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## GENERALIZED METHODOLOGICAL MODEL OF THE QUALITY OF HIGHER EDUCATION<sup>2</sup>

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***Abstract:** Light is life - a human necessity a priori. Light is a specific matter that is emitted from natural and artificial light sources. Lighting forms the organized light that is emitted or reflected by objects in order to realize different lighting tasks. Light (non-organized visible energy) and light (organized visible energy) form the so-called lighting environment. The harmonious lighting environment is a factor directly affecting quality of life, working conditions and productivity. Organized light is a matter of safety and health issues and has a great influence over the cultural development of society. This report represents a generalized methodological model of quality in the higher education, lighting design educational programme in particular.*

***Keywords:** GMmQ, Systematics, Methodology, Quality, SATI (2009), SATI+ (2017), GHMLE, SLD, Gestalt, Gestalicht (2013), Lighting Organization, Automotive Lighting Sculpture, ALS, ABLs (2009), Metasculptures, ALMS (2017), Synergy Bridges (2017), Culture of Lighting, Lighting Organization, Aesthetics, Creativity, Expert Assessments, Good Practices, Standards, Philosophy, International Higher Education, Mission 2015, Holistic ad-hock picture, Fractal thinking.*

***JEL Codes:** L10, L11*

### INTRODUCTION

Light is life, a human necessity a priori. Light, the non-organized visible energy, and lighting, the organized visible energy, form the so-called lighting environment. The harmonious lighting environment is a factor directly affecting the quality of life, working conditions and productivity. The reason is that visually people receive over 75% of the environmental information. According to Lighting Europe, about 19% of the global electricity consumption and about 14% of the electricity consumption in the EU is for lighting. According to a representative expert estimate, the electricity consumption for lighting in Bulgaria is **14.03%** of the total electricity consumption [10].

Nowadays, the lighting installations and technologies are developing dynamically, as a sign of this visible change is the breakthrough of LEDs, a technology that is irresistibly invading the visible world. A new high quality lighting standard is acknowledged along with a new high energy saving rate. Aesthetics in lighting does not relent either. In this respect, the lighting technical community in Bulgaria has established lasting traditions. At present, the national configuration in the field of light-based technologies is complete: lighting science and education, lighting design and engineering, lighting production (including light-emitting diodes), installation and operation activities.

This year is noteworthy because it marks the 50th anniversary of the membership of the National Committee for Lighting in Bulgaria (NKO) in the International Commission on Illumination, CIE (CIE); at the Congress in Washington in September 1967. The international academic community is particularly interested in the quality of higher education in the field of lighting because quality lighting is a prerequisite for cultural development with global dimensions. There are still fresh impressions of the celebration of 2015 - by decision of the 68<sup>th</sup> United Nations General Assembly (20.12.2013); 2015 was declared an International Year of Light and Light-based Technology (IYL 2015) [14,22,23].

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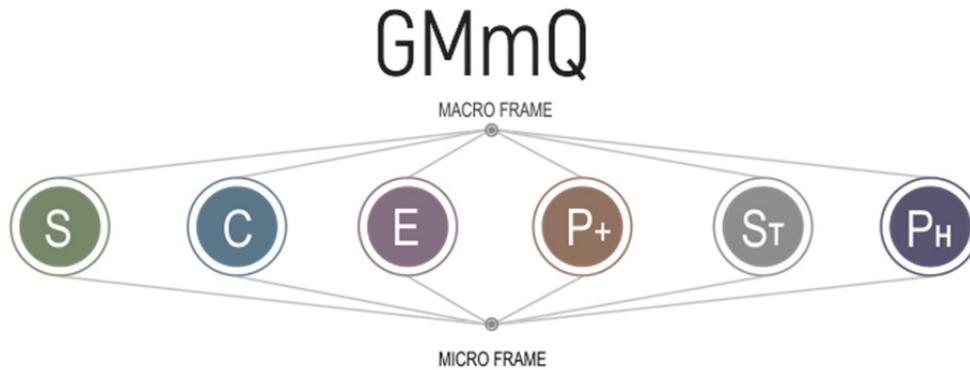
<sup>2</sup> Докладът е представен на 56-та Научна конференция на Русенски университет „Ангел Кънчев“ и Съюз на учените – Русе „Индустрия 4.0 Бизнес среда. Качество на живот“ с оригинално заглавие на български език: Обобщен методологичен модел на качеството на висшето образование

In 2015 standards and guidelines for quality assurance in the European Higher Education Area (ESG) [20] were approved. This year, the practical implementation of the new rating systems of the National Evaluation and Accreditation Agency (NEAA), which were adopted by the Accreditation Council of NEAA on 10 October 2016, began. [26]. The Strategy for Development of Higher Education [25] in the Republic of Bulgaria for the period 2014-2020 is in the process of being implemented. In this regard, this report presents a conceptual methodological model of quality in higher education.

**EXPOSITION**

**GENERALIZED METHODOLOGICAL MODEL OF QUALITY, GMmQ**

The generalized methodological model of quality is represented by two distinct branches known as a micro and macro frame. The macro frame is a holistic approach to the formation of system lighting design. The micro frame aims at identifying separate basic fragments. The general micro and macro framework forms a *holistic ad-hoc picture* of six dominants (fig.1), searching for the new educational vision, closely considering the past and present experiences. Due to its structural flexibility the GMmQ model allows it to be widely applicable in other fields of science. In this case, the model is assigned to higher education and contemporary practical training in lighting design.



**Fig.1.** Generalized methodological model of quality, **GMmQ**. Dominants: Systemology (S), Creativity (C), Expert Assessments (E), Good Practices (P+), Standards (St), Philosophy (Ph).

**I. SYSTEMOLOGY:MACROFRAME**

Lighting design occupies a specific interdisciplinary niche. It involves a set of approaches based on different sciences, (table 1).

*Table 1*

Micro and macro frame of the educational curriculum in lighting design at Rouse University.

**MICRO AND MACRO FRAME. LIGHTING DESIGN**

<b>1. Lighting Design</b>		<b>2. Industrial Design</b>	
1.1. Architectural lighting	1.4. Street and Road lighting	2.1. Product design	2.4. Automotive and Transp. design
1.2. Interior lighting	1.5. Automotive lighting	2.2. Graphic design	2.5. Lighting installations
1.3. Advertisings-Information lighting		2.3. Interior design	
<b>3. Concept thinking</b>			
3.1. SATI (SATI +)	3.5. Design Strategies	3.9. Creative-innovative technologies	
3.2. Automotive Lighting Sculpture	3.6. Synergy Bridges	3.10. Borders of Lighting design. Beyond Borders	
3.3 Gestalicht (Lighting organization)	3.7. Progressive non-linear systems	3.11. Concept design	
3.4. Metasculptures	3.8. Generalized hexagonal model of lighting environment	3.12. Quantum creativity. Authentic creativity	

The application of a systemic interdisciplinary approach [5,18,19] in the lighting environment design process forms the so-called systemic lighting design. The individual approaches involved in the general systemic framework are interconnected, interactive and complementary to one another, thus achieving a complex lighting solution. (table 2).

Table 2

Application of a systemic interdisciplinary approach

**SYSTEMOLOGY:MACROFRAME**

<b>SATI</b>	The methodological lighting design model <b>SATI (System Approach Towards Illumination)</b> includes 12 fundamental approaches that aim to build sustainable lighting systems. [9,11]. At present, the system is in the second stage of development, "SATI+", with an additional focus on technology, semantics, ethics, light security and politics.
<b>SLD</b>	<b>Semantics of Lighting Design, SLD</b> has a major role in formulating targeted strategies and tactics in lighting design. The quality of lighting design implies their synchronization (working together) and harmonization (reaching the state of synergy). The semantics of lighting design recognizes the process of revealing, unfolding the conceptual alternative of modern times: "Borders of Lighting Design" and "Beyond Borders".
<b>GHMLE</b>	<b>Generalized Hexagonal Model Of Lighting Environment, GHMLE.</b> The model includes: the systemology of lighting design; the theory of lighting composition and lighting environment; the structure of the lighting composition and lighting environment; the semantics of lighting design; the culture (harmonization) of the lighting organization; the evaluation system.

**SYSTEMOLOGY:MICROFRAME**

**LIGHTING CULTURE. LIGHTING ORGANIZATION.**

The organization of light is represented by a *pyramidal model of four hierarchical levels* - basic level (light) and four additional building levels [15,17]: "light - lighting - lighting systems - lighting environment – smart cities". The harmonized lighting environment is achieved by applying a set of components that lay out the lighting culture itself (table 3), [17].

Table 3

Components of lighting culture. Multi-factor and interdisciplinarity nature of lighting design

**LIGHTING CULTURE. COMPONENTS**

System approach	Methodology	Analyticity	Assessment system	Semantics	Social aspects
Lighting Factor-based Environment	Retrospection	Actual status	Forecasting	Professionalization	Psychology
Every street with its own appearance	"Visible" expenses	Intellectual property	Innovation culture	Restrictive conditions	Others
<b>RATIONALITY</b>	Rational use of electrical energy for lighting. <b>SAVED ENERGY IS THE CHEAPEST</b> - in addition, it does not pollute. Therefore, the culture of industrial lighting starts from the rational use of electricity, with the implementation of adequate energy saving measures. [11,12].				
<b>DEMOCRATICITY</b>	Democracy (energy and light-based technology culture) - with <b>EQUAL ACCESS WITHOUT RESTRICTIONS FOR ALL INDIVIDUALS</b> ; of appropriate quantity and quality, lighting is designed to provide an <b>ADEQUATE QUALITY OF LIFE</b> . The ethical approach to system lighting design is at the core of the lighting culture.				
<b>ETHICS</b>	Professional ethics in system lighting design. The development of light-based technics and technologies is related to the <b>INHERENT HUMAN STRIVING FOR THE NEW AND THE BEAUTIFUL</b> - to the satisfaction of the vital necessities of light.				
<b>INDIVIDUALIZATION</b>	The individual approach (human-centric lighting) enables the realization of lighting; that corresponds to the nature of the visual work and is adapted to the observer with his/her <b>INDIVIDUAL SPECIFICS</b> , incl. age peculiarities.				

**II. CREATIVITY: MACROFRAME**

The system lighting design is a potential productive area for the development of creative thinking. The training in lighting technics and lighting design takes place in the discipline "Lighting Techniques" at the Department of Industrial Design, Rouse University. Its aim is to consolidate the students' professional knowledge of contemporary lighting technologies and to create skills for practical application of the basic methods and approaches in solving various lighting design tasks. Priority has been given to the modeling process of the lighting environment and the influence of intuitive thinking in the search for creative original solutions (*fractal thinking*) (table 4,5).

Good education forms a system of basic knowledge and skills according to the state educational requirements. The university training programme aims to stimulate the realization of competitiveness in the students. The results of the implementation of creative techniques and technologies, incl. the intuitive search for creative solutions implies that students discover a new, unfamiliar to them, creative ground (fractal thinking) that stimulates the creative process in the search for adequate innovative solutions.

Table 4

Systematization of operations leading to the formation of creative thinking in the field of system lighting design

**CREATIVE THINKING: MACROFRAME**

<b>Basic knowledge</b>	The process starts by the formation of basic knowledge in the field of lighting, incl. the system sequence: light, lighting; lighting systems; lighting environment.
<b>Evoking an interest</b>	Evoking an interest in students. Targeting - the formation of creative thinking should be realized by achieving the following main goals: activation and utilization of the personal design potential; raising moral categories (taking into account the public significance and impact of lighting design products); creating skills to systematize the knowledge fundamentals; realizing the process chain from creative thinking to creating innovation and practical application.
<b>Select an object</b>	The student, after a preliminary discussion-talk with the lecturer (the one who co-runs the project), chooses the theme of his/her project according to personal preferences. Establishment of a potential lighting design niche.
<b>Operating principle</b>	There is no limit to ideas. Priority is given to original solution differentiating from the well-known ones, without limitation of ideas and whims in regard to capabilities of modern light-based technology to the aim of building different concept solutions
<b>Innovative approaches</b>	Targeting innovative approaches in lighting design. Switching from single and specific lighting solutions to applying a system approach incl. brain storming; morphological analysis; synergy bridges.
<b>Application of innovative solutions</b>	Targeting the application of innovative high-tech lighting products and solutions. The good knowledge of high-tech light technology is the basis for the development of creative thinking. Application of LEDs - technological transition from conventional to semiconductor lighting equipment.
<b>Professional terminology</b>	Acquiring and applying the correct terminology database. Scientific and professional terminology of standard Bulgarian technical language (and in English language, respectively)
<b>Presentation</b>	Presentation and discussion of the findings, awareness of the results of the creative activity and building self-esteem and conviction in the student's own creative capabilities.
<b>Team building formations</b>	The process ends up by creative team building formations in favor of future activities in subsequent periods apart from direct student activities as well as for future professional realization in the field of lighting design with potential employers, leading lighting designers, professionals, scientists and others.

Table 5

Systematization of operations leading to the formation of intuitive thinking in the field of system lighting design

**INTUITIVE APPROACH TO SEARCHING FOR SOLUTIONS: MICROFRAME**

<b>Task</b>	Students are given a problem to solve.
<b>Picture</b>	Students are presented with an abstract picture. The abstract picture is a metaphor - an open non-linear system that initiates the impulse for creative inspiration. The abstract picture is a visual metaphor that serves as a generator of ideas without limits.
<b>Generate a word</b>	Each student is invited to write the first word with which he/she associates the observed abstract picture.
<b>Play by words</b>	The word is written vertically, so each letter lies on a separate line. In it the student randomly generates words starting with the corresponding letter, located on the corresponding line, etc. "Play by words," following <i>Gianni Rodari's Grammatica della fantasia</i> .
<b>Semantic appearance</b>	Random selection of words taken from each line draws a sentence, which in most cases does not have any definite meaning, but has the potential to divert the attention to a direction different from that to which the originally defined problem is associated. This is a process of complete abstraction.
<b>Shaping the new meaning</b>	Formal logic processes the "vague" sentence until it gets a clearer picture of the meaning. Intuition again guides the direction of thought vectors. The students spontaneously begin to "shape" new waves of individual meanings and ideas.
<b>Modulation of meaning</b>	The newly created sentence is tested - free sentences' associations are generated to the given problem, hence opportunities to solve the problem.
<b>Antisymmetry modulation</b>	If no option is reached, the words in the sentence are replaced by their opposite-nuanced meaning equivalents; for example liquid-hardness; softness-ice cream.
<b>Dysymmetry modulation</b>	A spontaneously selected foreign word is added to the sentence. It is the "last chance" moment of unlocking the new idea.
<b>Fomulating a solution</b>	Consciousness is directed to an opportunity to solve the problem.

**III. EXPERT ASSESSMENTS: MACROFRAME**

Table 6 presents the macroframe involving a set of factors characterizing the complex nature of the lighting environment in Bulgaria according to an expert assessment of national specialists in lighting engineering [11]. The microframe represents an aesthetics based assessing system, the core of which is the status of *aesthetic acceptance* (5-point scale, positive and negative status, respectively partial/full acceptance/non-acceptance) that can be applied for various types of lighting. The ratings are normalized according to the weight of the aesthetics criterion for the class (table 7). The evaluation itself is recommended to be given by a group of 5 independent experts

included in a national expert list, with a random choice of the evaluating participants in a particular procurement procedure [13].

**Table 6**  
Factor Expert Assessment of the Lighting Environment in Bulgaria

**EXPERT ASSESSMENT:MACROFRAME**

A factor directly associated with ensuring people's safety	18.57	Factor related to global warming	5.10
Infrastructure factor	16.70	Biological factor	2.80
<b>Aesthetics factor</b>	<b>10.04</b>	A factor related to the quality of life	3.03
Ecological factor (light pollution, harmful waste and radiation)	8.15	Social factor	2.10
Psycho-physiological factor	5.98	Energy factor	9.79
Visual communication factor	5.94	Economic factor	11.80

In [13] there has been proposed a methodology for a *five-step expert evaluation of aesthetic acceptance* that can be applied to assess the various types of public outdoor lighting. *Table 7* briefly presents the proposed assessment system for aesthetic acceptance in the five-point system.

**Table 7**  
Classes of application of artificial lighting

Criterion rating	Status of aesthetic acceptance	Expert evaluation
<b>High grade</b>	Positive status of complete aesthetic acceptance, original design with artistic value	5
<b>Very good grade</b>	Positive status of complete aesthetic acceptance.	4
<b>Good grade</b>	Positive status of partial acceptance.	3
<b>Sufficient grade</b>	Negative status of partial aesthetic non-acceptance.	1
<b>Insufficient grade</b>	Negative status of complete aesthetic non-acceptance.	0

**IV. GOOD PRACTICES**

The culture of public procurement implies the application of good practices. The aptitude of the solutions that make up the lighting environment affects the culture of public procurement. The extension of the concept of *Good Practice* + covers the aesthetic factor as an upgrade to classical good practice because the "audience" is not indifferent to the aesthetization of the lighting environment in the urban areas and suburbs as well (table 8).

**Table 8**  
System operations in the organization and implementation of public procurement. Pyramid model: microfracture

**GOOD PRACTICES +**

<b>Aesthetic factor (10%)</b>	Some experts believe that public lighting procurement (particularly street lighting, and other types of functional lighting) do not require the employment of an aesthetic approach in regard to lighting products and solutions. However, the German approach to street lighting public procurement projects give 10% weight value of the aesthetic factor within the overall assessment of all other factors (cost, energy efficiency, operational efficiency) [7,8]. A representative study of an expert assessment of the lighting environment in the Republic of Bulgaria [10] shows that the relative weight of the aesthetic factor from a total of 12 factors of the lighting environment was estimated at 10.04%. It should be noted that public lighting luminaires are visually perceived by their appearance during the day, and hence their respective aesthetic outlook value as well.
<b>Target group</b>	Public lighting systems (including street lighting) must satisfy the full range of tastes and requirements, taking into account mentality, age structure, claims, in some particular cases and ethnic particularities.
<b>Settlement characteristics</b>	General picture of the settlement with regard to population, history, national psychology, traditions, position (including municipal or regional center, capital, etc.); architectural and town-planning features (including the general plan of the settlement);
<b>General lighting scheme of the environ.</b>	General lighting scheme of the environment in accordance with the master plan, if it is developed beforehand. A visual balance between functionality and aesthetics of the lighting system. [10].
<b>Status of the existing constructions</b>	Status and appearance of existing structures for positioning the luminaires (pillars, walls, trunks, consoles, other elements). It depends on professional judgment to determine the extent to which the project provides a solution for their preservation, rehabilitation, complete reconstruction and / or replacement, a new complete solution.
<b>Economic conditions and opportunities</b>	Economic conditions and opportunities. They should not be conclusive, but several times they lead to lighting design solutions with corresponding qualities, aesthetic values and emotional impact.
<b>Other requirements</b>	Other requirements, e.g. related to the realization of lighting systems under different European and national programs, which require consideration of additional factors such as renovation of the settlement environment, construction of village structures of regional and national importance, festivity, seasonality, etc.

**GOOD PRACTICES**

**FORMAL PRACTICES**

**V. INTERNATIONAL HIGHER EDUCATION.**

Lighting and lighting design in the national area of higher education. Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) have been approved at the Conference of Ministers in charge of Higher Education in the European Union. The event held on 14-15 May 2015 in Yerevan. Higher education, in the context of ESG (table 9), contains the following highlights [20]:

*Table 9*

Higher education, in the context of ESG

<b>ESG highlights</b>	
<b>Innovations</b>	A crucial role of scientific research and innovative solutions in support of social unity, economic growth and global competitiveness;
<b>Knowledge</b>	Higher education is to play an essential role in the socio-economic and cultural development by the establishment of European communities dedicated to knowledge in particular.
<b>Adequacy</b>	An increasing demand for skills and competences requires that higher education should respond in a new way;
<b>Change</b>	Fundamental change in the learning and teaching approach: more focused on students; covering flexible training models; recognizing the competences acquired outside the formal curriculum;
<b>Missions</b>	Universities should become more diverse in terms of their missions, ways of delivering education and cooperation, including increasing internationalization, digital learning and new forms of education delivery;
<b>Assistance</b>	The crucial role of quality assurance in higher education systems and institutions as an adequate response to these changes by considering the qualifications achieved by students and their experience in higher education remain at the heart of the missions of the institutions.
<b>Quality of training</b>	The main objective of the ESG Standards and Guidelines for Quality Assurance is to contribute to the overall cross-border collaboration amongst all academic representatives. The term "quality assurance" covers all activities in the continuous improvement cycle - the quality assurance and improvement activities. ESG is used by quality assurance institutions and agencies as a reference document for internal and external quality assurance systems for higher education.
<b>General framework</b>	Setting a common framework of quality assurance systems for learning and teaching at European, national and institutional levels;
<b>European space</b>	Providing possibilities and enhancing the quality of higher education in the European Higher Education Area;
<b>Mutual trust</b>	Supporting mutual trust, thus facilitating recognition and mobility within and across national borders;
<b>Accessibility</b>	Providing quality assurance information to ENQA.

**CONCLUSION**

According to global tendencies [21] by 2020, LED lighting will be the world's first commercially viable technology, outpacing leading high-tech industries such as electric cars, photovoltaics, wind power, smart grids, heating, ventilation and conditioning. The world's light market is expected to increase its volume about 1.4 times. This implies the preparation of lighting designers with university education, based on educational documentation with interdisciplinary content.

*Table 10*

Lighting design training at Rousse University. Mission (2015). Philosophy

<b>MISSION (2015)</b>	
<b>Thorough design examinations and analyses</b>	Higher education has the aim to contribute to the students' ability to conduct thorough design examinations and analyses towards the new tendencies and technologies in contemporary lighting design as well as to identify the new times necessities and preferences.
<b>Original ideas</b>	To challenge students to develop their own personal original ideas of a strong innovative and creative nature.
<b>Communication skills improved</b>	To contribute to the development of students' technical, verbal, writing and representational skills
<b>Personal expression of harmony</b>	To help students develop their own personal expression of harmony, closely studying the experience of the past and present.
<b>Purposeful attractors</b>	To help Bulgarian and international students find their own targeted attractors, to support them develop here in Alma Mater of Rousse and share them as ambassadors of Bulgarian science and culture throughout the world.

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