

Present Trends and Future Direction of Lighting Control in Dubai

R. Gomathi Bhavani, and M. A. Khan

BITS, Pilani - Dubai Campus, Knowledge Village, P. O. Box 500022, Block No. 11, Dubai,
United Arab Emirates

Abstract — A research study conducted to analyze various control technologies employed in lighting control in the new projects in Dubai, United Arab Emirates (UAE) is presented and the impact of lighting control on the present and future trends analyzed having three categories of projects as residential, commercial and hotel projects. The case studies of four major manufacturers present in Dubai are highlighted as illustrations for current trends in lighting control technology in the region. Also discussed are the demand drivers and future direction of automated lighting control in Dubai. We are currently researching in simulations for energy efficient control of building's lighting subsystems considering multiple criteria.

Index Terms — Automated Lighting, Dubai, Lighting Control, Intelligent Buildings, UAE.

I. INTRODUCTION

Presently, the United Arab Emirates (UAE) is witnessing a construction boom that few countries in the world could have experienced at a particular time. The Government's clear vision of the future of their country, their relaxed policies on trade and investment lead to the development of this country from the beginning of 1980s. The population spread of UAE is very different in the sense that expatriates from other countries outnumber the nationals by a huge margin. By the June 2006 census information, the nationals (citizens) constitute 20.1% of the total UAE population [1]. In the year 2002, the government decided to let the expatriates own freehold properties for personal and commercial uses, and there are lots of landmark buildings mushrooming in each Emirate of the UAE especially in Dubai. In the first half of 2006, in Dubai alone, 1128 buildings were completed at a cost of AED 5.579 billion of which 207 investment buildings, 710 residential buildings and 211 buildings were meant for recreational, service and industrial purposes [1].

The major boom in the building and construction industries has significantly enhanced the demand for lighting and electrical products. The many sophisticated developments taking shape across the UAE are wooing the customers using the dramatic effects that can be created through architectural lighting to enhance their properties and theatrical lighting, which uses intelligent lighting to improve the quality of the audience experience. Dubai, which is the commercial hub of the Middle East and melting pot of many nationalities, is

concerned about its image at night and to preserve and enhance its international brand identity. The objective of this paper is to present the results of the research study conducted to analyze various lighting control technologies employed in new projects in Dubai, analyze the impact of lighting control on the present and future trends in residential, commercial and hotel projects, highlight the case studies of four major manufacturers present in Dubai as illustrations for current trends in lighting control technology in the region and discuss the demand drivers and future direction of automated lighting control in Dubai.

II. CRITERIA FOR USE OF DIFFERENT LIGHTING CONTROL TECHNOLOGIES

Lighting controls make buildings more comfortable, productive and energy efficient. The popular control technologies taken in this study are dimming, lighting control panels, occupancy sensors, Building Management Systems (BMS) and daylighting systems. Lighting control panels and BMS contribute to the scheduling technologies for smaller and large buildings (100 000 ft² upwards) respectively. Scheduling systems activate lighting at pre-set time intervals. Daylighting systems not only save energy by reducing off electric lighting load but also increase user comfort and satisfaction.

The criteria for using a particular control strategy are often need based. The knowledge about the type of visual task that is going to be done in a given space and the electricity rates at various times of the day will help in deciding a particular control mechanism. In hotel rooms and restaurants, the priority is scene control because of the need to provide aesthetics and ambiance with different scene settings. In a villa, the convenience factor and the ability to control any device from any interface play a major role in going for occupancy sensors for hallways, toilets, garages etc. and time-based control for exterior lightings typically. Energy saving can be the objective of providing lighting control in a typical scenario. Simple time scheduling can be employed for large open office areas and schools while more sophisticated computer controls can come in handy for hotel exteriors.

III. ANALYSIS ON UPCOMING PROJECTS IN DUBAI

The results of a research study conducted on a sample of 205 projects under construction in Dubai are presented in this section with various control technologies of lighting analyzed.

A peek into the upcoming project scene in Dubai includes the following landmark projects which would require lighting solutions and services: Downtown Dubai; a working, living and entertainment neighbourhood, Dubai Festival City; a city within a city comprising schools, houses of worship, shopping, restaurants and golf courses, Dubailand; a US\$ 7.5 billion mixed-use theme park, Dubai Sports City; a US\$ 2 billion development for sports facilities, Dubai International City; 20 000 apartments in 350 buildings with townships based on China, England, Italy, France, Russia and Morocco, luxury hotel projects by the Raffles International group and the Rotana Group, Aqua Dubai Water park; a US\$ 200 million leisure, hotel and spa investment, Dubai Mall featuring ten distinctive atriums for hosting international events, Mall of Arabia etc. [2].

In the study, the upcoming construction projects in Dubai were classified as residential, commercial and hotel projects and these were analyzed as to whether they had any form of lighting control and if so what method of control under the five technologies specified earlier. The residential projects comprised of villas, apartments and staff accommodation while commercial projects included banks, offices, schools, universities, colleges, institutions, investment buildings, recreational facilities, hospitals and shopping malls. The hotel projects included hotel and service apartments.

A sample of 205 new projects in Dubai were taken up for the research study and it was found that 94 projects (45.9%) were using some form of lighting control out of which 53 were residential buildings, 25 were commercial and 16 were hotel projects. Given in Table I is the analysis of the five different forms of lighting control used in each of the three categories.

According to the study, the dimming is very popular in hotels (100%) mainly because of the prevalence of use of architectural control in conference rooms and ballrooms and stand-alone dimmers in hotel rooms. Commercial buildings widely adopt dimming (40%) and some of them for fluorescent lighting using

electronic ballasts and DALI (Digital Addressable Lighting Interface) and non-addressable digital control, DSI technology. Few of the commercial buildings are found to be using fluorescent dimming based on daylighting sensors. Lighting Control panels are housed near the distribution boards and they control the lighting circuitries. All the relays and dimmers predominantly are controlled by a common protocol such as EIB (European Installation Bus), C-Bus, PROFIBUS (Process field bus) etc. and lighting control panels are widely employed in residential projects (75.5%) and potentially could become a standard feature in future.

Occupancy sensors are mostly used in corridors and lift lobbies in residential projects and in conference rooms, boardrooms, car parks and reception areas in commercial projects. This simple technology has the reach to achieve significant energy savings in buildings. BMS has wide acceptability in most of the new projects and lighting control is generally interfaced with BMS thus offering flexible solutions, fast expandability and easy adaptation to customer needs, remote monitoring and greater energy efficiency. In some projects we find that lighting control panels are used as standalone as well. Daylighting though highlighted by most of the manufacturers in promoting their systems, is being adopted in few projects. This is likely due to heat gain problems associated with it in the desert climate of Dubai since it has a direct impact on the air-conditioning load.

IV. SPECIFIC CASE STUDIES IN DUBAI PROJECTS

The major manufacturers identified in lighting control business in Dubai are Clipsal, Dynalite, Lutron and Poloron. Clipsal offers the latest range of products such as the Clipsal Premise Gateway and Colour Touch Screen integrated with C-Bus technology [3]. The Clipsal C-Bus systems integrated with BMS are installed in the Dubai International Financial Center (DIFC), which houses two towers called gate building. C-Touch is used to schedule the external fazzad lighting to a 6 p.m. to 6 a.m. routine and the lighting in the common areas such as lift lobbies are controlled with 360° PIR (Passive InfraRed) sensors and 4 x 20A relays [4]. The office has C-Bus DALI gateways controlling dimming ballasts and C-Bus professional

TABLE I
INCIDENCE OF USE OF VARIOUS LIGHTING CONTROL TECHNOLOGIES IN NEW PROJECTS IN DUBAI

Categories of New projects	Dimming	Lighting Control panels	Occupancy Sensors	Building Management Systems	Daylighting systems
Residential	18.9%	75.5%	28.3%	37.7%	0%
Commercial	40%	60%	20%	80%	12%
Hotels	100%	62.5%	0%	100%	0%

series dimmers controlling architectural light fittings [4].

Dynalite has done landmark projects in Grand Hyatt hotel wherein 12 x 20A heavy-duty relay controllers switch the exterior fittings, which are concealed on the podium roof and are controlled via a time clock. These controllers can be programmed to stagger the switch on, minimizing peak demand current where it is beneficial to sequentially switch on large lighting loads [5]. 12 x 10A and 12 x 16A leading edge dimming are utilized in all of the restaurants, public areas, ballrooms and meeting rooms, controlling a total of 2448 channels of lighting hotel-wide. The hotel's two pillarless ballrooms are provided with scene control options to suit the mood or occasion via DTK600 LCD touch screen.

Dynalite dimming and lighting controls were also implemented in the public areas of both the residential and office towers, as well as the nine luxury penthouses in the BurJuman Centre [6].

Lutron Electronics Company has done dimming innovation in several projects such as DEC Towers and Fairmont Hotel etc. [7]. In the Royal Mirage Resort, GRAFIK 6000 Lighting Control System is installed for its flexibility for handling multiple set up requirements and for controlling large ballrooms, lobby and reception areas. The system offers advanced hardware capabilities as well as seamless integration of dimming, switching, window-shading systems, and daylighting [8].

The Polaron lighting control systems are implemented in two of the seven star hotels of the region. In Abu Dhabi, the neighbouring emirate of Dubai, the public areas and suites of Conference Palace Hotel are fitted with 2350 remote control plates and more than 16 000 dimmable lighting channels, as well as a central computer system and the project was worth approximately of £1 million [9]. The company had also done the complete lighting control system for the world famous Burj Al Arab in Dubai. Seamless integration and control as well as interoperability with the wide range of other equipments from various suppliers are other features of the system [9].

V. DEMAND DRIVERS

From the study, the following emerged as the demand drivers for automated lighting control: Meeting the requirements of the property developers, incorporating personal control for increased satisfaction, convenience and productivity, flexibility in controlling the floor area, willingness to embrace new technologies such as DALI and energy savings.

Major developers in Dubai see the automation in lighting as a selling feature to promote their properties. They offer lighting control or create containment for

future incorporation. Scene control, occupancy sensors and workstation lighting controls dominate the market due to user satisfaction and convenience factors. Though energy saving is the ultimate feature of automated control, it is still not a major driving force in decision making in Dubai, due the fact there are no specific regulation or energy codes in place and also the cost of energy is less because UAE contains 98 billion barrels, or nearly 10 percent, of the world's proven oil reserves. The UAE also holds the world's fifth-largest natural gas reserves and exports significant amounts of liquefied natural gas [10]. According to the Dubai Electricity and Water Authority (DEWA) billing system, an electricity unit is sold for UAE nationals at the range between five to seven fils per kWh and for government, commercial and industrial institutions, the charge is 20 fils per kWh [11]. Considering the fact that UAE enjoys the highest per capita income, the consumers are still not feeling the pinch due to cost of energy when compared to their other expenditures.

VI. CHALLENGES OF PROVIDERS OF LIGHTING CONTROL

A research effort was formed to address the various issues concerning the providers of lighting control and they were asked questions about the challenges they face in the Dubai market. The respondents include lighting designers, engineers and sales professionals from the companies engaged in lighting control business in Dubai. Overall, they all agree that lighting controls are becoming common in all commercial projects and the extent of advancement and sophistication is dependent on project type, scale, client criteria and cost.

The main resistance to adoption comes due to the initial cost, which is the same reason that concerns the providers the world over. The specific reasons for the BMS to face resistance are its initial cost and difficulty in educating the user to operate the controls. The respondents indicate that countering the delays and false-offs of occupancy sensors along with justifying the initial cost continues to be a challenge for them. The perception of some clients that these systems may not function as intended as they have experienced lights going off at wrong times also poses some problems for the designers. When it comes to cost cutting in a project, the lighting control becomes one of the first casualties. They also opine that if some new codes mandating lighting controls are enforced, the cost for these systems will eventually reduce because of increase in demand.

On the flip side, the awareness and willingness to experiment new ideas cause encouragement among the providers and this poses design challenges and search for innovative approach. BMS can offer minimal lighting control, which makes the owners question the

need to have separate lighting control system. Integrating lighting control systems with the BMS is seen as a major trend and the issues concerning interoperability raises more scope for improvisation in design and programming. The challenges also arise while integrating an existing light system with new controls where the designers have to look for more creative solutions. The engineers indicate that there is a general perception among the end-users that the advanced systems must be complex to operate and maintain. With a proper after-sales service network non-existent, the apprehension of clients is not completely unjustified.

VII. FUTURE OF LIGHTING CONTROL IN DUBAI

Dubai Electricity and water authority (DEWA) has an energy conservation cell and with the cost of energy going up it may in future mandate some energy code practices. DEWA releases advertisements in the local newspapers to raise awareness among the public for efficient use of energy [12]. The government of Dubai recognizes and encourages people who have adopted energy efficient strategies in their buildings and is committed to achieving sustainable environment protection by encouraging more green buildings to be constructed and Leadership in Energy and Environmental Design (LEED) ratings to be achieved.

The Pacific Control Systems has achieved the platinum rating for the Green Building under the LEED Certification Programme of United States Green Building Council (USGBC) [13]. Wafi City's District Cooling Plant was also awarded a silver LEED certification and the next one to join the list will be Metito's headquarters that is currently under construction at the Dubai Techno Park which would have the number of installed lights reduced by maximizing the use of indirect sunlight, thus reducing costs while ensuring each person was receiving appropriate illumination for his job [13]. Market pressures can simulate the need for lighting control technologies. We identify the challenges of implementing codes and regulations in Dubai.

A. Difficulties and Challenges of Implementing Lighting Code Regulations

Building codes and standards have enormous effect on the type of controls designed and implemented into a lighting system. The codes if implemented will make the designers think innovatively to structure a lighting system into a building's network. Devising of such control strategies to suit a particular requirement needs huge design expertise. When these sustainable design requirements become code, the industry and its products should rise up to the challenge and expect to

be refined for the better. The region should equip itself with the design skills to match these technical demands.

The lighting codes if implemented will set maximum allowable energy consumption levels for various lighting systems and will have its statements of requirements and evaluation methodologies. The assessment of impacts of these codes, its economic analysis and training is a complex and technical task [14]. The analysis of cost data for lighting products involve difficult calculations because products having variable costs and shapes can offer similar light at similar efficiency and efficacy. This poses challenge in cost analysis and hence requires training at this level too.

The training of design professionals, contractors, lighting equipment suppliers, code officials or inspectors is critical for successful implementation of codes and hence the training will have to be implemented by way of seminars, presentations, software to demonstrate lighting design compliance. Enforcing the codes requires high level of expertise and the government has to hire multiple code officials with specific areas of specialization. Recruitment of skilled code officials and training them could put additional pressure on the government.

With the insistence of codes, the government has to equip the residential consumers with the accurate and reliable information of products. The government has to insist on printing lamp output in lumens, energy wattage and average lifetime on the packaging of lamps. This will enable the consumers to choose more energy efficient products and help avoid confusion. Bridging the gap between available lighting technology and consumer knowledge is a significant challenge and one that in Japan is met jointly met by government and industry initiatives [15].

If codes become the norm and are well defined, the most popular control technology will evolve with time. The sheer amount of construction activities happening in Dubai can be seen as a tremendous opportunity for implementing energy codes and standards.

B. Industrial feasibility for residential customers

In the Middle East, the energy cost is not a major factor yet in general and so each home can start with energy-efficient devices and simple control mechanisms with short payback which can lead to a more focused approach. For example, by switching over from incandescent to energy efficient lighting such as Compact Fluorescent Lighting (CFL) an annual energy saving of 40 to 50% can be realized in a home. If a home uses ten 2'x 4' fluorescent fixtures with three 4' T8 (32 W) tubes per fixture, with the UAE electricity rate of US\$ 0.0543 per kWh being assumed, the hourly operating cost is US\$ 0.052. By employing automatic

shut off control for an average of 2 hour shut off per day, the annual cost savings of US\$ 38 can be reached.

By using improved electromagnetic and electronic ballasts, the operating, maintenance and energy costs come down with a marginal increase in first cost. Hence the life cycle cost also becomes less for these devices. So with local switching, central switching and time-based dimming a short payback of 1 to 3 years is expected because of reduction in energy cost as well as operating cost due to increase in lamp life and fixtures.

Ref. [16] indicates that the domestic power tariffs vary little across the Middle East. Customers in the countries examined by Middle East Economic Digest (MEED) are charged an average \$0.029 a kWh, indicating heavily subsidized services [16]. DEWA cannot only charge a relatively high tariff, but also rely on a healthy revenue stream [16]. Saudi Arabia has also set power tariffs to encourage non-peak power use by commercial users, even though these account for only half of overall national demand [17].

The region comprising of UAE, Saudi Arabia, Kuwait and Qatar will require an additional 26.9 GW of power capacity in 2007-11 and the expansion in demand is being driven by broad-based social and economic development, with rising salaries driving the take-up of domestic power use [17]. So all these economies are keen to promote energy efficient measures and lighting control is here to stay and grow in this region as a whole.

VIII. CONCLUSION

This research study identified that intelligent and automated lighting finds its place in almost all landmark developments in commercial and hotel projects in Dubai mainly due to the ability to employ multiple control strategies simultaneously with a centralized intelligence. This is mainly because building owners and property developers see them as a way to promote the image of buildings or properties. There is still lot of scope in residential sector for some form of lighting control to develop and establish as a must-have feature.

The objective of lighting control as an energy conservation scheme can be achieved if the government imposes tougher standards on commercial building energy usage as it is done in the developed countries or by giving incentives to organizations or consumers adhering to some form of energy efficient methods. Building owners will then highlight their buildings as energy efficient and justify the initial cost to their customers and lighting control can then become a standard feature in each building. There is scope for lighting control schemes to grow in the entire region.

The case studies highlight that Dubai is on par with the rest of the world in welcoming and adapting to the

state-of-the-art lighting control systems. With the technology and infrastructure available and a government with a readiness and vision in place, Dubai is progressing in that direction when the project developers and building owners are going to see the automated lighting control as a unique selling point for distinguishing themselves from the rest.

ACKNOWLEDGEMENT

The authors wish to acknowledge the support of BITS- Pilani, Dubai in the completion of this work.

REFERENCES

- [1] UAE – The official web site – news [Online]. Available: <http://www.uaeinteract.com/news/default.asp>
- [2] Middle East Electricity, Lighting Regional News [Online]. Available: <http://www.middleeastelectricity.com/Lighting/LightingRegionalNews.html>
- [3] Clipsal completes second phase, *Gulf Industry Magazine*, Al Hilal Group publication, vol. 15, no. 3, pp. 23-23, March 2006.
- [4] C-Bus lighting management systems: case studies in major projects, project database 06.2, 2006, unpublished.
- [5] Dyalite company website [Online]. Available: <http://dynamite.com.au>
- [6] Architectural lighting control- case studies [Online]. Available: <http://dynamite-online.com/frames/index.htm>
- [7] Lutron company website [Online]. Available: <http://www.lutron.com>
- [8] B. M. Howard, "Centralized lighting control," *Architectural Record*, vol. 192, no. 12, pp. 323-323, December 2004.
- [9] Polaron wins 1 million lighting contract for seven star hotel, *SourceWire*, UK, 21 st May 2004 [Online]. Available: <http://www.sourcewire.com/releases>
- [10] Energy Information Administration –Official energy statistics from the U.S. department website [Online]. Available: <http://www.eia.doe.gov/international/>
- [11] Dubai Electricity and Water Authority (DEWA) website [Online]. Available: www.dewa.com
- [12] Organiz the time you use electricity between 1.00 p.m. & 5.00 p.m., *Gulf News*, Friday, Al Nisr Publishing, Dubai, pp.18, 23rd Feb. 2007. [15]
- [13] N. C. Salian, Staff writer, Green Initiative, The green building concept is catching on in the UAE, *Gulf News*, Supplement, Al Nisr Publishing, Dubai, pp. 21, 19th September 2006.
- [14] A. T. Chan, and V. C. H. Yeung, "Implementing building energy codes in Hong Kong: energy savings, environmental impacts and cost," *Energy and Buildings*, vol. 37, no. 6, pp. 631-642, June 2005.
- [15] S. W. Sanderson, K. L. Simons, J. L. Walls, and Y. Lai, "Innovation challenges in the lighting industry: From 1990 to 2006," Conference on globalization and innovation, Rensselaer Polytechnic Institute, NY, February 11, 2007.
- [16] K. Oliver, "Footing the bill (Tariffs): A discussion of the Middle East's electricity usage," Middle East Economic Digest (MEED), July 2003.
- [17] Gulf power Part 1: Rising Cost, feedstock scarcity challenge GCC expansion plans, *Middle East Economic Survey (MEES) 2007*, vol. 50, no. 30, pp 23-24, July 2007.