LOOKING AT ART IN A NEW LIGHT

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Abstract

Looking at Art in a New Light aims to be a comprehensive study on museum and gallery lighting discussing a range of topics including lighting typologies, daylight, and modern technologies in exhibition display lighting. A key objective of the study is to constructively critic some common methodologies in this sector, in a time where gallery and museum lighting systems are likely to go through extensive upgrade, mainly due to the impact of the government energy legislations and lamp phase outs (such as the Australian MEPS, 2007) providing the opportunity for the cultural institutions to take on new approaches to programmatic and curatorial requirements, conservation strategies, apply new technologies in a sustainable manner.

Looking at Art in a New Light aims to address these interrelated aspects in four parts:

Light Culture and Light Typology
As the nature of museums and galleries is changing and evolving over time, so do the requirements on the lighting. Signature architecture with varying sequences and designs as well as the variety of exhibition types and curatorial concepts make lighting for museums and galleries become an inherent part that influences the overall experience of both the institution and exhibition.
This part looks at the use of light for museums and galleries. It explores various lighting approaches and techniques that respond to the various requirements of exhibition and building design.

In the Light of the Day
Daylighting in exhibition spaces can have different purposes. The experience of art under daylight has a different visual quality and aesthetic than under electrical lighting. Utilising daylight has a sustainability aspect. Dynamic properties of daylight also give the visitor the connection to outside world and help support the comfort. However, the use of daylight in gallery spaces has historically been a challenging task.
This part discusses different techniques of daylight control and integration in exhibition spaces.

Conservation to Conversation

Museums and Galleries are spaces where collections are shared with public, however another important role for these institutions is to keep and protect the cultural heritage for future generations. Light may damage exhibition materials by causing fading of pigments, and may degrade objects over a long period of time. This part discusses the opportunities to improve lighting conservation strategies with the intention of enhancing visitor experience whilst protecting the materials against light damage.

Greening Exhibition Spaces

In the recent years, awareness of sustainability has helped the efforts to reduce the impact of buildings on the environment. As a result, new legislation on energy performance requirements have been put in place for different types of buildings.With both voluntary and obligatory legislative measures, museums and galleries are no exception. Also, rapid development of some lighting technologies and phase out of certain light sources requires re-think in the design of museum and gallery lighting. This part discusses strategies to tackle the challenges with respect to sustainability in exhibition spaces.

Keywords: Lighting, Museum, Gallery, Exhibition, Sustainability, Daylight, Conservation

1 Light Culture and Light Typology

The history of museums and galleries has seen many changes over the years.

From the moment the Louvre opened its door to people of all status and wealth (1793) by being the first institution to granting free access to the collections, museums and galleries have shifted closer to the public sphere, being more democratic and pluralistic in nature. Throughout the 20th century, the focus has shifted from collecting and conserving artwork to creating places of mass attraction and attention.

Museums and galleries, as signature architecture, nowadays become artwork and attractor themselves; a phenomenon sometimes themed as Bilbao Effect, following the success of Frank Gehry's Guggenheim Museum in Bilbao „with over (..) ten million visitors to its credit" (from http://www.guggenheim.org/bilbao). The success of an institution is mainly measured in terms of attendance figures and generated tourism.

Figure 1: Gugenheim Museum, New York
(Photo taken by Mirjam Roos, Steensen Varming)

As the nature of museums and galleries is changing and evolving over time, so do the requirements on the lighting which responds to the adjusted museum typology. Signature architecture with varying designs as well as the range of exhibition types and curatorial concepts make lighting for museums and galleries become an inherent part that influences the overall experience of both the institution and exhibition.

Greater emphasis is given to architectural and feature lighting, outdoor art and landscape lighting, creating interest and optimizing the visual experience. Lighting can no longer be seen as a tool to illuminate art and render the museum building visible, but becomes part of the exhibition and the architectural experience and signature features of galleries. Museum and gallery buildings with their increased focus on retail and café require the lighting to be considered in a holistic way, creating an overall image of the sequences of spaces.

Display lighting needs to master new challenges arising from these trends, the extended flexibility requirements, interactive exhibits and responsive environments. The lighting solution and technique should be considered as part of both the curatorial and architectural requirements, and be designed to be in harmony with the space and collection on display, whilst using appropriate technology and equipment. The following lighting design approaches represent a range of "lighting typologies" - different techniques, responsive to different requirements,.

The White Cube
The white cube, as it has been discussed in the art critic Brian O'Doherty's essays, dominated the 20th century galleries. As Doherty describes, this gallery type "subtracts from the artwork all facts that

interfere with the fact that it is 'art'. The work is isolated from everything that would detract from its own evaluation of itself".

The installation of certain types, mainly contemporary, artwork negates light dramatization also require neutral, un-dramatic and reduced lighting..

The white cube space is typically lit from above with a diffused light ceiling, creating even shadow-less lighting. As fluorescent and neon technology has been predominantly used by artists as studio lighting from the second half of the 20th century, the same type of light was demanded in the exhibition space and is still most commonly used for the creating of "glowing ceilings".

Reductive, concealed lighting on tracks or ceiling gaps is another way to maintain the visually clean environments that merge with the art displays whist providing more direct lighting onto the collection.

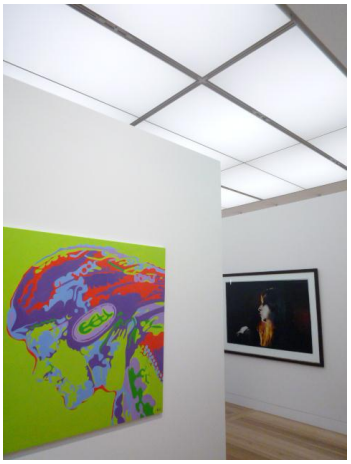

Figure 2: The National Portrait Gallery, Canberra
(Photo taken by Steensen Varming)
Figure 3: The National Portrait Gallery, Canberra
(Photo taken by Steensen Varming)

The Black Box
The black box approach restricts lighting to the objects alone and can provide extremely dramatic rendering of some types of objects.

Objects are displayed and lit on dark backgrounds in a space where all other light is excluded. In many cases it is an attempt to make sensitive objects, which need to be displayed in low light levels, stand out.

Care has to be taken to avoid the lack of background light provoking a sense of gloom. A way to increase the apparent brightness is to use wall washing at low light levels, providing the suggestion of a lit environment with a minimum of light and potential glare sources.

Light as part of the exhibit
Light can be an experience in itself, becoming an integral part of the actual exhibit and curatorial planning.
Daylight, patterns of light and light sequences can form part of the display to evoke emotion or a sense of surprise, linked to the theme or focus of the exhibition.

Light can be used to create in a symbolic sense and to convey a meaning by focusing on certain parts of the exhibition, drawing attention or connecting certain aspects of the display.

Figure 4: The Jewish Museum, San Francisco
(Photo: Mirjam Roos, Steensen Varming)

Light derived from the artwork itself
Lighting is used in many ways, and innovative and experimental lighting designs lead the way to new thinking in the application of display lighting: there are examples of installations which have been based on the idea of taking the light in the artwork as an inspiration for the lighting concept of the exhibition (e.g. Hammershoi and Dreyer Exhibition, Barcelona, 2007).
Lighting design can then reiterate and recreate the lighting atmosphere or direction that is illustrated in the artwork.

It is common that the above mentioned typologies are often used in combination with each other or in an integrated manner to create a sequential series of spaces within the same complex.The role of light becomes a part of the exhibition contents and the curatorial composition, rather than as a means to make the exhibition visible. For a successful installation, communication and collaboration of curators, exhibition designers, artists and lighting designers is essential and makes the difference.

2 in the Light of the Day

The selection of the lighting typologies and the light sources have a strong correlation, in that the characteristics of the light sources used affect the visual quality of the context and the overall experience of the exhibition.

Natural light has been the prevalent light source in museum and exhibition spaces until it has been excluded from the majority of display spaces due to conservation requirements. As the culture shifts towards having more emphasis on optimum viewing conditions for experiencing the art and the architectural context of the exhibition spaces to support visitor satisfaction, daylighting is re-entering the museum and gallery architecture; not only in favour of the exhibits, also to increase the experience and comfort of the visitors.

Daylighting in exhibition spaces can have different purposes and serve different aspirations:

- Natural light can be used as the illuminant (i.e. the source of light) under which the exhibits are viewed.

The dynamic properties of natural light are perceivable and constantly change the perception and appearance of both the space and the displayed work.Under daylight, the experience of the artwork is often different each time visiting a gallery. Daylight is often used as the illuminant in sculpture galleries with less sensitive display pieces, as apparent in the Metropolitan Museum of Art, New York/ U.S., or the Louisiana Museum of Modern Art, Denmark. Although these spaces do not provide controlled or consistent qualities of lighting, the spatial quality and the visitor experience is unique at every visit.

Figure 5: Metropolitan Museum of Art, New York
(Photo taken by Mirjam Roos, Steensen Varming)
Figure 6: Louisiana Museum , Humlebæk
(Photo taken by Emrah Baki Ulas, Steensen Varming)

- The connection to the outside world through the experience of the dynamics of natural light and a view to outside can increase visitor's attention, comfort and wellbeing in the space; both psychologically and physiologically.

- Daylight has an excellent colour rendering quality. With the naturalness of the appearance, the visual experience under daylight is often considered to be more satisfactory than the one under an artificial light.

- Paintings prior to 20th century have mainly been created under natural light. Using daylight for exhibition lighting can illuminate the artwork under similar conditions it was created and can make the space and the objects appear the way they would do in nature.

- In foyers, entry halls and areas outside the display spaces, natural light can be used to illuminate a space or architecture. Admitted to the space it will naturally lead to a particular grading of light through the room geometry and will affect the appearance of the building surfaces and materials. Surfaces and objects within the space respond to the different light colours, varying direction of light and strengths of modelling enhancing the architectural design and creating a memorable space.

Figure 7: Kiasma Museum of Modern Art, Helsinki
(Photo taken byEmrah Baki Ulas, Steensen Varming)

- There is also the sustainability factor that gains increasing importance in museum and gallery architecture; utilising daylight can bring in the opportunity to save evergy as the electric lighting may possibly be reduced.

Although these properties are in favour for applying daylight to an exhibition area, its highly variant character as well as the ultraviolet content that has high photodegradative potential and the infrared portion that has radiant heating effects, present challenges for its use for display lighting and may require highly sophisticated techniques for adequate control.

A challenge in daylighting applications is managing the varying intensity of daylight; the lighting conditions are influenced by the geographic location of the institution, the cloud cover of the sky and the sun position (Altitude and Azimuth) which varies throughout the day and year. During the course of the day, natural light undergoes spectral variations and shifts from warm reddish light colour to blue tones. Other factors that need to be taken into consideration are the building orientation, over shadowing through adjacent structures and influences of reflective surfaces that can change lighting conditions within a space.

The lighting control strategy can be based on active control or passive (static) control principles:

The goal of an active daylight control system is a consistent, narrow band of illuminance levels as performance target. In order to limit the fluctuations in daylight intensity, lighting levels need to be actively modulated by means of automated louvres or blinds. These control mechanisms are relatively complex systems which need to manage a range of sun angles and sky conditions, often with higher maintenance and control system management requirements. There is a rsik for the modulation in the lighting conditions to cause distraction and disturbance to the visitors.

The passive daylight control system aims for overall annual exposure targets and allows for reasonable variations within this range. As the system is static, it has to provide exclusion of sunlight for all sky conditions and transmittance of diffuse daylight and reflected sunlight only (e.g. through fixed louvers or skylight/ window design). Static systems generally have the advantage of a reduced maintenance. However, as light levels are more variable within the set limits, the display of sensitive artwork with very limited exposure time should be carefully considered and rotation of artworks might be required.

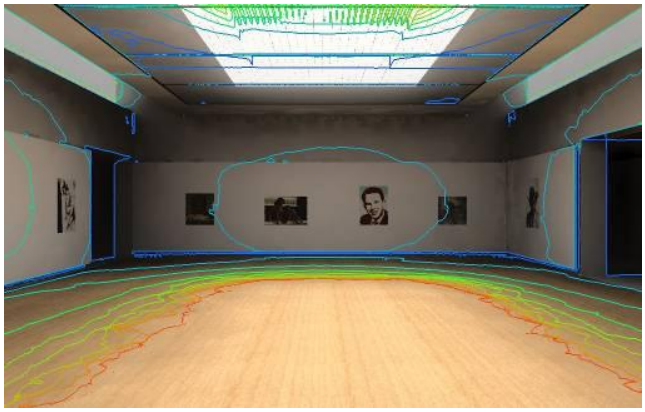

Figure 10: An Illuminance Isoline Diagram Generated Using Computer-based Daylight Modelling Software (Graphic: Steensen Varming)

Electric lighting needs to be considered in an integrated manner with the daylighting system; the electric lighting system needs to balance and blend in with the daylight in terms of light colour, intensity and direction.

3 Conservation to Conversation

Museums and Galleries are spaces where collections are made available, and where old or new information, heritage values, cumulative knowledge and experience of individuals and communities can be shared and cultivated further to advance the society and to help contribute to people's lives. At the same time, these are the very institutions that preserve and protect the cultural heritage, and keep it safe for the benefit and enjoyment of the future generations. Often these two key objectives conflict with each other, because exhibiting objects may cause aging and have a detrimental impact on the exhibition materials. An institution's decision to exhibit an item may mean that its future usable life is compromised to some degree. It is therefore crucial to understand the effect of the environmental parameters on the exhibited items within the display (and the storage) spaces so that they are displayed in a manner that minimizes the impact on the objects, whilst providing adequate conditions to maximise the visitor's experience. This generally requires the design of the spaces, the selection of the material and the setting of the environmental parameters to be working hand in hand.

Lighting is important for the appearance of the displays and is a fundamental element in shaping the visitor's experience. On the other hand, lighting, as an environmental parameter, is one of the key issues in conservation. Light may cause damage exhibition materials by causing fading of pigments, and may degrade objects over a long period of time; this process is called photodegradation. Photodegradation can be defined as the decomposition of molecules cause by the absorption of energy in the form of photons, particularly from the ultraviolet and visible parts of the electromagnetic spectrum. As a result of photodegradation the material composition breaks up and becomes irreversibly transformed, i.e. it may be impossible to create or repair the lost information on an exhibition object through interventive methods.

Figure 11: a little bit stolen everyday
(Image from a Minolta lightmeter advertisement, 2006)

Most of the common knowledge and approaches to lighting and preventive conservation are based on relatively old data. For instance, a key document for many current lighting conservation guidelines is Garry Thompson's "The Museum Environment", written in 1978. Whilst this book and similar key sources are milestone documents for several decades, modern approaches to preventive conservation and lighting is in need of further work, for reasons such as the differences of the modern lighting technologies (such as LEDs) and the difference of their spectral compositions to incandescent

based sources most of which the current lighting guidelines are based on. In addition, the precision and accuracy of the devices and measurement techniques can help benefit conservation strategies.

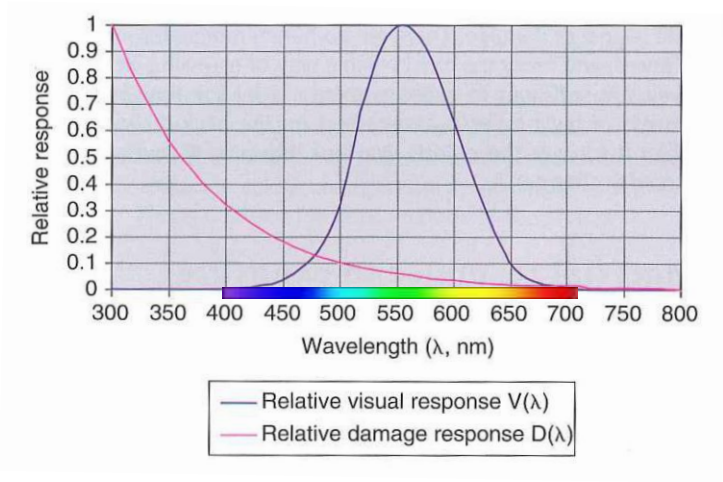

Figure 12: The Berlin Function
(Light for Art's Sake by Cit Cuttle, PLDC 2011 Conference Proceedings, 2009 Via Verlag)

Current lighting guidelines for conservation are mostly based on the nature of the light that is emitted by incandescent light sources. It needs to be considered that the composition of the light output from an incandescent source is very different compared to that of a metal halide discharge lamp or a fluorescent tube, or more importantly LED sources – which are likely to become the primary source in exhibition display lighting in the near future.

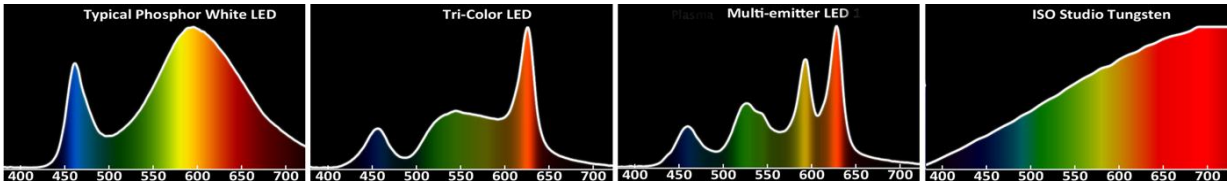

Figure 13: Typical Spectral Power Distribution Diagrams for LED and Incandescent Sources

Below, we discuss two common issues with the common practice that affect preventive conservation strategies:

1) *limiting of illuminance (Lux) levels*
There are certain illuminance (lux) levels that are widely regarded as the acceptable limits of illumination for certain types of exhibition objects. These levels typically follow a hierarchical manner based on the classification of the exhibition material in terms of light sensitivity – with lower acceptable levels of light for highly light sensitive materials and higher for materials that are relatively less sensitive.

The question of the amount of light damage on an exhibition object is a multidimensional issue with many parameters; summarised as follows:

-The composition of the energy contained in the light (both luminous and non-luminous)
-The material and the light related properties of the surface
-The duration of light exposure on the object

Whilst light damage follows the law of reciprocity in general, each of the above parameters, have complex sub-parameters of their own and play a role in the extent of fading; all of these parameters should be considered in order to determine an acceptable level of lighting for display. Therefore, the light levels that are often noted in loan agreements and industry guidelines actually do require further information on a range of factors.

For instance; 200 lux illumination provided by an incandescent source would almost certainly

have a different photodegradation potential compared to 200 lux illumination provided by an LED, due to the difference in the spectral energy distribution of these two sources. The extent of damage will be dependent on the duration of exposure as well as on the objects surface characteristics such as the absorptivity and reflectivity responses to the different parts of the incoming light energy.
It can therefore be suggested that, through managing the duration of the exhibition display and by tailoring the composition of the incoming light to certain surfaces, it is possible that the level of illuminance levels may be increased or decreased to suit the exhibition needs.

2) 50 Lux as the minimum acceptable level of illuminance for the viewing of artworks
Though often applied as a rule of thumb, the minimum acceptable level of illuminance may be altered depending on the accompanying information

- "on what type of objects? (in terms of size or colour/black-white contrast)"
- "in what type of environment? (in terms of the background/foreground colour/black-white contrast)" or
- "for whom? (in terms of the effects of ageing on visual acuity and expectations of visitors.)".

A range of parameters play an important role in determining an acceptable level of illumination for satisfactory viewing of artworks:

-The composition of the luminous energy contained in the light
-The material and the light related properties of the surface viewed
-The size/detail/contrast and colour diversity of the surface viewed
-The position and the distribution of the light source and the observer
-The state of adaptation and visual skills of the observer

When determining the acceptable lighting conditions in an object specific manner, one may find that the required level of illumination can be much lower or much higher than 50 lux – which than can then inform the conservation strategy.

In summary, lighting in exhibition spaces should primarily respond the exhibition experience for today's visitors and the extent to how far into the future it will be practical and possible to keep the exhibition material for the following generations to benefit from it.

To achieve both goals, a possible way forward can be developed by carefully reconsidering an acceptable level and type of illumination for the satisfactory viewing of the exhibition. At the same time, a decision needs to be made on the desired usable life of the exhibition material. These two parameters can then be used in making the programmatic, including spatial and operational, arrangements.

This can open up new opportunities for different conservation methodologies and help creating a bridge between the two fundamental aspects in exhibition display lighting; the longevity of the exhibit for tomorrow's visitors and the communication and connection of today's visitors with the exhibit - a bridge from conservation to conversation.

4 Greening Exhibition Spaces

The increasing global trend and necessity to minimise energy use require a change of mind in the traditional ways of lighting in museum and gallery facilities. In response to these developments, best practice expectations for exhibition display are evolving and appropriate display lighting conditions for cultural collections and exhibitions continue to be a major topic of discussion on an international level. Most of these discussions revolve around the legislations regarding the phasing out of the inefficient light sources, which have a significant impact on the museum and gallery facilities.

Most government actions on the issue of lighting are driven by energy savings aspects, and are triggered by the developments in lighting technologies within the last decade; these developments shifted the focus of key lighting manufacturers into new areas of research and product development, which resulted in a change in the business interests as well as manufacturing trends. It is predicted that the use of incandescent lighting is likely to shrink significantly within the next decade, and even completely disappear in some countries. With most museum and gallery lighting being primarily based on the incandescent lighting technology, as far as museum and gallery sector is concerned, the phasing out of inefficient light sources is perhaps the most significant legislation to date in history in the field of lighting.

The government legislations on the phase out of the incandescent light sources have been widely criticized by different groups and organisations for the extra costs imposed on the public by government dicta, as well as for the light characteristics of the available alternative technologies that do not match certain qualities of the incandescent lamps such as the continuous colour spectrum, smooth dimming and colour shift when dimming, which can be preferable for certain applications. There are also environmental concerns over the potential for mercury pollution and contamination, particularly since the compact fluorescent (CFL) type lamps that have been commonly proposed as replacement contain toxic mercury and there is little regulation and guidance on the appropriate forms of disposal and recycling.

As the alternative lighting technologies rapidly develop, the concerns are being reduced and alternative ways forward are opening up new possibilities for museum and gallery lighting. Common strategies taken on by many institutions to cope with the phase out of certain lamps in the last few years can be summarised as:

- bulk stocking of spare lamps
- direct replacement of the lamps only with the alternative lamp technologies
- replacement of the complete luminaires or systems with alternative fixtures using alternative technologies

Although being in contradiction with the objectives of the government initiatives, bulk stocking of spare lamps has been widely used as an interim measure, being a cost effective solution in the short term, and giving museums and galleries time to enable alignment of their budgets and planning to consider a future major upgrade for their lighting systems. It also provided museums and galleries the time to wait on any major upgrade while alternative lighting technologies have been rapidly evolving and developing in the last few years; and while the costs of these systems have been coming down to more affordable levels. This way, many institutions have bulk stocked spare lamps in recent years and were able to maintain their lighting system for extended periods, without having to undertake a major upgrade. The industry is now moving on from bulk stocking of spare lamps, to a phase where the replacement technologies are widely being considered.

Lighting is a complex topic that extends beyond only energy saving considerations and requires understanding on various other aspects. When considering the alternative lighting technologies to replace incandescent systems for museum and gallery lighting upgrades, it is important to study these wider issues and their impact in relation to specific spaces and specific applications; and to select the systems that respond to the requirements in an optimum manner. Therefore, it is

important to understand that there is no one-fits-all type of approach for exhibition lighting, and that a wide range of lighting considerations need to be taken into account when looking for suitable options. These considerations include issues such as the quality of light in terms of its spectral characteristics, beam distribution and conservation aspects as well as lamp life, maintenance, embodied energy, disposal, recycling, flexibility, dimmability and control, future availability and the capital and operational costs. The change of lighting technologies also has an impact on other services,such as air conditioning having to deal with generally lower lighting heat load.

As far as today's alternative lamp technologies are concerned, there are three technologies of today that have reached a stage where they are able to provide good quality lighting with significantly less operational energy compared to incandescent sources. These are: high pressure discharge sources (such as metal halide and white son), low pressure discharge sources (fluorescent lamps), and light emitting diodes (LEDs). Although each have distinct characteristics and qualities that differ, all of these technologies offer certain advantages and may be given consideration in planning a new exhibition lighting system.

High colour rendering versions of the high pressure discharge lamps have crisp white light and superior illumination characteristics suitable for certain types of display lighting applications, whilst being energy efficient. Being a point source they can be controlled via optical means to achieve different effects. It must be taken into account however, that these types of lamps are not practically dimmable through electronic means.

Figure 15: The Art Gallery of New South Wales Kaldor Gallery in Sydney utilises a high colour rendering metal halide lighting system
(Photo taken by Simm Steel, AGNSW)

Low pressure discharge lamps such as the linear fluorescent tubes in high colour rendering versions can be effective in providing even and uniform display lighting conditions. Furthermore, they are smoothly dimmable using electronic control gear, energy efficient and have long lamp life.

Figure 16: The National Portrait Gallery in Canberra utilises a combination of high colour rendering fluorescent lighting system, track lighting system and daylighting
(Photo taken by Emrah Baki Ulas, Steensen Varming)

LEDs are the latest of the alternative technologies that have improved significantly within the last decade and have now become practical for many display lighting applications. LEDs today are available in various warm, neutral or white colour temperatures as well as tuneable colours; and are dimmable on compatible control gear. The energy performance of LEDs available in the market has

reached a stage that is comparable to the fluorescent and metal halide sources, and is expected to improve further in the near future. Colour consistency, smooth dimmability and optical control of the LEDs are still undergoing development, which needs to be carefully considered in the design and planning process.

Figure 17: Australian War Memorial in Canberra utilises light emitting diodes for the lighting of display niches
(Photo taken by Mirjam Roos, Steensen Varming)

The Organic Light Emitting Diodes are also an upcoming technology. Whilst the practical uses of these sources are still limited to decorative effects and low brightness applications for screens and mobile devices, they may become common in the architectural lighting market in the future.

The perspective for the sustainability in lighting for exhibition spaces should be widened from the light sources to also include considerations for the lighting controls. Often, how a lighting system is controlled can be at least as effective in saving energy as how efficient the light sources are in converting electricity to light. Techniques such as zoning, dimming, timer or occupancy controls can provide substantial cost and energy savings.

When planning new lighting systems or upgrade of existing lighting systems for exhibition display, a sustainable result should be achieved through focussing on the visitor experience, and taking on a holistic approach that understands the interdependence of design parameters and develops integral solutions as part of one another. Consulting qualified and independent experts in the field of museum and gallery lighting does not only simplify a complex and multifaceted task but also provides well-informed and tailored solutions that achieve a balance between optimum viewing conditions and conservation requirements, while often providing additional savings and creating sustainable outcomes.

References

1. Museums, Libraries and Archives, ASHRAE Handbook 2007, Chapter 21
2. Cassar, M., 1995, Environmental Management: Guidelines for museums and galleries. Museums & Galleries Commission
3. Thompson G. 1978, The Museum Environment, London
4. Cassar, M., 1994, Museums, Environment, Energy – Museums and Galleries Commission/ Energy Efficiency Office
5. British Standard BS 5454:2000 Guide for the Storage and exhibition of Archival Materials
6. PAS 198:2011 Specification for environmental conditions for cultural collections
7. Cuttle, K, 2009, New Opportunities for LEDs in Museum Display Lighting, Professional Lighting Design Convention 2009, Berlin, PLDA, pp.38-43
8. Davis, W. & Ohno,Y. 2011, Development of a Colour Quality Scale
9. Commission Internationale de l'Eclairage. 1995. Method of Measuring and Specifying Colour Rendering Properties of Light Sources, CIE 13.3
10. Shrum, G. 2011, "Light Art Matters", Archlighting, Jan/Feb 2011pp.19-21
11. Skarda, C.A., "Perceptual Form of Life", Journal of Consciousness Studies, 1999, Vol 6, pp.79-93
12. Roos, M and E.B. Ulas, "Looking Art in a New Light", Papyrus Magazine - Official Publication of the IAMFA (International Association of Museum Facility Administrators), Vol 12. Pp14-16 and Vol 11. pp35-36,
13. Ulas, E.B. 2010, Steensen Varming Daylighting and UV Study for the National Gallery of Australia
14. Ulas, E.B. 2010, Steensen Varming Daylighting and UV Study for the Museum of Contemporary Art, Sydney
15. Ulas, E.B. 2011, Steensen Varming Lighting Study for the NSW Parliament House, Brett Whiteley Artwork Display