of Liepāja. Aside from the city centre (Vecliepāja), Karosta is the neighbourhood that attracts the highest number of tourists. Although it does not offer any night-time points of activity, its sights encourage people to visit the neighbourhood at night. In terms of the night-time cityscape, the lighting of various buildings, such as the Naval Cathedral Church of Saint Nicholas, and the Karosta Prison, can be assessed as good. A well-lit and attractive connection between this neighbourhood and the nearby Ziemeļu Priekšpilsēta is provided by the Oskara Kalpaka Bridge, which is a rotary bridge with a wooden plank deck. At the same time, other landmarks that are just as important (e.g. Ziemeļu Fortifications, and Karosta Water Tower) remain in the dark.

Providing these objects with lighting could improve navigation within the city, offer the potential for a high-quality night-time route for tourists, and successfully strengthen the identity of the neighbourhood.

Recommendations for developing city neighbourhoods in the context of night-time cityscape:

- Emphasise the unique character of every neighbourhood by lighting the elements that form its identity. At the same time, the city-scale lighting concept must contain unifying elements, to avoid fragmentation;
- Provide lighting to neighbourhood-scale landmarks to improve navigation;
- Create safe connections between neighbourhoods, and in particular, between each neighbourhood and the city centre. There must be connections for cars, pedestrians, and cyclists.

Access. The city can be accessed in six different ways. By car, one can access Liepāja using the roads: A9 (Riga (Skulte)–Liepāja), A11 (Liepāja–Lithuanian border (Rucava)), P110 (Liepāja–Tāši), and V1188 (Liepāja–Šķēde–Ziemupe). The city offers both free and paid parking. The roads also enable coach access, with routes connecting Liepāja to cities in Latvia and Lithuania. The coach terminal and railway station are in the same location. Trains run less frequently than coaches, only twice a week. However, they provide a connection to the capital. The Liepāja International Airport is just outside the city boundary, and currently accommodates regular flights to and from Riga. Because of the city's advantageous geographic location, access is possible by ferry, using the Liepāja–Travemünde (Lübeck, Germany) route, and the yacht marina in the city centre makes it possible to come to Liepāja by boat [9].

The main streets of the city can be divided into three categories: city streets, neighbourhood streets, and pedestrian streets. In the context of urban spaces, the categories are defined by their users, functions, and scale: city streets used by lorries are larger in scale, for example, while pedestrian streets have a smaller, human scale. The rail tracks include tram line infrastructure, and railway infrastructure. The tram line is largely arranged parallel to roads or integrated with them. Meanwhile, the railway line sets relatively stricter boundaries of the landscape spaces; it splits roads, sometimes running parallel to them, moving further away in other locations.

Railway infrastructure can be grouped in the railways only intended for cargo, and those that can also be used for passenger transport. For more detailed divisions, bicycle paths can be broken down into international EuroVelo routes, city routes, and bicycle paths. The EuroVelo routes cross the city in a vertical direction, while the city routes have a circular shape. The bicycle path system is not well-developed in the city, largely arranged along major roads. There is a lack of safe connections in the central part of the city, and its residential neighbourhoods. The current road situation in terms of night-time urban spaces in Liepāja can be considered good. A visit to Lielā Street, which is one of the city's biggest and most presentable streets, reveals the use of lighting elements of appropriate size. The intensity of the light and its white colour are appropriate for the intense use of the street. In Roņu Street, whose use is less intense, one can find appropriately smaller lighting elements. The design of the lighting elements suits the current mood of the urban space.

Recommendations for developing city streets in the context of night-time cityscape:

- In terms of street lighting, one can identify three light intensity zones: first, city streets with the highest level of light intensity and perceived scale of night-time spaces; second, neighbourhood streets with a medium light intensity, and third, minor local streets with a low light intensity;
- Bicycle paths and pedestrian streets need relatively smaller, human-sized lighting solutions that are comfortable for the users;
- One must improve the network of bicycle paths, creating uninterrupted links between the neighbourhoods and the city centre;
- In terms of tram and railway infrastructure, particular attention must be paid to crossing safety. The crossings must have higher levels of lighting, with better rendering of colours. The same applies to pedestrian crossings of roads;
- Points of access to the city must be provided with lighting, given that these locations function as the first landmark that tourists see when they come to the city;
- In designing the lighting elements, one must take into account the urban space surrounding the section of the road in question. More modern solutions will better suit recent developments, while in historic development areas – older-style elements.

Nodes. Businesses and locations that generally see activity at night, after 22:00, were identified in the context of urban nightscape planning. These locations were determined based on the information posted on the website of the Liepāja Region Tourism Information Office, and these are the following: Juliannas Courtyard, Red Sun Buffet Beach Bar, '7. līnija' beach bar/cafe, Klondaika Recreation Centre, CukurFabrik Lounge & Club, Fontaine Palace Nightclub, BIG7 Nightclub. Although the word 'night' invokes the usual associations with midnight and early morning hours, one should keep in mind that during longer winter nights, night-time cityscapes also include evenings. This is why in determining points of activity, it is important to identify public venues that operate between 17:00 and 22:00. These include culture and entertainment venues, sports facilities, hotels, and shopping centres. It is also necessary to identify the more intensely used outdoor public spaces, such as parks, squares, and various nature areas intended for recreation.

An analysis of hubs of night-time and evening activity shows that these venues concentrate around three different points of activity in the south section of the city. The most important point of the activity is on both sides of the Tramvaja Bridge, which connects the Vecliepāja and Jaunliepāja neighbourhoods. It is notably linear in shape, and includes all of the venues listed above, offering options for entertainment, shopping, active and passive recreation, and night accommodations. This point of activity enjoys the highest level of artificial lighting intensity. This is a place that sees the most attention in creating various themed light installation during public holidays. The second point of activity is in the coastal area, with more focus on sports, culture and entertainment. Third is a relatively small point of activity in the southwestern section, consisting mostly of shopping centres. Active venues are virtually absent in the north section of the city, beyond the Karostas Canal.

Recommendations for developing city nodes in the context of night-time cityscape:

- Plan the development of the three key points of activity in Liepāja;
- Make arrangements for different options to access the points of activity, including roads and parking, bicycle paths with parking for bicycles, pedestrian routes, and bus stops. Arrange the creation of a multifunctional night-time outdoor space, providing the infrastructure for active and passive recreation, as well as basic functions (various products and services, night accommodations, public amenities, etc.);
- Provide safe connections between the points;
- In selecting lighting elements, pay attention to using a design that matches the visible surrounding areas of the quarters. Avoid chaotic lighting in laying out the elements;
- In terms of choosing the lighting, develop a more detailed lighting strategy, taking into account the fact that the points of activities are the most visited areas at night.

Landmarks and viewpoints. If provided with lighting, landmarks can improve navigation at night, direct traffic in the needed direction, and improve the overall visual arrangement and skyline of the city. In Liepāja, major architectural sites play the role of landmarks, including cathedrals and churches, water towers, industrial and port structures, hospital, concert hall, monuments, major shopping centres, and city gate motifs.

On the city level, landmarks should be considered in combination with the most important visual lines. At night, people look at lit objects. For example, during the day there is a clear visual line in the direction off the sea, which blends in with the background and is thus invisible at night. In contrast, a lit steeple will stand out against the dark sky.

Although all of the city-level landmarks identified already have lighting, not all of it is complete. The angles for lighting the cathedrals were found to be wrong. The light is directed from the bottom upwards, and does not reach the tops of the buildings, thus reducing the potential distance from which they can be seen. The most striking viewpoint for looking at the Holy Trinity Cathedral is obstructed by a streetlight. The bank building to the right of the cathedral distracts attention from the visual line with its excessively bright signs. A streetlight also obstructs the view of the Naval Cathedral Church of St Nicholas. The lighting of the cathedral is relatively low intensity, which reduces its visibility at longer distances. Lighting this cathedral from its bottom also means losing the view of its most impressive element, the golden domes.

Recommendations for developing city landmarks in the context of night-time cityscape:

- On the level of the city, provide landmarks with lighting to improve navigation, and to strengthen the identity and night-time skyline of the city. Keep in mind that the landmarks will be visible from different sides. Consider the look within the overall composition of the urban environment. Adjust the intensity of the lighting, its direction and colour, to create a balanced appearance;
- Landmarks that are located at points of activity in the city and are aesthetically more attractive should be lit more brightly. These are the religious facilities, the concert hall, and the monument;
- In lighting objects, take into account the brightness of the lighting, to avoid glare. It is also important to pay attention to the possibility of glare caused by buildings with reflective surfaces;
- Analyse the objects to be provided with lighting, to choose the best colour of the light and its direction, as well as the design of the lighting elements to be used. Proper selection of lighting enables correct presentation of the landmark at night;
- It is recommended to lower brightness connection zones between lit objects, in order to improve the visual composition;
- Create safe traffic links between landmarks. Lower light levels and smaller elements can be used for this;
- Make sure that the views of the lit landmarks are not obstructed. Unobstructed views improve navigation and direct traffic flows.

Liepāja lighting master plan

The lighting plan concept is based on the idea of creating a uniform and visually appealing night-time image of the city, at the same time emphasising the individual valuable features of every neighbourhood and creating a safe and functional outdoor space, see Figure 4.

Three keywords describe the concept:

- **Dynamics**. First, this means creating different layers of lighting in the urban environment, with a hierarchy of lighting and smart technologies that adjust the levels of lighting to the needs of its users. Second, this means emphasising the characters of different neighbourhoods, by providing lighting to different elements that form their identities. Third, dynamism manifests itself in the scale of the lit elements, starting from city-wide landmarks to the lighting of lower layers and surfaces in urban spaces. Dynamism also symbolically fits well with the windy nature of the city;
- **Amber** used as the unifying element for the neighbourhoods. This is one of the symbols of the city. The 'Lielais dzintars' ('Big Amber') concert hall and its immediate surroundings form the heart of the city, and a central point of night-time activities. The use of amber colour in lighting extends throughout the city and can also be found in the architecture of principal landmarks. In addition to the symbolic meaning of the colour of the lights, it has a positive effect in terms of reducing light pollution, because of its lower environmental impact, as compared to bluish white lights;
- **Sustainability**. The lighting plan is based on creating safe connections between the city's neighbourhoods, its nodes, and points of activity at night, providing full functionality, and avoiding wastage of light. Aspects associated with light pollution and advantages of smart technologies were taken into account, and activities were planned to promote night-time urban spaces, with the goal of changing the negative attitude towards darkness among the public.

Lighting hierarchy. All of the nightscape elements listed above must be taken into account in developing a city lighting master plan. However,

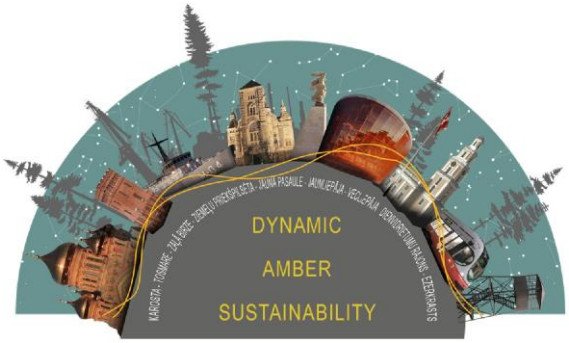

Fig. 4. The concept of Liepaja lighting master plan [8]

creating a balanced and functional space in the city, one must additionally define zoning with different lighting intensities, based on the value, type of development, amount of natural environment, and the level of use of the areas in question. Creating a hierarchy of lighting adds dynamism to the nightscape, helps with navigation through main traffic routes, and provides compositionally appealing and diverse views. In addition, properly adapted levels of lighting intensity help reduce light pollution. Four artificial lighting level zones are defined in Liepāja, see Figure 5, 6.

The image of the city. Liepāja is referred to not only as the city of winds, but also as the city of amber. This is reflected in one of the city's most prominent architectural sites, the 'Lielais dzintars' ('Big Amber') concert hall, and the 'Dzintara pulkstenis' ('Amber Hourglass') urban object set up in the nearby pedestrian street and designed with the involvement of Liepāja's citizens. It is proposed to bring the symbol of this golden stone of the sun to the night-time cityscape, thus unifying different neighbourhoods. First, it is the use of amber-coloured lights for decorative purposes in locations where good rendering of colour is not a priority, providing lighting of objects, connections, amenities. According to literature, in addition to strengthening the city identity, the use of golden-colour lighting is more environmentally friendly than that of bluish lights. Second, it is the thematic design of outdoor objects and municipal improvements that include irregular, round and oval shapes, similar to those of amber. In addition to the aesthetic benefits that these objects create in the urban space, they could function as larger or smaller-scale aids in navigation.

Smart technologies. Smart technologies can help the city improve its energy efficiency, make its outdoor spaces safer, improve traffic, and meet the needs of its residents. In subsequent modernisations of the lighting system, it is recommended to install even more efficient and dynamically adjustable lights making it possible to set the intensity of individual lights or groups of lights adapting them to the given situation at night. A combination of three lighting control strategies can be used:

- Astronomical timer, calculating when the lighting is to be used based on the individual time of sunrise and sunset every day;
- Natural light analysis, adjusting the intensity of the light based on the amount of natural lighting detected by sensors;
- Traffic detection, adjusting the intensity of the lighting based on motion sensors [1].

It is proposed to combine lighting elements with

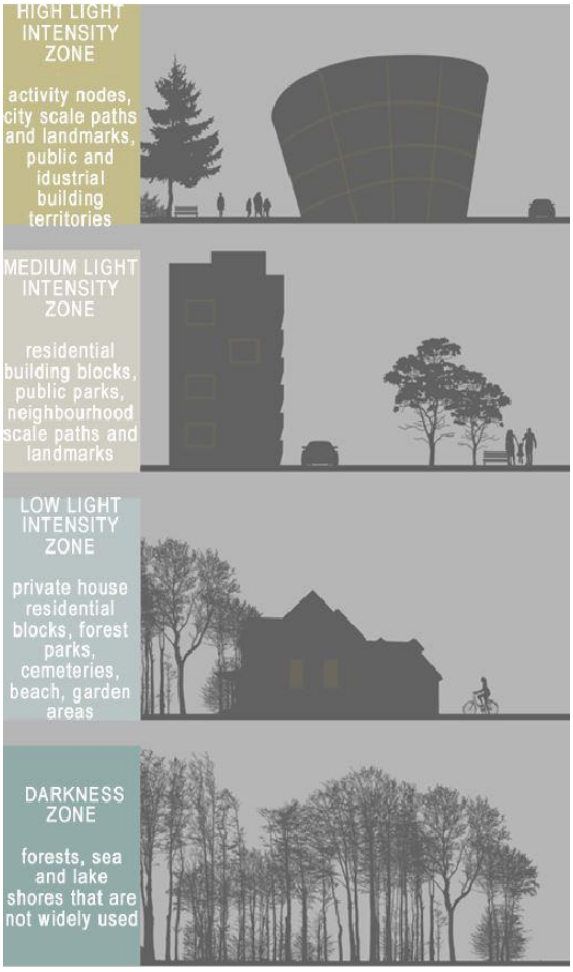

Fig. 5. Proposed lighting hierarchy [8]

Fig. 6. Overview of the proposed Liepaja lighting master plan [8]

other smart technologies, thus improving their functionality. Lighting poles could be equipped with charging stations, interactive information panels, Wi-Fi routers, surveillance cameras, sensors analysing air quality, noise pollution, weather, traffic intensity, and availability of parking space. In addition to all of that, one can use solar or wind energy to power the smart systems [1].

Conclusions

The development of a city lighting plan plays a critical role in defining the perceptions of night-time urban spaces by their users, and in promoting tourism. There is economic benefit to be gained from increasing the time the urban environment can be used within the 24-hour day. Improving the aesthetic and functional qualities of the night-time cityscape increases the quality of life of local residents and strengthens the city's identity. Reducing light pollution makes it possible to contribute to combatting rapid climate change.

In order to ensure successful implementation and sustainability of the city lighting plan, the local government must collaborate with organisations as well as private citizens. Changing the night-time urban space is easy: all that is necessary is to provide light. It is necessary to develop rules about the lighting of various advertising elements, shopping windows, and signage, in order to prevent the overall balanced night-time image of the city and its colour palette from breaking apart. One must determine the maximum acceptable levels of lighting intensity and colour. Provisions must be introduced requiring that the lighting of public buildings and buildings located along major streets must be approved by the local government. It must be ensured that spaces within individual blocks be aesthetically harmonised. A more creative approach is possible in smaller urban spaces, because these are only visible from shorter distances. In setting up lighting on the upper floors of buildings or in larger structures, one must assess its impact on the appearance of the city's skyline and cityscape. Light festivals are a possible option for encouraging public interest in the use of night-time urban space and promoting tourism. They are an opportunity to show the city from a different perspective and cultivate a feeling of pride among its residents. At the same time, it is important to educate locals and the public as a whole on the value of night-time outdoor spaces, their special mood, as well as the consequences of light pollution. This can be achieved by promoting astronomy, and organising events associated with it. There is value in preserving dark-sky areas for stargazing within the city boundaries. The primary goal for the engagement of the public is to change the centuries-old negative attitude towards darkness and understand that living organisms need it.

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Kopsavilkums. Mūsdienu tehnoloģiju attīstības un urbanizācijas iespaidā, pilsētas spēj nodrošināt plašu pakalpojumu klāstu arī pēc tumsas iestāšanās, kas nozīmē to, ka nakts ainavtelpas kļūst arvien intensīvāk izmantotas. Pētījuma mērķis ir izstrādāt rekomendācijas nakts laika ārtelpas un tās elementu plānošanai pilsētvidē, kas uzlabotu funkcionālo un estētisko kvalitāti, kā arī mazinātu gaismas piesārņojumu. Mērķa sasniegšanai veikta teorētisko materiālu izpēte, lauka pētījumi un fotofiksāciju uzņemšana teritoriju izvērtēšanai, iegūto rezultātu apkopošana un grafiska attēlošana. Lai risinātu ar nakts ainavtelpām saistīto problemātiku uzmanība pilsētas līmenī tiek vērsta apgaismošanas ģenerālplānu izstrādei. Ar plānu palīdzību iespējams veicināt tūrismu un ekonomikas attīstību, kā arī uzlabot iedzīvotāju labklājību. Pilsētas līmenī nakts laikā nozīmīgi ir tādi elementi kā malas, apkaimes, ceļi, vietzīmes un aktivitāšu punkti. Minētos elementus nepieciešams identificēt uz izcelt atbilstoši izstrādātajām rekomendācijām. Piedāvātā Liepājas pilsētas apgaismošanas plāna attīstība stiprinātu pilsētas identitāti, veicinātu drošu nakts ārtelpas izmantošanu, ērtu orientēšanos un nodrošinātu estētiskus skatus. Papildus, tā ir iespēja mazināt gaismas piesārņojumu un pievērsties ilgtspējīgiem risinājumiem, pielietojot dažādas ar apgaismojumu saistītas viedās tehnoloģijas.