Digitalizing Urban Lighting
Technological Change Raises Political Issues by Transforming City Spaces

Nona Schulte–Römer

Summary: Recent technical developments serve to promote the digitalization of public lighting. Along with these technical innovations sociopolitical questions arise that reach far beyond such functional aspects as security, or the need for a certain light color or product design. The growing demand for 'intelligent' control systems and high-quality light give rise to more general questions: Which criteria should be used to evaluate public lighting, and what is the basis for discussing and negotiating the various concerns?

"The digitalization of lighting is picking up speed", so the press release for the 2012 Light+Building, the world's leading annual trade fair for lighting in Frankfurt/Main, Germany. Cities and municipalities are already testing so-called intelligent lighting concepts in pilot projects. In such experiments, streets or walkways are minimally lit until a vehicle or pedestrian triggers a sensor signal, thus causing the lights to peak for a brief period. The selection of conceivable systems is large, ranging from presence detectors and video cameras to interlinked lighting and energy infrastructures that take traffic volume as well as the feed-in of renewable energy sources into account. The main aim of these new lighting concepts is to save energy.

The light emitting diode, or LED, plays a key role in any discussion about the future of public lighting. The beaming chips mark the transformation from electric lighting to electronics. While in traditional light sources gas is discharged or a glowing filament radiates light and heat, solid state lighting technology like LEDs and the organic OLEDS is based on electroluminescence. Diodes are especially advantageous for lighting control and system solutions because they can be gradually dimmed from zero to one hundred percent or quickly switched on and off. In contrast, gas-discharge lamps take minutes until they reach their full level of brightness, therefore making high switching frequencies impossible.

LEDs are also part of the European Commission's future-oriented lighting solutions as presented in its "Digital Agenda for Europe". In December 2011, the Commission published the Green Paper "Lighting the Future" to advance the market uptake for solid state lighting products. "Expanding LED lighting is a 'no-brainer'", explains Neelie Kroes, the European Commission's Vice President. "It means more money in your pocket, and a healthier planet." The new technology also allows the Commission to align its European innovation policy with its climate change policy. After outphasing incandescent light bulbs and high-pressure mercury-vapour streetlamps, LEDs are expected to meet high energy efficiency standards as they are laid out in the European Ecodesign Directive.

The pressure to act is complemented by national and European support schemes and incentives such as the ESOLi (Energy Saving Outdoor Lighting) programme. The initiative for intelligent outdoor lighting systems promises a 64 percent reduction in energy consumption if European cities and municipalities implement "modern street lighting". German federal ministries have set up grants and awards for municipalities that refit their aging infrastructures with LED technology.

Despite political support and the impressive developments in solid-state technology, the digitalization of public lighting is not self-evident. The new challenges and chances in the field of public lighting raise political issues in that highly technical province of engineers and electricians. Developing sensor technology and standards for LED products is the key to commercializing innovation. Solving organizational constraints and establishing best practices is the key to the future of public lighting. How should digital electronic systems that light our cities be programmed and managed in the long term without interrupting operations and in view of staff resources and competencies?

The intelligent control of public lighting offers a great energy saving potential. However, the history of public lighting suggests that energy efficiency has never been the sole criteria for appropriate public lighting systems: were that so, the most effective solution would be to just switch off the lights! While those who prefer a dark night sky might support this step, it conflicts with security concerns, urban lifestyles, and economic and sales interests.

Thus, the new options for lighting night-time public spaces raise basic social questions that go beyond technical savvy and skill. Whose sense of security can be compromised under which circumstances to reduce public energy consumption? The new flexibility calls for new considerations and decision-making. While the criteria for switching on the lights between dusk and dawn can be determined quite objectively, 'intelligent' systems concern more heterogeneous needs. Arguments like cost- and energy-efficiency, security aspects and surveillance options now compete with more subjective quests for high quality urban spaces and atmospheres and might conflict with concerns regarding light pollution.

Measuring the value of feeling safe opposed to that of a dark sky is a difficult task. There is no universal solution, nor is there only one method to assess these different aspects of light and their relevance for a particular place. Wherever offices of city planning, city marketing and cultural heritage preservation cooperate with civil engineering authorities and energy providers, the challenge of public lighting exceeds mere technical requirements.

Meanwhile, lighting concepts and master plans have abounded in European cities and municipalities since the 1990s. A WZB survey of 38 large German cities has shown that integrated urban light planning nearly doubled between 2000 and 2010. Such cross-divisional urban policy can improve the perceived quality of urban spaces. However, existing examples differ considerably in scope and success.

"The right light at the right time in the right place", is a goal that lighting designers, city planners, manufacturers and politicians share. But it is not yet clear who is to judge and decide which light is considered to be the best suited one. Light sensitivity varies not just from person to person but also in a cultural sense. What methods should be used to identify the 'right light', and where and when it can be dimmed or even switched off?

Depending on whom you ask, the responses may differ – not only because of the opposing interests of city planners, manufacturers and lighting designers, but also because of their different approaches and their various instruments for producing knowledge.

The European road lighting standard EN 13201, for example, proposes important scientific guidelines for measuring the brightness of public spaces and lighting for various types of streets. The recommendations regarding the photometric values are based on physical and physiological findings like the scientific fact that for the human eye the sensation of brightness is highest in the green spectral range.

While this knowledge about our sight is documented by laboratory experiments, it is generally more difficult to explain other empirical findings such as northern Europeans' common preference for warmer light colors. In our regions, city administrations regularly receive complaints when more efficient –'cold' – street lighting is installed, whereas in southern European countries, lighting manufacturers' sales figures reveal greater acceptance for cold white light. Although the phenomenon has not yet been conclusively explained, the color of street lighting clearly has an effect on the perceived quality of public spaces. This is reinforced by local initiatives that campain for preserving gas lithing in Berlin and Düsseldorf as a cultural heritage.

From the viewpoint of those concerned, the definition of appropriate light also varies at the local level. An expert workshop, held at the WZB in 2010, revealed

Nona Schulte-Römer is a researcher in the research unit Cultural Sources of Newness. She is concerned with innovative lighting planning in European cities. For her Ph.D. project she studies innovation in public lighting by looking at LED projects and the role of local actors. *[Photo: David Ausserhofer]*

nona.schulte-roemer@wzb.eu

that lighting designers resort to an expanded repertoire of methodologies in their effort to understand the nighttime habits and needs of residents and tourists, of adolescents and older people. Extensive on-site observations and nighttime tours with resident groups complement photometric calculations. A key to good design is the importance attached to the illumination of public squares, streets, underpasses and parks. Identifying 'scary places' or meeting places that should be better lit is as important as information about unused or over-lit spaces where lighting could be reduced.

Sociological studies on the light perception of users of public spaces take a position between scientific knowledge and far broader subjective design practices. The light evaluation EVALUM offers an example. Using an experimental research design, urban geographers at the National Institute of Applied Sciences in Lyon have confirmed the assumption that people feel uneasy with public lighting that focuses on traffic zones only while leaving facades and surroundings in the dark. They found that test persons felt uncomfortable when walking on lit streets and pathways that were surrounded by darkness. The results have implications for the use of LEDs. With the diodes it is technically possible to exactly direct the light flux to selected spaces, thereby saving energy. But with regard to a perceived sense of security and urban atmospheres a certain amount of ambient brightness is desirable – and therefore relevant to the issue of appropriate lighting.

In contrast, another field test showed that the participants did not object and sometimes did not even realize when the street lighting was dimmed in order to save energy. In this case, the discussions only begin when local feedback suggests that light levels could be dimmed below the technical standards as they are scientifically tested in laboratories and negotiated in committees. But who should have the last word? Citizens on the street who do not even notice when the lights have been dimmed and are in favor of environmental protection or experts, including manufacturers, who recommend compliance with standards for traffic safety and visual comfort?

The contestation of lighting practices and conflicts over methods for determining the quality of light in public spaces can be seen as an opportunity with regard to the proposed digitalization of light systems. They raise awareness for the variety of claims and propose an interdisciplinary and cross-divisional development of lighting concepts. New networking platforms also enable and support the productive exchange of ideas. Such a forum is offered by LUCI, the international network of cities, founded in 2002, with its regular meetings where cities present their lighting projects on site and discuss them with manufacturers, researchers and designers.

Looking at a particular urban space, the question of appropriate lighting is as complex as the specific local situation. Public lighting infrastructures can only be linked and controlled when, in addition to the organizational and technical hurdles, urban spaces are also considered as meaningful places that fulfill social functions. Aware of the challenges ahead, light planners and developers are showing an interest in social science research on the nighttime city and the nighttime activities of users of public spaces. "We need sociological research in order to develop scripts for digital lighting solutions", stated a light manufacturer at the 2012 Light+Building. Thus, the digitalization of public lighting also offers a new and challenging field for social and urban studies.

References

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