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Strategy to promote dynamic lighting in accordance with social demands & the state of the art technology

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1. Abstract

Many municipalities have not started the implementation of Dynamic Lighting yet, due to the lack of knowledge about the potential for public space, the complex technology, the expected investment costs, and the right criteria for making the right choices.

By making accessible information on the process how a lighting concept based on the user needs can be developed and has been implemented in the project, municipalities, urban planners and infrastructure providers can make use of the experiences of the project partners which is summarized in the strategy for a successful implementation of dynamic light based on the needs of the users. The strategy is describing objectives and criteria which are transferable to other territories and stakeholders.

The strategy highlights that it is not predominantly a technical question how to make use of the potential of dynamic light, but even more important to analyse the use of spaces and to develop a lighting concept in order to provide adequate and accepted light in many user situations to make full potential of the use of dynamic light.

The strategy is describing objectives and relevant quality criteria based on the needs of the users. The perspective of the user offers several advantages for strategic approach, as decisions are not related to the functionality of the currently offered (and quickly changing) product ranges of manufacturers which are changing rapidly, but on quality criteria which are dedicated to a space and its specific kind of users and situations of use. So even when after some years technology and technical data have been changing, quality criteria are still valid and can be brought together with up to date technology solutions in order to provide the best service for the user and the space. Providing adequate lighting for the user in different situations results in a high acceptance of the new technology and the provision of high light quality. As the user needs need to be identified for each single installation individually, this strategy can be applied in all partner countries and regions and can be applied by all stakeholders.

In order to improve energy efficiency and lighting quality, it is important to provide light in the future as required at the desired time for the desired duration and a specific target group. 15 partners from seven countries of Central Europe cooperate in the project for the investigation and evaluation of typical lighting situations in the participating European municipalities. This should help to connect the technical aspects of lighting with urban planning concerns in order to exploit the technological possibilities. The aim is to optimize the lighting design of public spaces with dynamic light, while at the same time reducing the amount of light in favour of lower energy consumption and limited light pollution.

2. What is Dynamic Light?

Dynamic public lighting, hereinafter referred to as ”dynamic light”;, refers to adaptive and proactive lighting that provides light only where and at the time and in the quality required, where and when desired or needed. The goal is to increase the quality of evening public spaces while reducing light pollution and saving energy.

Adaptive lighting adapts to changing usage situations. For example, such as changing vehicle speed, traffic volume and / or composition, ambient luminance, weather, and other measurable external factors. The respective situation is detected by sensors, and the lighting changed accordingly.

A proactive lighting corresponds to the expected or desired usage situation. This makes it possible to offer the required lighting quality without a specific situation having already occurred. By digitizing and networking data that is available in different sources, for example, the lighting of a bus stop before the

arrival of the bus are designed so that it is optimal for embarking and disembarking and so call the waiting for getting ready for entry.

Dynamic Light combines adaptive and proactive lighting control with high-quality lighting that takes into account the physiological and psychological needs of people, such as the sense of security, as well as social, such as communication. Aesthetics and the relation to urban space play an important role, since the light is only visible where it illuminates. As a mediator between man and space, the quality of light can only be seen in the context of illuminated space.

If high-quality lighting in general and Dynamic Light in particular can increase the positive acceptance of a location, this form of lighting would be a decisive economic factor in addition to saving energy. Since with LED systems in addition to the luminous flux, the luminous intensity, light distribution and the light colour temperature and the colour rendering quality in a luminaire can be changed, expanded or limited, the required light quality can be adjusted according to the respective requirements.

In summary, Dynamic Light is sustainable lighting because it is ecological, economic and social.

Ecological quality:

Dynamic Light can reduce light pollution, respect fauna and flora when light is offered only in the place, only at the time and only as much as needed.

Thus, Dynamic Light is part of the concept of the "European cities of tomorrow", which protects the quality of the environment, the eco-efficiency is high and in which the economic progress is decoupled from the consumption of resources, by increasing the quality of the lighting and the negative influence the environment is reduced.[1]

Economic quality:

Dynamic Light can reduce the consumption of electrical energy if the lighting meets the requirements. Dynamic lighting can, if the lighting offers places for positive identification, increase the economic attractiveness of a community.

If "European Cities of Tomorrow" are to be places of great attractiveness and engines of economic growth with a high quality of life and attractive architecture, Dynamic Light can make a decisive contribution to this by ensuring that the special and careful design of a city continues into the evening and into the evening to get into the night.[2]

This will help local communities to attract the knowledge economy, skilled and creative workers and tourists;

Social quality:

Dynamic light can improve the quality and adequacy of public lighting when it is planned to meet the changing needs of users and their social activities! Thus, Dynamic Light supports the design of a high-quality, functional, user-oriented, urban space with an appropriate infrastructure.[3]

[1] See Territoriale Agenda der Europaischen Union 2020 (TA2020); S.22,ff

[2] ibid

[3] See ibid

3. Social Aspects

“The European cities of tomorrow" are places of far-reaching social progress; they are platforms for democracy, cultural dialogue and diversity; they are places of ecological renewal, and they are places of high attractiveness and motors of economic growth.” [4]

Dynamic Light serves this purpose by allowing the heritage and architectural value of historic buildings and public spaces in conjunction with, developing and enhancing the urban scene, landscape and urban space into the evening and night areas, and allowing it to set new accents which increasingly allow residents to identify with the urban environment. [5]

Lighting in the public space has an emotional effect on the user, which can be influenced by the cultural background of the viewer, but is also based on a number of universal assessments. “The urban lighting influences the emotions of observers. The emotions are linked to a cultural background as in the case of pleasant surprise; inspiration; unpleasant surprise; contempt; and disappointment. A special relation between the positive emotions and the visual information of the images was observed. In the images…..with clear visual information of the urban space, the participants agreed with positive answers; whereas in the negative reported images, visual information about the use or orientation of urban space was unclear”. [6]

It is particularly interesting that the experience of urban space has a great influence on its assessment. A reduced, just sufficient lighting thus serves less the above-described goals of sustainable urban development and thus sustainable lighting, if it affects the experience of urban space.

Example pedestrian areas:

In cities, the areas that serve pedestrian traffic, such as shopping streets and pedestrian areas, are multi-functional. Close observation of user behaviour opens the possibility of dynamic lighting adapted to it. Facade lighting, the bright lighting of pedestrian areas in shopping areas, supplemented by additional non-planned lighting through shop windows for new concepts can be used. The lighting of a pedestrian zone could consist of several components, a basic lighting for the central, necessary running area, a lighting that also includes the peripheral areas and creates distinguishable, atmospherically shaped evening urban spaces and a facade lighting that provides the vertical luminance, the are necessary for a good experience of the room.

However, it would also be conceivable to leave the entire lighting switched on for longer than usual in good weather and high user frequency, since it is to be expected that the citizens will spend more time in the pedestrian zone than usual. If the weather is bad, the shoppers, although there are still many on-site at the end of the shop, will go home immediately after closing time, so that now the deviation from the rule could be to do without the atmospheric lighting.

Around Christmas or on other special occasions, despite bad weather, all lighting could be available for a while, so as not to disturb the festive mood. In addition to a general recording of the frequency of the pedestrian area, a differentiated reaction to locally delineated areas is conceivable. Even every single

[4] Ibid, S.

[5] See ibid

[6] 6 Amparo Berenice, Calvillo Cortés, Luis Eduardo Falcón Morales;
Emotions and the Urban Lighting Environment: A Cross-Cultural Comparison;
SAGE Open, January-March 2016: 1–8, DOI: 10.1177/2158244016629708; sgo.sagepub.com

luminaire could, to a certain extent, react autonomously to the respective situation. This would allow further scenarios, including emergency notification of unusual events.

Dynamic Light creates a variety of atmospheres related to ambience and time that appeal to the viewer in different ways and better meet functional requirements than a uniform lighting that is typically averaged out of the various functions that has traditionally been installed. This usually represents a compromise between high quality of light and low cost and energy consumption. The goal of Dynamic Light is not much more light, but better, adequate lighting. This can also mean that there is little or no light in certain situations.

Seasonal and action-related scenarios may also play a role, where a barely perceptible transition from one scenario to another is desirable in order to maintain the constancy of the perception of public space, unless in special events the experiential character is in the foreground.

The lighting can look very different in the morning than in the evening, not only to take into account the circadian rhythm, but also to respond to the different patterns of behaviour during the day.

Joint Monitoring-Tool

The joint monitoring tool developed in this project was developed as a way of presenting what information needed to plan different lighting situations relevant to the particular use and social situation. A checklist with main topics is the starting point for the subsequent demand analysis.

The checklist collects information in the following categories:

1. Functionality of the area,
2. Analysis of the stakeholders
3. Built environment / urban structure, access and traffic
4. Usage time
5. Number of users and frequency of use
6. Inventory analysis of the lighting

The open nature of the checklist gives planners the opportunity to change the topics and sharpen their profile for each project. This means that planners have a responsibility to decide on the most relevant information categories for their location and to emphasize the collection and analysis of information for those areas. This judgemental analysis of the planning fundamentals is a crucial part of the design process and should be carried out consciously and reflectively for each new project.

Another important factor is the availability of information. Since clients and planners with different organizational backgrounds participate in the activity analysis, they differ in their ability to gather information. For example, municipalities could have easier access to statistics on crime or user frequency than other partners.

4. Demand Analysis

After identifying relevant topics and gathering the required information, the purpose of Needs Assessment is to organize and analyse the collected information to formulate lighting requirements for the various users, which are then translated into dynamic lighting functionalities. Formulating user's lighting requirements from the collected information is an essential step in ensuring that the lighting can be planned according to the social needs of the users.

By linking light changes to practical user activities, it ensures that light changes are motivated by what is happening in the area and respond to user expectations in the current situation.

5. Technical Aspects

Technically, it is possible to control each luminaire or to control each individual LED within a luminaire.

Changes in light intensity, light color and light distribution are possible at any time. In the meantime, connections between lights can be made wirelessly, and groups of lights can connect independently. Of course, it is still a challenge to plan a dynamic lighting system, but more and more sophisticated and mature systems facilitate the technical realization.

A bigger problem than the technical realization of the installations is deciding how the system is used and how it is configured.

Previous methods to control the lighting, for example, according to the user frequency, are reactive methods that always make the lighting adjustment only when the event has occurred. This is unsatisfactory because the environment should not change unexpectedly. Otherwise, the perception of the constancy of the space would be called into question and thus the reliability of the environmental conditions. The knowledge of the durability of the environment contributes significantly to the sense of security and thus to the usability of public areas. In doing so, the question of which changes are tolerable in which periods is to pay special attention.

The sensor and control technology is able to process complex signals. So far, there is no possibility of assigning the various signals according to different usage and environmental factors in such a way that a model arises which determines the illumination required in the next time unit.

6. In the “24 hours society”

With the digitization of everyday life and the digitization of urban infrastructure, more and more data about life in public space becomes available. Data from the Internet and data from urban infrastructure and government and local government systems can complement each other to better understand public space than ever before. This knowledge of public space, its features, and the nature of the users can be the basis for much better and situation-dependent provisioning of services based on the current “real-time” usage state.

Greater use of the possibilities of digitization in public space will lead to greater individualisation, with the possibility of individual control of the community increasing.

The illumination now no longer represents the claim to power of the state, which in turn is obliged to guarantee a uniform basic supply, but an offer that can be called up. This increases the design freedom..

7. Design process

Designing a Dynamic Light project is an intrusion into public space. As a result, many aspects in addition to the technological requirements of public lighting should be considered. Important factors include the social needs of end users or recipients, the environmental impact of the intervention and the legal and regulatory framework that influence urban planning. In addition, due to the innovative nature of dynamic lighting solutions, the municipalities may not want to implement such projects over the necessary human resources. Based on the experiences of the communities that have implemented such solutions on a pilot

basis within the Dynamic Light project, it is advisable to develop synergies with private developers working in this field.

The previously described goals of Dynamic Light also lead to a changed planning process. So far, the planning in the lighting in public space has focused primarily on compliance with standards that reflect predominantly on motorists as users of public space. The results of the planning lead to a uniformity of the public space, which leaves little play for a challenge lighting in the sense described above. Despite the need for a changed planning process, Dynamic Light is often tried to develop in the manner of technology-oriented planning.

8. Technology-orientated design

Technology-oriented design is the most widely used planning method when it comes to designing dynamic lighting solutions, as it is obvious that Dynamic Light is based on a series of technical innovations, each of which already has a limited benefit for the communities. The LED technology alone offers considerable energy savings and, with good planning, a better quality of light. The networked control allows better monitoring and maintenance of the lighting systems. A sensor-controlled control system offers the option of completely or partially switching off the lighting in sensitive areas without having to completely forego lighting options. Here you essentially follow the steps below.

Which data can I collect and how?

This should clarify which technical possibilities are as easy as possible to gain data. (The lighting infrastructure is ideal for data acquisition)

How do I evaluate the data?

What relevant information can I extract from it to improve my technological and administrative processes?

What technologies are available to use the data?

Are there the simplest possible technologies to use this data, can processes be automated?

What improvements are there for the lighting in the previous steps?

Are there any qualitative improvements from these possibilities?

Programming algorithms!

In the final programming of algorithms, technical parameters remain in the foreground, the sustainability of the lighting takes a back seat.

This design based on the analysis of technological and analytical possibilities puts the needs of the user second. As a result, the potential for sustainable lighting planning can generally only be used insufficiently.

9. User-orientated design

The choice of technology must be in line with the lighting requirements that meet user needs in order to fully exploit the potential of public space. The so-called Rittel dilemma (1973) “Systemic planning processes can not solve social problems, but technical problems already” explain why technology-oriented planning is often used. In the project "Dynamic Light" methods were developed to describe approaches for a socially motivated planning process. Dynamic light could be part of initiatives for creating places that aim to make places more liveable by promoting specific user situations and a diverse and vibrant use of the physical environment.

For this the above questionnaire is extended.

Who is the user?

Certain population groups, older people, for example, have special lighting requirements.

What requirements does the user have?

Light changes its function with the user situation and can provide different qualities and moods that seem appropriate to provide a better quality of life at a particular time. (In other cases, energy efficiency could be the priority, and the light could be aimed at avoiding unneeded light, resulting in low energy consumption.)

What improvements can I offer the user?

Since lighting can transform the perception of public space into different moods with relatively little effort, it is a suitable medium for making the building environment flexible and interactive. Lighting can not only move people in the evenings or make them feel safer in certain environments, but it can also change the perception of spaces and encourage them to use a space in a specific way. These proposed uses can change dynamically. And thus enable a more intensive and versatile use of public infrastructure.

Encounters and meetings could be promoted to develop common experiences in the public space. For certain occasions, stories could be told using dynamic light (and other media or interventions). Stories can be told, unique user experiences can be arranged.

Who decides and who benefits?

Municipalities must avoid the risks of a sector-specific view, for example, purely on the improvement of the lighting infrastructure, based solely on technology. The dimension of the problems, engaging in the urban structure and the social potentials, requires a deeper understanding of the chances of qualitative improvement and possible technical answers within a broader social context.

Which technologies are available and what can be used for their benefits?
What data do I have to collect for this? How do I evaluate the data?

These are questions that describe steps in the design process that are similar to those already described in the technology oriented design.

Programming algorithms!

This transition from the lighting requirements to a control scheme that describes the light scenes (consisting of colour temperature, luminous intensity and light distribution) and how they are triggered (time, brightness, presence, tra In order to make the design process as transparent and successful as possible, it is worth mentioning to include citizens in the definition of lighting requirements. From the Chicago Lighting Project, the following four indications were derived, which are also confirmed in our pilot actions.

1.) Transparency is valuable

2.) Urban ideas have to be pragmatic

3.) message for the press

4.) Clarify the value of open data initiatives

Gathering data in public space has long been commonplace. Together with the citizens it has to be decided which ones should and must be used in order to find satisfactory algorithms for the use of Dynamic Light.

10. Policy Paper

When it comes to the willingness of local authorities to consider the implementation of dynamic public lighting in the expansion, renewal or modernization of the public lighting infrastructure in their area, it is obvious that most of them are interested and the recognize positive effects.

But there are also significant obstacles. The majority of local authorities in our project identified insufficient financial resources as the main obstacle to introducing the dynamic public lighting system. In addition to the financial difficulties, many respondents feel that they do not have enough knowledge about this type of technology and do not even get enough information about it. Another important obstacle is the lack of competences, i. professional staff employed in local administrative units.

Therefore, here is a strategy to control the process of implementation.

FACTS / PROBLEM

“Our cities face a number of challenges that are challenging each and every one of them. Diversity must be transformed into a positive driving force for innovation and attractiveness, supporting and not undermining cohesion. Cities must adapt their economic strategies and social services to an aging population. In order to develop an environmentally friendly, healthy and attractive city, a holistic approach to environmental and energy issues needs to be pursued. Pollution and unsustainable use of raw

materials must be reduced, mobility must be sustainable, inclusive and healthy. Public space needs to be upgraded again.“ [7]

Light plays a crucial role and is comparatively inexpensive when it comes to improving the infrastructure and adapting the construction environment to current developments. (For example, more comfortable, easier to orient and create a feeling for public / private situations.) Dynamic Light offers the possibility of high quality in terms of a livable, economically attractive and environmentally friendly, so sustainable lighting of the evening public space to ensure. For this purpose, the lighting should be adapted as far as possible to the respective usage situation.

In order to recognize the usage situation, the luminaire must be provided with corresponding data. (Different record for different user situations, this may be the time in the simplest case or the camera monitoring in the most complex case). The use of the data should help to determine the current and future user situation in order to adjust the lighting accordingly.

Obstacle 1: Administration:

The organizational structure within the cities is divided into offices. Interdisciplinary issues / topics (such as digitization / smart city) will require discussion and decision-making in a wider range of ministries, and will cover more areas; the synergies of the combination of technologies and data will show their impact on a larger scale.

The existing administrative structures are still based on the well-known analog technologies. So the lighting is often assigned to civil engineering, as well as the entire traditional infrastructure. However, Dynamic Light expands the content of lighting, so that an assignment for urban design in cooperation with social institutions, etc. must be designed interdisciplinary.

Measure:

A modern administration with simplified hierarchies allows for an interdisciplinary approach, also involving citizens in “Citizen Labs” and “Citizen Science”.

From the project we know that each community has to find its own approach on how to use the relevant information as a basis for the demand analysis, especially because Dynamic Light requires site-related decisions.

This requires training or workshop activities. To initiate this process, a clear objective and a commitment to sustainability of the top management is required.

One way to reorganize the administration is to use a Chief Information Officer (CIO).

In particular, the CIO would be responsible for managing the three IT roles

- Strategy and IT vision (planning)
- Design of the IT architecture (technology selection together with the IT architect or CTO)
- Implementation of the IT services of the municipality

With regard to Dynamic Light, the CIO would be responsible for involving all relevant parts of the

administration, obtaining and evaluating the required data and involving citizens in deciding how to use the data. He sets new strategies and uses technologies to improve the final result. [8]

[7] Smart city charta

Bundesinstitut für Bau, Stadt-, Raumforschung, Bundesministerium für Umwelt, Naturschutz, Bau und ReaktorsicherheitS. 86

[8] https://www.d-level.de/berufsverzeichnis/cio--chief-information-officer-mw

Obstacle 2: Analog technologies in the transition to digitization

Linking different technologies and analysing a growing number of data sources makes it easier than ever to understand public life and the use of public space. The potential for using and combining different types of data to manage public space is enormous. The more data from different areas are involved, the greater the consequences for different neighbourhoods.

Lighting devices are available in each street and can be used to collect a variety of data that can be used to manage other services in public space.

There are limitations to the existing infrastructure. The installed devices do not always allow the use of the new features because the new systems are not always compatible with the existing systems.

For example, a large number of light poles are not connected to the mains during the daytime. This meant that sensors and measuring devices could not be supplied with power during the day.

Measure:

The introduction of "Dynamic Light" should always be linked to a master plan, which includes the transformation of the entire lighting system into a sustainable one. As a result, the inevitable "isolated solutions" can be combined in the long term into a functioning overall system. Despite the difficulties, renewal measures should always be planned and implemented for the future. To shy away from the size of the problem is not to have a plan for the future.

Obstacle 4: Market and sales system

The advent of LED technology has greatly expanded the functionality of street lighting, but due to the limited availability in the market, it is not always possible to take advantage of the variety of functions. Currently, luminaires and control systems on the market are designed to provide the functionality of "analog street lighting" available in recent years and decades. However, these features improve the efficiency of street lighting. The current focus is on the efficiency of lighting systems and not so much on the quality of light and all the possibilities that digitally controlled lighting could offer to public spaces. Thinking about street lighting is still within the bounds of old technology and has the advantage of improving efficiency with the new technology.

Compatibility: Systems from different manufacturers are not interchangeable. For example, DALI lighting control systems from one manufacturer do not work with luminaires or sensors from other manufacturers. Not all DALI systems offer the same functionality and work with the same protocols.

As a rule, DALI systems are connected to the luminaires via a bus system. You can give instructions for each individual component of the DALI system. So all components are addressable. In street lighting, some DALI systems can not respond to individual luminaires, but are designed for a very limited functionality. These components send a "broadcast" to all connected lights, which then perform the same operation. (Example: All lights on a light pole are dimmed or switched at the same time.) This limited functionality is often sufficient for today's type of street lighting, which has developed from the use of technologies in recent decades on the basis of a completely different lighting technology.

In the meantime, lighting in lamp posts is becoming more and more multifunctional: the lighting for the street, the lighting for the footpath and the lighting for the facade can be realized from a single pole or even from a single pole. To control these different functions via the light tower and / or the luminaire, control systems are required that address individual luminaires or even a large number of LEDs in the luminaires.

Measure:

As this is supply and demand, manufacturers may be encouraged by an increased demand for an improved offer of Dynamic Light. It would also be an opportunity if renowned manufacturers recognized Dynamic Light as a unique selling proposition and a competitive advantage.It is also important that the lighting designers and other experts recognize that the lamp post is more than just a data source or a charging station, but rather crucially also the tool for the design of the evening space.

Obstacle 5: User acceptance

The communities generally have a higher level of information about the potential of technology and available technology than the population. Lighting is generally not considered negative, no matter how low the quality of the lighting is.

Ideally, public spaces should be multifunctional and cross-generational, as well as old and child- friendly, and serve as meeting places as well as for specific public functions such as libraries, playgrounds, education, etc.

This goal can be supported with Dynamic Light.

The mere reduction of CO 2 emissions has few immediate benefits for the cities. As a new lighting promises more quality, but also represents a fundamental change from the usual, is considered critical.

Measure:

It is therefore necessary to increase the acceptance and knowledge of the benefits through examples and the involvement of citizens in the decision-making process.

One means is information events and integrative planning processes.

Even for this group of professionals, the level of information and experience can not be described as high. Therefore, training and demonstration of existing projects are useful measures to improve knowledge as a basis for discussion (and procurement). Preferably, training should be organized (or extended) by independent consultants in favor of industry professionals who are tempted to provide information primarily based on their available product range rather than being interested in the needs of site users.

Obstacle 6: Costs

An obstacle to the implementation of dynamic light is certainly the high additional cost of purchase for dynamic lighting systems. Many municipalities indicated that this is an important barrier to investing in Dynamic Light.

Measure:

Here it is necessary to draw up a total cost calculation, which also considers the profits in other areas than the lighting. This is difficult with soft benchmarks such as room comfort, or well-being of users. However, higher sales or reduced vacancies are indications that also count for other quality improvement measures, such as replacement of the plaster, which is much more expensive.

11. Summary

At the moment it seems a good time to implement and test dynamic opportunities because the general public is very interested in this modern form of lighting and seems to be surprisingly open to the variaton of the lighting conditions. This situation offers good possibilities to implement dynamic lighting and find out where dynamic light with the most advantages and with the highest acceptance can be implemented. More information and personal experience would be needed to consolidate the current expectations. Since communication about public light in general and especially about dynamic light, that the majority of people don't experience personally, simulations and practical installations seem to be suitable.

Measures to improve knowledge about dynamic light and the experience of users have to be taken to practically test the change in lighting conditions.

12. Outlook into the future

Urban spaces are increasingly experienced as relative rather than an absolute value. Furthermore, there is a tendency to shrink the sense of public space. The city is developing into more and more private clusters loosely connected "islands" or zones. These changes to shopping blocks, entertainment centers, business parks are also changing the scale of the city. These developments give rise to the need for a flexible and adaptable lighting systems. Lighting systems created by such urban changes need to respond to new and unique requirements. Light requirement is always individual, not bound by time and space.

Such changes in the need for lighting, eventually lead to rethinking in the approach of public lighting. Public lighting does not have to be tied by a specific time or place. Good quality light can not be confined to the business centers anymore.

Evolving urban lifestyle: The technological revolution has brought a quantum leap in our lifestyle - constantly connected to the world over electronic devices. This has led to a shrinking world where physical distances no longer matter. Technology has broken the traditional boundaries of time, distance and space. The real purpose for public lighting is being transformed as a result of these changes, the need for functional lighting from point A to point B will be replaced by the need to have proper quality of light for social interaction, entertainment, sharing and awareness ,

Social media platforms along with the ubiquitous smartphones provide innovative methods for designers and city planners to better understand a city, its features and the user's behavior.

Many social media platforms allow posting and uploading of status, location and especially photos. Such information, which is freely and openly available on the Internet, can be used as a powerful tool for urban design analysis, tourist and public movement, time and length of stay, complaints and problems just to name a few. Internet of Things and Big Data: The concept of IoT is simple, everyday objects become network connectivity, allowing them to send and receive data over a network, whether that is wired or wireless. Sensors can detect motion, direction, tread, ambient light, temperature, light output, color

temperature, quality, and operating temperatures. On-board processors can analyze on-site the data they receive or upload to the central management system.

Self-Learning and Correcting Systems: Dynamic lighting control allows for the consideration of an intelligent self-learning system that learns from itself and implements changes and modifications as required. The wide range of sensors, controls and data processing applications offers the unique opportunity to study and learn from various parameters, variables and conditions. Such solutions can affect the various parameters and variables affecting public lighting in a situation, and by ways of big-data and data processing that analyze lighting conditions in the future. SMART indicators for a “smart city” can be easily learned and predicted: the traditional SMART indicators are defined as follows:

- Specifically,

- Measurable,

- Reachable,

- Relevant and

-Limited

The Smart Indicators are a tool that allows each set of actors to measure progress in their own area, as well as indicators that work beyond the state of other sectors such as checks and balances. This set of indicators can be easily adapted to public lighting, allowing for the assessment of the broad and comprehensive vision of a desired future for a location, but also include the detailed measures of success that indicate positive progress towards that vision.