METHODOLOGICAL APPROACH TO CREATING AN URBAN LIGHTING ATMOSPHERE WITH REGARD TO HUMAN NEEDS

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The purpose of this paper is to assess how lighting correlates with human needs and emotions and to examine the implications for lighting design. The complex variables of urban lighting include practical, social, cultural and semantic elements of the urban environment. The research identified the most promising opportunities for using lighting technologies responsive to the basic levels of the human need for lighting. The dynamics of "LIGHT-VIEWER-ATMOSPHERE" were applied in order to explore critical areas of interdependence. To determine the most critical areas, the hierarchical principles of A. H. Maslow's pyramid of needs were adapted and applied to the data. The authors studied the interaction between the viewer and light technologies in order to determine the most likely enhancements to the emotional impact of lighting. The "Expanded hierarchy of needs with regard to the presence of light" illustrates the issues considered here. The classification of societal needs is based on an analysis of the emotional impact of examples of lighting solutions in architectural environments within a clear social context. A morphological analysis was carried out using the cross-consistency assessment method (CCA). Criteria for evaluating the effects of light were considered on 4 basic levels of needs following Maslow's pyramid configuration.

Key words: **lighting design, urban lighting, needs of society, concepts and city lighting programs.**

INTRODUCTION

Examining the purpose of a design is an important tool for implementing architectural concepts of "light architecture". Light architecture is a holistic system that solves compositional and planning tasks related to lighting decisions.

This article introduces the term "light effect". It is the influence of a light source on the perception of the illuminated architectural environment on one or a group of viewers, with the subsequent emergence of an emotional response. Qualitative indicators of this effect are brought together by the concept of "atmosphere created by the light effect", which determines the emotional state of the audience. Human needs with regard to lighting depend on the individual's need for the presence of light in essential everyday activities.

Technical outdoor lighting systems for urban spaces are rapidly changing. Their use in the urban environment requires a special methodology for lighting open spaces, which is of interest to the suppliers and developers of lighting systems, designers, architects, and urban environmental authorities (Zielinska-Dabkowska, 2019). The technical capabilities of lighting technologies to create high impact effects remain under-developed. The unsystematic use of light configurations leads to visual discomfort (Efimov, 1990).

The development of an integrated approach to forming the luminous environment of the city includes identifying the missing criteria and determining the factors influencing the construction of the hierarchy of interaction for types of lighting, with the task of artistic harmonization in the urban space. For the modern urban environment, it has become important to use creative concepts, i.e., visual and decorative

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principles of lighting arrangement to enhance the emotional impact.

The psychology of light perception and light's influence on the emotions is thoroughly considered in the work of philosopher G. Böhme (1993). According to his theory, in the interaction between an individual and a spectacle, the atmosphere has fundamental meaning for the emotional perception of the viewer. Böhme gives an original interpretation of "atmosphere", implying the physical presence of the viewer in the "space that concentrates mood, emotions and affects".

An emotionally-saturated environment, that is, an atmosphere filled with the viewer's reaction to works of art, and to the totality of the natural and design materials used, including the use of light effects, is the main factor in the perception of beauty and its contemplation (Ingold, 2016).

From the point of view of M. Bille, the atmosphere produced by light architecture is the main "starting point of an analysis of socio-material life where lighting acquires an important position" (Bille, 2019).

In turn, Edensor (2017) describes light as the creator of the interaction space for people, saying that the light atmosphere has special unifying and "aestheticizing" roles.

Based on the psychological aspects of the research into the atmosphere mentioned above, interaction between the three main elements in the process of perceiving light effects in architecture is considered: the atmosphere, viewer and light (Figure 1).

The main research focus is illustrated by the diagram of a hypothetical "LIGHT-VIEWER-ATMOSPHERE" relationship. The authors' philosophical approach is in the theoretical assumption that when the viewer contemplates a light source, a special emotional space is formed and transmitted to neighboring observers. Light should be regarded as a living element, which plays a key underlining role with darkness. In total, both elements envelop the impact area.

The light effect is one of the conditions for creating a special atmosphere, presented in the form of glowing visual images,

illuminating graphic drawings, video sequences or any other application of light art. The viewer's contact with the atmosphere created by the light effect evokes an emotional response in him, expressed by various feelings (wow effect, delight, a sense of happiness, distraction from problems). The influence level of the light effect most often depends on one's preparedness for the perception of that effect. The main focal point of the research is based on the interaction between the light, the viewer and the atmosphere. It is the basis for creating productive lighting decisions in an architectural environment. For the viewer, the reactions to light effects are determined by various needs (practical, social, visual, sacral).

METHODOLOGY AND SOLUTIONS

In order to determine the range of societal needs and requirements for achieving the potential of light technology, this study uses the hierarchical description in the theoretical pyramid of human needs proposed by psychologist A.H. Maslow (1943). Maslow developed a theory based on the degree of human needs, describing the living requirements of an individual in society.

The choice of Maslow's theory has the advantage of applying the scientific concept and adjusting it to the needs of an individual in relation to light. A.H. Maslow's unique hierarchical concept has seven levels of needs. Here, the seven levels were combined into four (Figure 2).

The general philosophical hierarchy of categories of human needs formulated by A.H. Maslow allows us to suggest guidelines for the development of lighting technologies and to give a qualitative assessment of the perception of light effects in the urban environment (Figure 1).

Despite the theoretical nature of the hierarchy of his pyramid, it is often used in market research to explore people's needs (Novatorov, 2016), and could also be used to determine the need for lighting. The task of the research is to use the four main levels of the diagram of needs to describe the effects of light: practical, socio-communicative, visual (aesthetic) and spiritual (sacral) (Figures 2, 3).
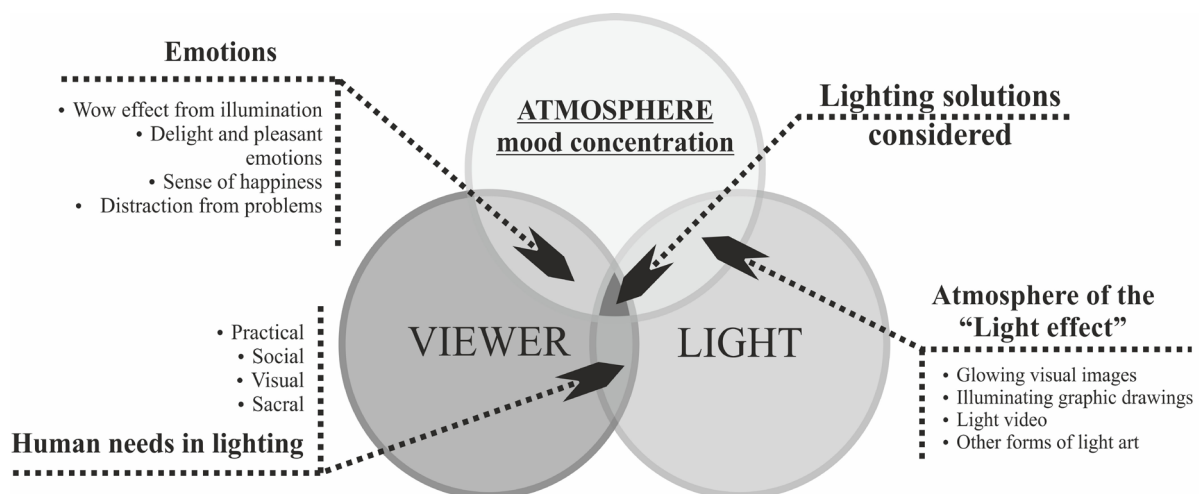

Figure 1. "LIGHT-VIEWER-ATMOSPHERE", the relationship between the viewer and the light observed
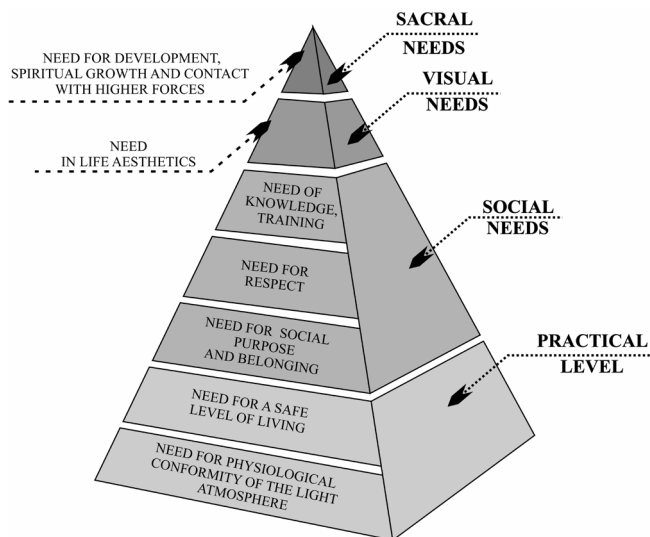*(Source: authors)*

Figure 2. Hierarchy of needs in relation to the presence of light, based on the principles of A.H. Maslow's pyramid (Source: authors)

The distribution of needs over the hierarchical pyramid is based on the fact that a person cannot experience "high-level" needs as long as he needs things that are more primitive. The first "need for light" in a society lies in the area of satisfying physiological needs of a practical nature (Fisher, 2014). The need for security also depends on the presence of light, both natural and artificial (Böhme, 1993).

Shown on the social needs level of the hierarchical pyramid (Figures 2, 3) are the needs of a sociological orientation, together with the use of light technologies for the transmission of information. It is assumed that there are interactions between different social groups by age, by occupation, and by the forms of organization of individual and social life. In accordance with the objectives of the research, the need for respect and approval of society is related to the social level of need. Cognitive needs for knowledge and information are located at the social level of the hierarchy.

The visual level determines the need for light in order to enhance the aesthetic perception of the environment, filling it with beauty and art (Shchepetkov, 2006). The viewer's perception of lighting in the most beautiful and valuable parts of the city gives the lighting solutions the status of art that meets the aesthetic needs of society.

Finally, the highest step of the pyramid of needs is occupied by the sacred level of light perception. The sacred effects of light are examined in a wider sense. This is all that relates to the divine, religious, celestial, extramundane, irrational, and mystical, as opposed to the ordinary. This also includes the desire of an individual for self-actualization, which meets the spiritual needs of a human being and his desire to know what life is about. The relation of man to the sources of light (sun, moon, fire) always has a sacral element. Therefore, it is precisely the satisfaction of this level of needs through the creative development of light technologies that evokes the greatest emotional response from the perception of light fluxes (Figure 3).

Practical need - the light use needed to solve practical issues

The primary need is for the presence of light to fulfil basic physiological requirements. Vision, orientation in space and a sense of security are impossible in the absence of lighting. The impact of light on the perception, behavior and psychology of the viewer is considered to be essential. The amount of solar energy received in the process of life directly affects one's emotional state and sense of joy. An important physiological factor that should be considered is the functioning of the circadian rhythms of the body (IWBI, 2017). They are responsible for our sleep and wake cycles, also affecting the blood pressure, metabolism, reproduction and immune response, and they require a certain amount of illumination. In large cities, people often face a chronic lack of daylight because of, for example, the duration of the daylight hours in different regions or a misunderstanding of the importance of smart illumination design processes. Thanks to lighting specialists, the invention of innovative light sources and their implementation into architectural practice has significantly expanded. Up-to-date approaches make it possible to obtain additional artificial illumination with the physical properties of natural lighting.

Sometimes the high building density in large modern cities creates living conditions in which the presence of natural sunlight is becoming less possible. In cities which, due to their natural surroundings, have a limited number of insolation hours, devices for additional illumination with reflected sunlight are being used. The city authorities of Rjukan (Norway) have begun to install large heliostats – mirrors (Figure 4).

The main aim is to redirect the sun's rays to unilluminated places of urban development, where illumination is weak and does not penetrate because of high mountains. Such devices have also been applied in Northern Italy, in the town of Viganella. Reflected sunlight compensates the lack of daylight, creating a more joyful and cheerful mood for people living there. This approach has made it possible to simultaneously solve psychological problems, together with issues of energy saving and the rational use of natural resources. There is an economic benefit in the form of reduced consumption of artificial lighting due to the use of reflected lighting.

Another original approach to the application of lighting devices was invented in Beijing (China). The city administration faced the problem of a sharp decrease in the natural illumination in large urban areas due to the constant presence of smog, which blocked the sunlight. Unable to get rid of the smog, they decided to reduce the psychological consequences of weak illumination by installing a huge multimedia screen of an artificial sunrise (Figure 5). The installation of high-resolution wide screens with a bright image of the sun created the effect of a natural light source and increased the amount of street lighting. Thus, besides being used for advertising and informational purposes, the use of huge media screens in this case contributed not only to their social and communicative impact on society, but also to a relative decrease in psychological stress from the impact of a man-made urban environment.

PRACTICAL NEED
The light use needed to solve practical issues

Light comfort	Health and light ergonomic issues	Improving safety features	Energy saving
Sufficient illumination Sunlight imitation Stable mental health	Increasing the amount of daylight in cities Avoid glare	Fight against night crime Illuminated space to feel safe	Use of solar energy

SOCIAL NEED
The need for light during various types of interaction and communication

Communication and mutual exchange	Education
Formation of small social groups Intercourse Interaction with people Meeting Conversation Conviviality Communion Attractive place Highly attended space	Motivation Life prospects and plans Cognition Development of intelligence Ambitions Awareness Gaining knowledge Spreading knowledge Broaden the horizons Purposefulness Advertisement

Cultural enrichment	Entertainment and leisure
Cultural level Sense of beauty Succession Artistic taste Style formation Aesthetics of action Transfer and receive artistic vision Respect the heritage Concept of beauty	Rest and relaxation Festive events Emotions Performance Entertainment Spectacle Distraction from pressing issues Show Feeling of happiness Daily leisure Bright event Point of attraction

VISUAL NEED
The need for perception of new visual information

Beauty and magnificence	The game of visual perception	WOW effect	Alternative to the usual
Aesthetics and taste Sense of magnificence Perceiving of light paintings	Light drawings on surface The play of light and shadow Visual optical illusions	Correcting visual appearance Catching attention Delight from light effect	Alternative image Nighttime light show Distortion of perception

SACRAL NEED
The need to search for hidden meaning, to feel the presence of higher forces

Spiritual development	Presence of higher forces	Search for the hidden meaning of life	Awareness of the place in the universe
Figurative meaning in religious doctrine Impact on religious feelings and consciousness	Sensation of contact with the supernatural Sacred atmosphere "Magical glow" Divine environment	Perception of mystical, spiritual and symbolic Mystical context Semantic meaning in religious doctrine	Man as part of the universe

Figure 3. Viewer's need for light. Expanded hierarchy of needs with regard to the presence of light
(Source: authors)

An important aspect of the practical nature of our need for light is the need for the feeling of safety (Figure 3). The lack of sufficient illumination is identified with a low level of security. According to studies carried out in 2008-2013, the renovation of the Los Angeles city lighting system made it possible to achieve a reduction in night crimes, in particular, vehicle theft, burglary (robbery, theft) and vandalism (Smalley, 2013).

Figure 4. Heliostats – mirrors, Rjukan, Norway
(Source: Askinasi, 2018)

The functionality of lighting in relation to human need is represented primarily by light ergonomics, that is, its ability to influence mental and physical health in general. In urban development, when creating the spatial environment of a city, physical volumes and their position relative to the light fluxes are taken into account. It is also taken into account that the quality of visual ergonomics is influenced by the light intensity, depending on the position of the viewer in relation to the lighting device, as well as the comfort and visual perception (IESNA, 2008) (without excessive glare in the observer's field of view, avoiding the effect of over-illumination at night, eliminating light and color pollution, etc.) (Powell, 2002).

Figure 5. Artificial Sunrise screen, Beijing, China
(Source: Khaw, 2015)

However, it is important to emphasize the other side of this issue. The brightness of modern light sources has a serious impact on the urban environment. This has led to the need for revising the regulatory standards of insolation and permissible values of illumination. The issue of additional control over light sources, their video-ecological compatibility (Filin, 1998, Filin, 2007), ergonomics and energy efficiency has become very topical (Tomassoni *et al.*, 2015). It is essential to avoid flickering light, rapidly flashing light, and a highly-contrasted environment in urban space, as they can have an adverse effect on human health (Yoshimoto *et al.*, 2017).

Social need - the need for light during various types of communication

The examples of satisfying the need for light considered here have shown that not all lighting requirements in urban spaces can be solved by the functional and practical recommendations in normative documents. The technical issues related to the formation of illumination are closely connected with the social and psychological aspects of its perception (Figures 2, 3). A person does not care about the quality of light fluxes until they become unacceptable or uncomfortable for him, or he ceases to notice them.

Any event or light technology scenario in the urban environment is addressed to the user – the viewer, who is the main character assessing the potentials, advantages and disadvantages of the proposed solutions (Rüdiger Ganslandt, 1992). Modern society is at a new social and communicative developmental stage in which visual information has become insufficient. The best results can be obtained by combining the technological aspects of lighting with a person's philosophical attitude to light, both natural and artificial. It is a huge research scope including the implementation of various activities in which light acts as a unifying element, the connection between the units and participants in the processes (Bille, 2019).

The social role of lighting solutions is designed to achieve an emotional effect and maximize the response from as many viewers as possible. It consists of forming a culture of human behavior in an urban environment. The objectives of this study include the theoretical justification of social and psychological factors in the modernization of programs in urban light space. Herewith, the concepts of media and light complement each other, representing an instrument of influence on the viewer, a means of communication.

Computational design frameworks, which are digital light devices placed on a building's facade are an example of a unique socially oriented modern technology. These light panels are a system of sensitive light sensors that scan a person's movement and reflect his actions in the form of a pixel image on a building's shell, creating a dynamic atmosphere of interaction (Krietemeyer *et al.*, 2015). Together with important energy-efficient characteristics, they make it possible to create a time-varying atmosphere on a building envelope. Individuals become participants in a socio-spatial game between the internal space of a building, the facade glazing and the environmental lighting.

Numerous authors confirm the social binding role of lighting, which allows citizens to feel involvement, acceptance, and belonging in a particular social group. At the moment of interaction, a special emotional climate is created

within the radius of the light installation, encouraging the surrounding people to gather into small social groups (Hare, 2003). A small group can be characterized by the following properties: the period of time during which it exists, the presence of certain common goals and tasks, the ephemeral structure forming the group, the correlation of the individuals with the whole group and the alliance of the constituents (Taylor, 1970). In terms of a sociological description, the intercommunion between individuals supposes the following types of activities – practical (joint labor activity), gnostic (joint research activity), aesthetic (joint satisfaction of aesthetic needs), or hedonic (leisure, entertaining), directly communicative, ideological and socio-political practice (Enikeev, 2005). Most of these aspects have the potential to establish interaction between social groups and light technologies.

It is within the framework of the socio-psychological level of satisfying the needs of society for light that promising, innovative and creative lighting technology concepts and lighting techniques can be discovered.

Visual need - the need for perception of new visual information

Light acts as an element of visual expressiveness, strengthening the urban spatial context. The role of light in the perception of the beauty of works of art, architecture and urban planning, visual types of design and technology that saturate the urban environment is so great that it becomes possible to talk about meeting the aesthetic needs of man (Figures 2, 3). Planning and considering the viewer's perception is important for places supposing a long stay and aiming to attract more visitors (Barnaby, 2016).

At present, the rapidly expanding spectrum of opportunities for digital light technologies allows architects to use new concepts of ephemeral light space solutions in their creative work. For example, nowadays it is possible to create shining visual effects and change the perception of architecture. Scott McQuire treats light as the main determining factor that "effectively transforms the modern industrial city into a perceptual laboratory, the site for the construction of new and often unexpected "special effects" (McQuire, 2008). The main designation of light is to strengthen the communicative interactions between the viewer and the surrounding space. Thanks to digital design technologies, architectural solutions for buildings create previously unimaginable ephemeral forms of space, setting new tasks for those developing lighting solutions and creating new illumination concepts in the architectural spaces of a city.

The purpose of light design is to attract attention to the forms and spaces of a city's architecture using aesthetically designed illuminating techniques, in order to generate an emotional response from the viewer. An important tool in this process is the construction of an attractive atmosphere, previously mentioned in the text of the article. For example, according to T. Edensor, the atmosphere is formed by a combination of events and sensations, which in their turn "provoke immersion, engagement, distraction and attraction" (Edensor, 2015). Different lighting solutions can completely change the view of familiar places or even improve the perception of unattractive zones. At night, the

sight of a highlighted building may be significantly different from its daytime version, thereby creating other aesthetic feelings of familiar places for the city dweller. Light is a new tool for the formation of aesthetics in the urban environment.

A thoughtful approach to light design makes it possible to highlight the architectural features of a building and the composition of its architectural forms, emphasizing the important and evading the illumination of passive zones (Rode *et al.*, 2014). With the help of light solutions, the plastic on an architectural facade can be visually corrected. Even with a simple design solution on the building's facade, a new unusual lighting solution can be created, increasing the aesthetic value of the building. For example, by organizing the flow of light into a graphic composition on the facade, the aesthetic perception of it becomes different. Digital control of light fluxes allows the light compositions to be dynamically adjusted and modified.

Sacral need - the need to search for hidden meaning, to feel the presence of Higher Forces

The sacral level of the needs of society for light (Figures 2, 3) is located at the very top of the pyramid based on A. H. Maslow's principles in relation to the need for light. This hierarchy gives the highest value to the search for self-realization, the truth of life and one's universal destiny. The question of an emotional response is of particular importance, with direct or hidden meaning, and with mystical or divine scope (Ozorhon and Uraz, 2014). Due to the fact that light is capable of evoking sensations of "mystery and fear," L. Roth describes it as one of the most effective elements in the creation of a sense of divinity (Roth, 2007).

The state of enlightenment and catharsis effect are often used in the architecture of religious and occult buildings and structures. At the same time, embodying the Divine Principle, light becomes a unifying factor in the interaction between a man and higher forces. The visual and optical properties of light are used in tandem with colored glass effects (Farahani *et al.*, 2018), together with the creation of spatial barriers and achieving the sense of the presence of supernatural powers.

The history of architecture has examples in which the lighting design, resulting from a deep analysis of the spatial location of the object, the landscape and the orientation to the sides of the world, makes it possible to have an original visual solution, together with a sacred context. For these purposes, the architecture uses the properties of both artificial and daylight.

Drawing special attention to the implementation of social approaches and creative concepts, architects have explored different technical and construction capabilities. An example of this is the ancient Mayan tribes and their Pyramid of Kukulkan in the city of Chichen Itza, Mexico (García-Salgado, 2010). The creation of the complex of pyramids where it stands dates back to the 11th century. The building itself is believed to contain information about the structure of the world and important astrological data. The Mayan Indians designed and positioned the pyramid so that the shadow of its faces fell on the stairs, forming a wave-like black-and-white image of the Feathered Serpent sliding down the stairs (Figure 6). Here, a unique approach to the use of light in architecture

can be observed. It is included in the process of spectacular occult events dedicated to the days of the spring and autumn equinox. Emphasizing the position of the light's main source – the Sun, was the main concept of its architectural design.

Figure 6. Kukulkan pyramid Chichen Itza, Mexico
(Source: Schwartz, 2018)

Human admiration for the luminous beauty of the sun underlies the concept of creating large light art objects – artistic analogues of the heavenly body. Light devices in the form of an artificial sun have appeared in different cities in the world, such as the lighting installation of the Solar Flare in Calgary, Canada, 2014, and the Dawn over Dnepropetrovsk monument in Dnepropetrovsk, Russia, 2012.

The installation of the Tropicana Sun luminous sphere in Trafalgar Square in London, England aroused great interest and an emotional response from London residents, stirring the imagination and reflections on the important role of the sun in the life of humankind. These are examples of the conceptual embodiment of the special significance of sunlight in people's lives, whereby the man-made sun personifies the philosophy of the unifying principle addressed to all the inhabitants of the planet.

Figure 7. World Financial Centre installation, New York, USA
(Source: Collman and Christie, 2015)

An example of the social and psychological role of light and its sacralization was embodied in the light concept in memory of the greatest tragedy of September 11, 2001 – the destruction of the World Trade Center, New York, USA (McQuire, 2008). Two powerful light streams repeating the shape of two ruined skyscrapers with strict verticals are directed to the sky (Figure 7). The dust particles that are in the air create the effect of soaring substances, as if they represent the departed souls. A deep psychological effect is produced. Thus, the observer has a multifaceted impression, touching on various sensations of the soul.

The above analysis of the examples of light technology in the urban environment in accordance with the chosen research methodology shows that the light environment of a city is fragmentarily formed. The sacral principles of the influence of the socio-psychological needs of society on the development of light technologies are not sufficiently disclosed. The regional individuality and expressiveness of the light environment are not sufficiently taken into account, which reduces its informative significance and negatively affects the psycho-emotional state of a person.

RESULTS AND DISCUSSION

The study shows that theoretical generalizations with regard to the characteristics of lighting technologies allows us to identify the degree of their influence on the formation of interesting directions for lighting design. We should take into account the influence of knowledge related to the social and psychological role of light on this process, in order to create a methodology for the formation of lighting programs for outdoor lighting in urban spaces.

The scientific data presented in the paper in the fields of philosophy, sociology and psychology make it possible to deduce a logical relationship between the interests of city residents and the producers of light programs and technologies. The viewer, his emotional needs in the process of perception, and the social nature of the atmosphere created by the light effect in urban spaces are key in the methodology for using light technologies in urban spaces (Figure 8).

Further, using the results of the study, a morphological analysis was made using the cross-consistency assessment (CCA) method, initially proposed by scientist Fritz Zwicky (1969), which has since been adapted by others. For example, Álvarez and Ritchey (2015), Ritchey (2015) and Demirkan and Afacan (2018) have developed methodological recommendations for determining the parameters and criteria in this method.

Basically, the CCA method is used for finding new ways to develop a particular sector and for finding more effective combinations of its properties. By applying this method, it becomes possible to obtain an expanded list of needs, taking into account the relationship between all aspects considered. This paper considers the viewer's four basic levels of need with regard to applying light solutions in the urban environment. The morphological method makes it possible to find options for the most successful combination of types to satisfy needs within a specific light solution.

When conducting this analysis, 4 parameters (A, B, C, D) were identified, corresponding to each level of needs. They
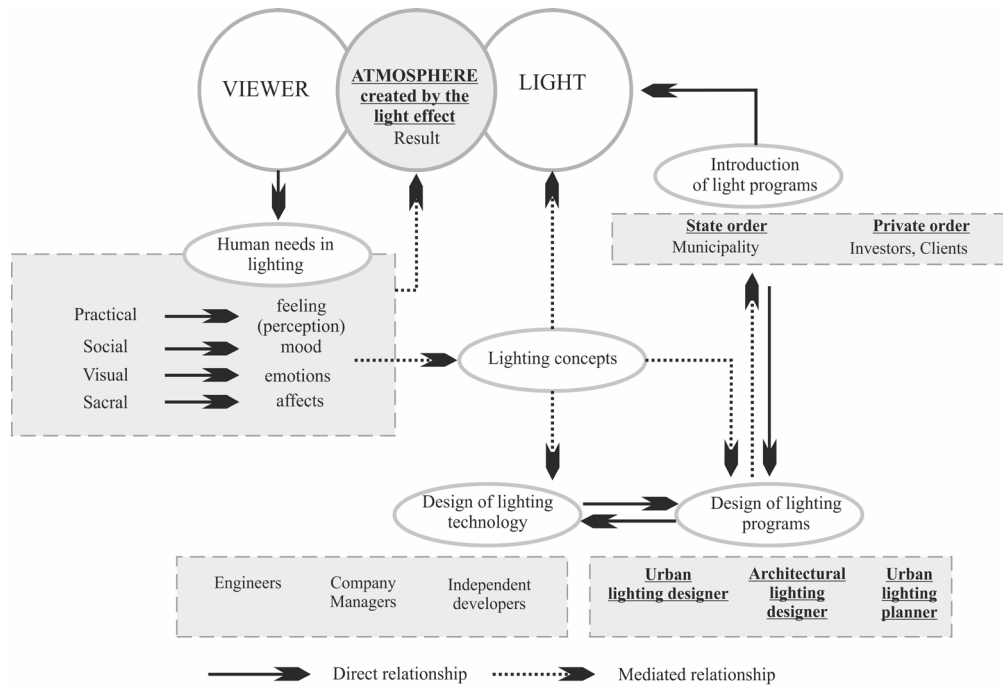
Figure 8. Scheme of logical relationships between participants in the perception process
(Source: authors)

are expanded in Figure 3 in the Methods section of the paper. Each parameter is defined by 4 basic conditions A1, A2 and so forth (Table 1), based on which the morphological analysis was carried out.

Further, the basic conditions are distributed horizontally and vertically in Table 2 in accordance with the CCA analysis methodology. According to the method, parameters A – C are arranged horizontally, while parameters B – D are distributed vertically.

Three main criteria were introduced in the assessment as markers: "+ - Possible combination, well-matched needs", "K - Possible combination, relatively matched

of acceptable combinations are highlighted. The conditions of social needs are well compatible with the practical conditions, and the visual with sacral conditions.

According to Table 2, it is obvious that the most poorly matched condition is the energy saving sector. Being an important aspect developing lighting technology and forming a budget for urban lighting, such a serious topic requires a separate study and approach. These issues are not addressed in this paper.

Tables 1 and 2 explain the main conclusions of the research; they can be used to interpret and systematize scientific and technical proposals for further development of lighting

Table 1. A 4-parameter morphological field

Parameters			
Parameter A	**Parameter B**	**Parameter C**	**Parameter D**
Practical	**Social**	**Visual**	**Sacral**
Condition A1: Light comfort	Condition B1: Communication and mutual exchange	Condition C1: Beauty and magnificence	Condition D1: Spiritual development
Condition A2: Health and light ergonomics	Condition B2: Cultural enrichment	Condition C2: The game of visual perception	Condition D2: Presence of Higher Forces
Condition A3: Improved safety features	Condition B3: Entertainment and leisure	Condition C3: Wow effect	Condition D3: Search for the hidden meaning of life
Condition A4: Energy saving	Condition B4: Education	Condition C4: Alternative to the usual	Condition D4: Awareness of one's place in the universe

*(leftmost column spanning all rows, rotated: **Condition**)*

needs" and "X - Impossible combination, poorly matched parameters". The layout of the assessment markers allows visual selection of the sector that received the maximum amount of "+" markers. These are the combinations of the most efficiently compatible conditions: social and visual, as well as visual and sacral needs. Further, two more zones

technology and the practical implementation of urban lighting programs.

The scientific importance of identifying the principles and classifying the methods of light usage is explained by the need to improve the functioning of the social environment (Ellin, 2012). The use of light technologies is becoming a socially

Table 2. Cross consistency assessment of human need in relation to lighting technologies

Human needs with regard to light		Practical				Social				Visual			
		Light comfort	Health and light ergonomics	Improved safety features	Energy saving	Communication and mutual exchange	Cultural enrichment	Entertainment and leisure	Education	Beauty and magnificence	The game of visual perception	Wow effect	Alternative to the usual
Social	Communication and mutual exchange	+	+	+	X								
Social	Cultural enrichment	+	+	К	X								
Social	Entertainment and leisure	+	+	+	X								
Social	Education	+	+	X	X								
Visual	Beauty and magnificence	+	+	К	X	+	+	+	+				
Visual	The game of visual perception	+	К	X	X	+	+	+	+				
Visual	Wow effect	К	К	К	X	+	+	+	+				
Visual	Alternative to the usual	X	К	К	X	+	+	+	+				
Sacral	Spiritual development	+	+	+	X	+	+	К	+	+	+	+	+
Sacral	Presence of Higher Forces	+	+	+	X	К	+	К	+	+	+	+	+
Sacral	Search for the hidden meaning of life	+	+	+	X	К	+	К	+	+	+	+	+
Sacral	Awareness of one's place in the universe	+	+	+	X	К	+	К	+	+	+	+	+

+ Possible combination, well matched needs	К Possible combination, relatively compatible needs
X Impossible combination, poorly matched needs	

significant tool, a unifying factor that influences the existing atmosphere in urban spaces and introduces positive changes to the structure of the urban environment.

CONCLUSIONS

Lighting technologies have become increasingly important, and they have a great impact on the organization of urban life, both day and night. Technical progress in lighting design provides new tools for the visual transformation of space. The variety, sophistication and affordability of the technology require a much wider conceptual approach to the lighting design process. Light technologies themselves, implemented without a coherent and purpose driven concept, can only serve as technical devices. For this reason, the article offers a methodological approach to avoid mistakes during the design process and to achieve the following goal: to achieve a memorable visual impact with maximum regard for important human needs. The scientific contribution of the article lies in the development of theoretical provisions for conceptual formation of the urban lighting atmosphere based on human needs in relation to lighting.

The research describes and illustrates important scientific approaches in creating an urban lighting atmosphere. Using the principles of a A.H. Maslow's pyramid of needs, a social model of four basic levels of human needs in lighting is created. An algorithm identifying effective combinations of needs in lighting (CCA method) is proposed. Using the results of the study, the concept of a light project can be thoroughly elaborated. Applying this method in practical design work is a matter of great importance. It can be further used in the development of lighting programs, thus improving the health, comfort, psychological state, and perceptual abilities of individuals. It offers opportunities for improving the concept and establishing the value of human-oriented design.

This article also analyzes the interaction between the viewer and the light technology, with the subsequent formation of a special atmosphere that creates a more intense emotional response in the viewer. The main factors determining the process of such interaction in the surrounding socio-psychological atmosphere are specified. The research results can be further used for considering the perception, emotional response to and philosophical understanding of lighting. These socio-psychological and sacral needs can be considered as the basis for further areas of research, especially research that integrates current discoveries in the neurology of vision.

Another important point developed was the logical connection between the formed environment, with its components and creators – participant technologists and designers, responsible for the application of lighting concepts. The range of factors influencing the choice of design tools and techniques was expanded. In order to prepare municipal programs to improve lighting in the urban environment, one should understand the algorithm for creating light effects, as well as the relationship between the project participants. It is essential to organize the work processes properly, to invite the right participants and to make long-term strategies for improving urban spaces. Ultimately, further application of the results is able to make positive changes in the design and application of lighting technology and present the opportunities for lighting technologies in the best way.

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