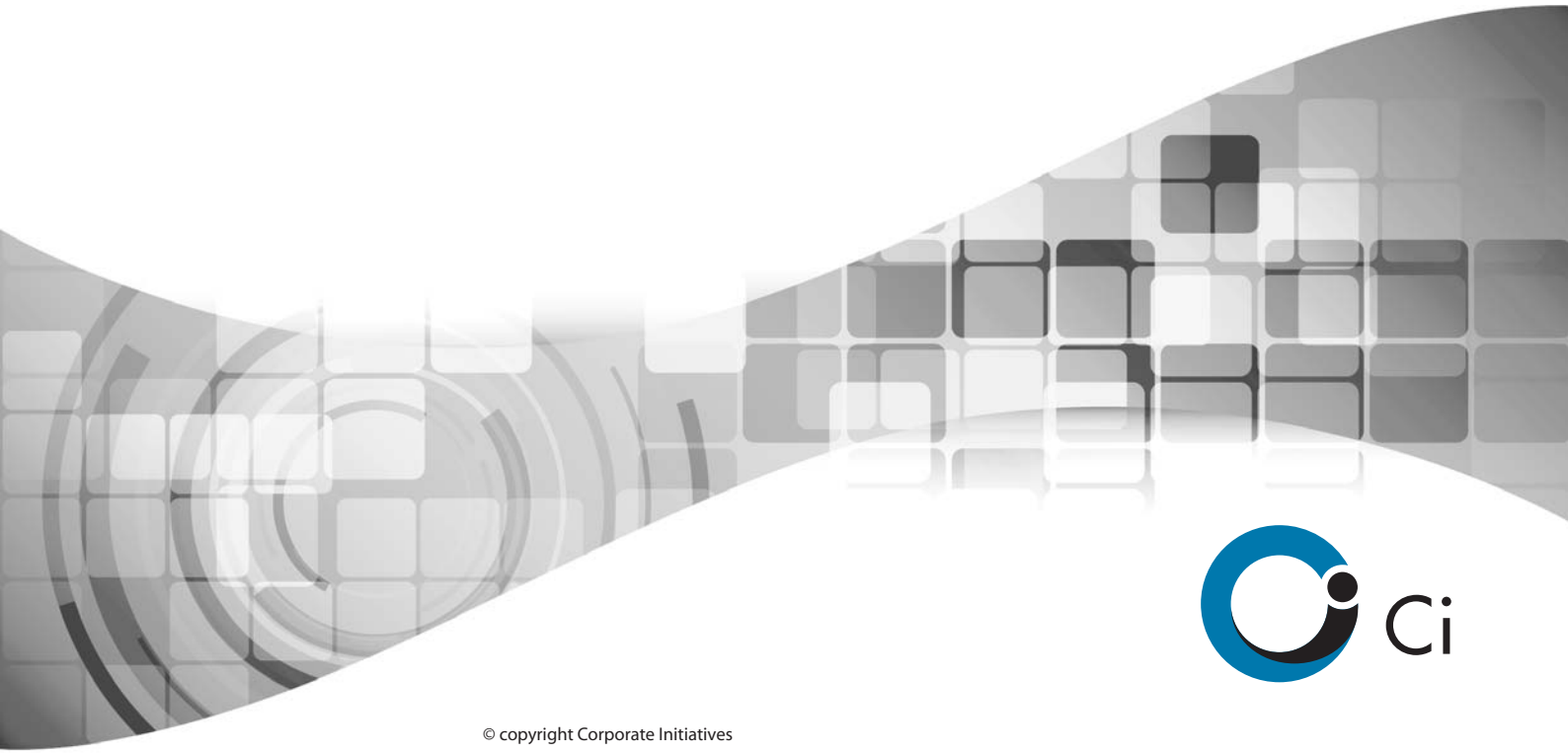
whitepaper

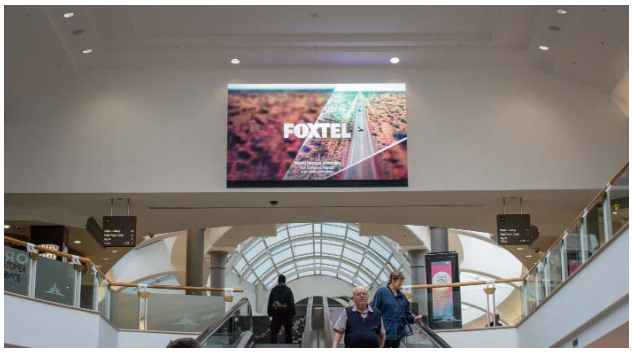
LED white paper for architects & designers



Introduction

LED display can vary in price significantly, even when specifications appear to be very similar. LED is therefore a technology in which it is very easy to make a purchasing mistake, or give erroneous costing advice. This white paper attempts to outline the issues involved so as a professional designer you are better informed on the pitfalls.

There are a number of aspects that need to be understood in order to get the complete picture on LED. These aspects include: build quality, ease of installation, serviceability, support, viewing distances, viewing angles, cooling method, colour accuracy, content, content management and more. You also need to become aware of the different specialist applications of LED technology in order to maximise your design possibilities.



As authors of this white paper, Ci (Corporate Initiatives) can offer some serious industry credentials. Ci achievements include Australia's best stadium LED (MCG/Etihad), best light transparent media façade (Emporium) and Australia's most impressive shopping centre LED examples, both indoor and outdoor. Future achievements will include Australia's most ambitious civic LED project.

Ci

Build Quality

How it varies. Why it varies.

LED Component Quality

It is well known that LED technology creates images from an array of individual light source components (LED = Light Emitting Diode). What is less well known is the extent to which these components can vary enormously in price, even when appearing on the face of it to have a similar specification. Two different light emitting diodes, for example, can offer the same brightness levels but differ hugely in cost. This is because one is engineered to last a long time before requiring replacement and the other is not.

Some applications of LED display don't actually need durable components because the set up is only temporary and there is always someone on hand to replace sections if need be. An example would be LED for a theatre set or trade exhibition. A billboard 10 metres in the air, however, is another matter entirely. Getting up there is difficult and with several billboards spread over a wide territory frequent panel replacement becomes costly. Such an LED installation, like LED installations at shopping centres or civic plazas needs to be considered as mission critical. The more reliable and durable such a display is, effectively the less expensive it is to manage.

Leaving an LED display in a less than perfect state is not an option for most permanent installations, so you need to choose the right quality level of component in the first place. Higher value LED componentry looks better, lasts longer, and in the context of a mission critical application, offers a total cost of ownership that generally works out to be much lower than its cheaper but less reliable rivals.

Componentry suitable for mission critical applications, however, also varies in price. The best value for money is derived from matching each project specifically with the right product. Just as it is possible to spend too little on LED, it is also possible to spend far too much depending on the project. Helpful expertise in product selection makes all the difference.

System Component Quality

There is more to image quality and reliability than just the light emitting diodes. An LED display comprises of thousands of these tiny light sources so the quality of connection and conductivity within the overall system also becomes an issue. Without unequivocal industry standards it's a buyer beware situation, so you need to be able to trust your manufacturing source. These are aspects that affect both reliability and performance. Quality control in this area is therefore a key consideration and something necessary to have at the point of manufacture.

LED Component Types

SMD vs DIP - Understanding the differences

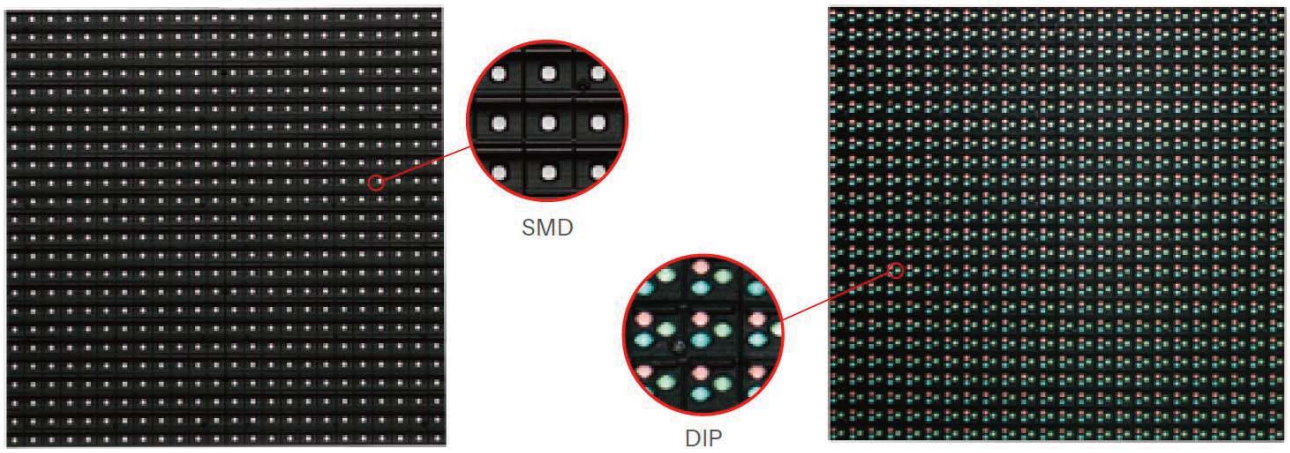
There are essentially two types of LED; SMD and DIP.

DIP (Dual In-line Package) is the older of the two technologies. DIP components have higher optical decay, lower CRI and efficacy than the later SMD (Surface Mount Diode) variety. However DIP LED is still used for certain applications for which it remains better suited.

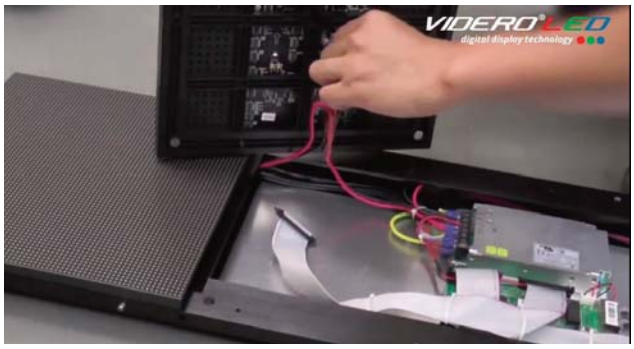
Physically DIP displays comprise of separate RGB light sources as shown below on the right, while SMD displays comprise of single point light sources as shown on the left.

Where DIP continues to hold the advantage is in offering a higher brightness level, an important consideration for outdoor locations exposed to direct sunlight. It is also more economical to waterproof. In practically every other respect, however, SMD holds the advantages; in angle of view, in precision of image, and in reducing weight and bulk. The brightness of SMD will doubtless improve over time but for now is its limiting factor. Sometimes DIP is still the optimal choice.

A good supplier offers both types of display. Both technologies have their uses, and a good supplier will make sure you choose the right one for your particular application.



Ease of Installation



LED product with thoughtfully designed modular construction systems can slash the overall project cost.

A hidden cost of LED projects, especially substantial LED projects, is the cost of installation. This can be affected not only by the intended location of the display, but the speed at which the product can be assembled. Time is money, especially on a building site or for installations where disruption to ongoing business operation needs to be kept to a minimum.

The best LED products for permanent installation are therefore designed to be easy to put together in a precise manner. This entails industrially designed construction modules that fit together easily and align perfectly, allowing the project to be successfully realised in less time. In addition to speed such precise modularity also leaves less room for error.

The following video link demonstrates such modular engineering in action.

https://vimeo.com/209514956/848456e320

Ease of Serviceability

Just as an LED display needs to be easily installed, it also needs to be easily serviced. Unlike previous display technologies, LED displays are regenerative. Rather than requiring total screen replacement, sections can be replaced as needed. Serviceability and ease of maintenance are therefore key product considerations. An LED screen needs to be kept in good working order over its lifetime.

Screens that go on walls generally need to be serviceable from the front otherwise you face major servicing costs in removal and replacement. The alternative is servicing from the rear, which requires space behind and access to that space. In many instances such a provision is either impractical or impossible.

The choice between front or rear servicing is not your only consideration. The ease at which the servicing can be carried out is also a cost factor. Display systems that are well designed for access make such servicing simpler to accomplish. The design therefore impacts on the total cost of ownership.

Regeneration of displays also comes with an extra challenge. You need the section you are replacing to match the remainder of the screen in display characteristics otherwise you end up with a patchwork effect on screen. Mission critical LED displays allow for easy screen calibration so sections both old and new work coherently as one seamless display.

The following video demonstrates what is meant by ease of serviceability.

https://vimeo.com/209514578/1dfb4993de

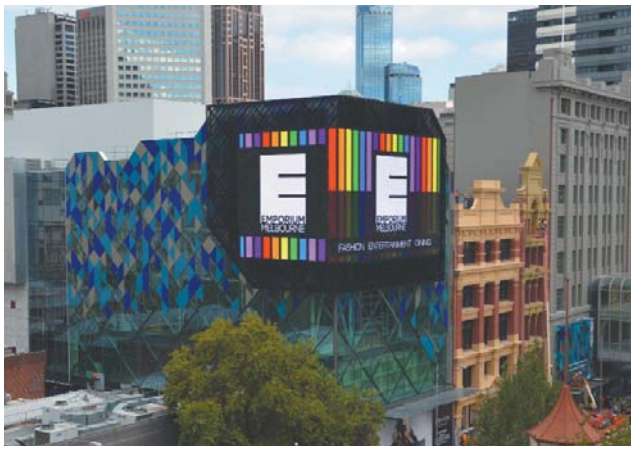
The ongoing support factor

An example of LED screens needing mission critical ongoing support - those located around the boundary at the MCG and Etihad. These screens are seen by millions of viewers each week and substantial advertising revenue is dependent on their operation.

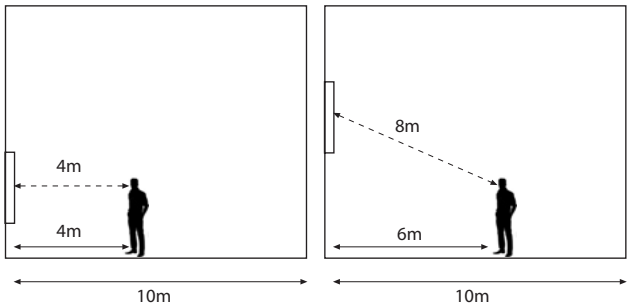
We have already spoken of factoring in regeneration with LED display. Regeneration not only needs LED components that are easy to replace successfully, you also need continuity of supply for such components plus skilled personnel available to change them over. In other words, the ongoing support factor is crucial.

You therefore need to choose a supplier that is likely to be around for you in the years ahead, and that can offer ready access to replacement panels as needed. You also need them able to provide you with skilled people for ongoing maintenance and upkeep at the screen location. National clients will need national support.

With LED your supplier choice effectively becomes as critical as your product choice. Making an informed LED choice is therefore not just about what you purchase but also from whom you purchase. The two aspects become inseparable.



Viewing Distance and Pixel Pitch



Raising the screen elevation changes the viewing angle and viewing distance. It also pushes the viewer back a little to obtain a more comfortable view.

How viewing distance affects both price and value

A basic specification given for direct view LED display is pixel pitch, the distance expressed in millimeters between the individual LEDs arranged on the display grid. The shorter the pitch distance, the more pixels you have per square metre and the cost per sqm of the display increases accordingly. How many pixels you will need per square metre, however, will depend on the size of the screen and the viewing distance. As a rough rule of thumb, a metre for every millimeter of pitch will give you a minimum acceptable viewing distance, and 2 metres for every millimeter will give you an optimal viewing distance beyond which the image quality doesn't really get appreciably better.

So the first lesson to be learnt with pixel pitch is that matching the pitch to the viewing distance helps determine the cost necessary to succeed with the display and the value for money that is delivered. Location counts. In some instances spending a great deal more per square metre will actually achieve very little because no one will ever get close enough to notice. Opting for a better quality screen with a wider pitch would be a much better value proposition under such circumstances. Not only would it look better at the viewing distance, the expected upkeep cost over its lifetime would be significantly lower.

Screen location should therefore be considered as both a cost factor and a design factor. A screen located at a higher elevation can drop the price per square metre needed significantly because the minimum viewing distance might jump from a metre or two to 8 metres or more and the cost per sqm can drop accordingly.

A real world example of controlling viewing distance through height.

Height is not the only design element that can engineer viewing distances. Sometimes a barrier can be placed between the screen and the viewer, such as a void, a garden or a stage. Controlling viewing distances can be a great way to keep costs lower. Purchasing twice as many pixels per sqm as needed, for example, on a 5mm pitch screen won't deliver an appreciably better image at a viewing distance of 20m or more. A 10mm pitch screen will get the job done for considerably less.

Due to viewing distance, most billboards are more than 10mm in pitch.

Sometimes, however, shorter viewing distances are unavoidable and on those occasions other budgetary measures are needed. If the viewing distance is short and the budget finite, the design element to control is the screen size, because the cost will be proportional. A smaller screen with a better image will give a better result.

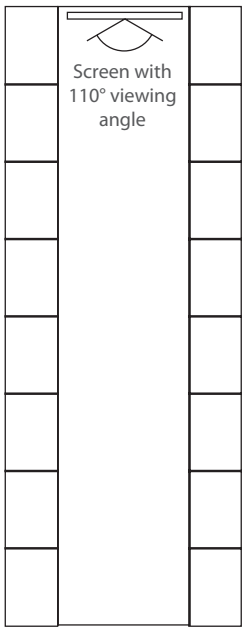
The great non-negotiable is the viewer experience. It has to remain uncompromised.

The following video link shows an example of 2.5mm pitch LED display used in a retail context for up close viewing.

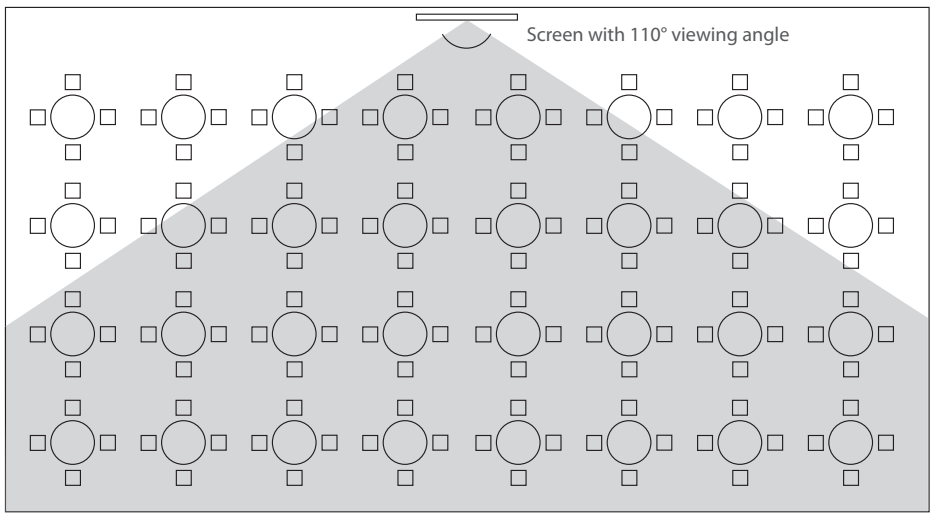
https://vimeo.com/210200582/04dfea72bf

Viewing Angle

The likely viewing angles entailed are important factors to consider for many screen locations. A screen located at the end of an arcade or on a highway billboard, for example, is less likely to have off axis viewers. An LED screen in a building foyer, on the other hand, may be viewed from far more acute vantage points due to the floor layout. In most instances maximum viewers means maximum value, especially if advertisers are involved. So getting this aspect right is worth your while.



110 Degree viewing angle in Arcade



110 Degree viewing angle in Food Court (almost 25% of the seats can't see such a screen)

Brightness

A good example of display management, this sign is luminous within the location without being overpowering, colours are not overblown, solids are flawless, and legibility of the fine print is impeccable.

If ever an LED specification needed to be better understood it is brightness. Brightness levels with LED are like volume levels with a sound system. You need it set to the right level for the task at hand. An outdoor LED in direct sunlight needs to be very bright, but the same brightness level on an overcast day and even more so at night will look over bright and garish. In fact in some jurisdictions a sign that is too bright will be considered a visual pollutant and incur a financial penalty.

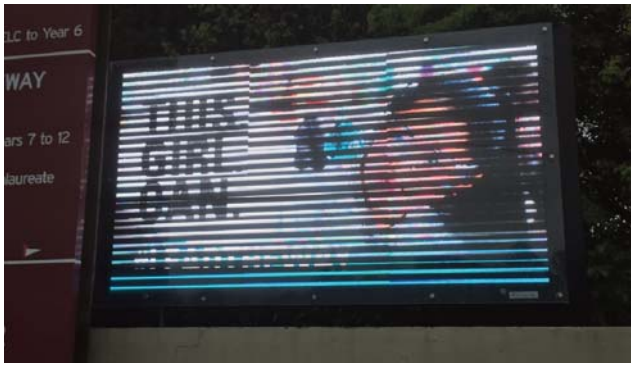
Brightness level as a specification is important because it indicates the headroom you have to reach the right level of brightness as required. However brightness should also be viewed as an aspect that needs to be successfully controlled. The use of light sensors in conjunction with a control system can control brightness levels in response to prevailing light conditions. Great LED display therefore requires control expertise. In the case of the MCG, for example, patrons at the ground are spared the glare of daylight brightness LED when sections of the perimeter signage fall into shadow. This required some clever engineering.

Colour Accuracy

Grey scale is one of the key determinants of colour accuracy, and colour accuracy is an important consideration for most mission critical LED applications. This is not just a matter of having better-looking images. Advertisers in particular can be very demanding of colour accuracy. Cadbury purple is very exact, for example, as is ANZ blue or Coles Red.

A screen with inaccurate colours is less likely to attract advertisers, so the price ultimately paid for it needs to include lost revenue.

Camera Friendliness



This outdoor screen shown above actually looks ok to the naked eye in real life, but due to its specification it won't ever look good to a camera. This is a pitfall worth avoiding. Ensuring camera friendly LED requires expertise, a key reason why the MCG and Etihad perimeter screens look so much better on TV than do all the rest.

Another specification that should not be overlooked with LED display is the refresh rate. A screen with an insufficient refresh rate will not look good on camera even though it looks fine to the naked eye.

This aspect does not matter in an environment where the taking of photographs is forbidden, but it matters a great deal in locations where photographs are encouraged or likely.

Photographs play such a huge role in the success of social media and people are less likely to post photographs that don't look good. Generating interest through social media is desirable for most businesses and institutions, so this aspect becomes a real screen selection issue. A screen with a poor refresh rate kills that enthusiasm stone dead.

Content

This reactive media created by ESI Design for building owner Beacon Capital Partners makes an otherwise ordinary building lobby extraordinary. 1700 square feet of media offering a variety of content modes ensure that things are never dull.

Screen content is actually what makes a screen interesting. The LED display hardware can make that content look as good as it should, but it is the content itself that generates the interest.

Not all screen content is advertising. In fact a screen can be composed of various elements within the one composition. A single screen, for example, might feature a corporate video as the main image in conjunction with a ticker tape news feed, a display of the current temperature and weather outlook, and the time. Or it might feature the wellness dashboard or the environmental dashboard of a building in real time.

Screen content can also be generated in artistically interesting ways. In the examples shown here from ESI Designs in the USA, the imagery is driven by algorithms, or based on real time data whether sensory or numeric. The result is screen content that is forever changing rather than endlessly looping so it becomes far more interesting to watch. This is particularly relevant for screens located where they will be mostly seen by the same people everyday, such as screens located in office foyers.

Content Management

Here is an example of a digital signage composition that combines entertainment, advertising and information on the one screen. This can also be done with LED screens.

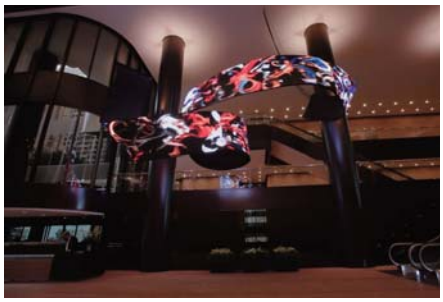
We mentioned on the prior page how a screen could be composed of various elements simultaneously. Having a content management system that can provide such flexibility is therefore useful. However a content management system can also do a great deal more. It can schedule content to the time of day, keep track of paid advertisements and when they got displayed, and ensure the image displayed always looks good (and with minimal drag if a moving image). A really good content management system never leaves you with a blank screen.

When designing with display technology you also need to be mindful of how many pixels you are dealing with and how easy they are to manage. An easy mistake to make with digital display is to use the wrong technology for the application. Using hundreds of LCD screens, for example, to create something interesting in a huge atrium might look good on the page, but each screen contains millions of pixels so when you start using hundreds of them, you end up with billions of pixels requiring a lot of computing power in order to manage. To make matters worse, most of these pixels end up a total waste of money because they are unnecessary at the viewing distances involved.

Deploying LED for the same task would mean fewer pixels, a noticeably brighter image that is more vibrant, plus much lower power consumption and heat generation.

Specialised Applications

Flexible LED



Floor LED

Ceiling Tile LED

Pre Packaged
LED Modules

Rooftop LED

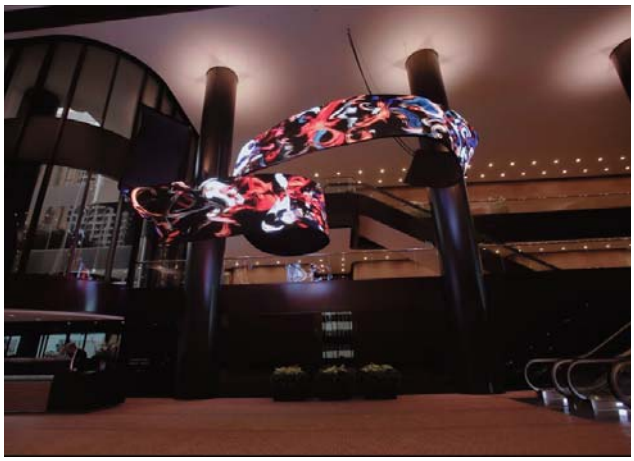
Light
Transparent LED

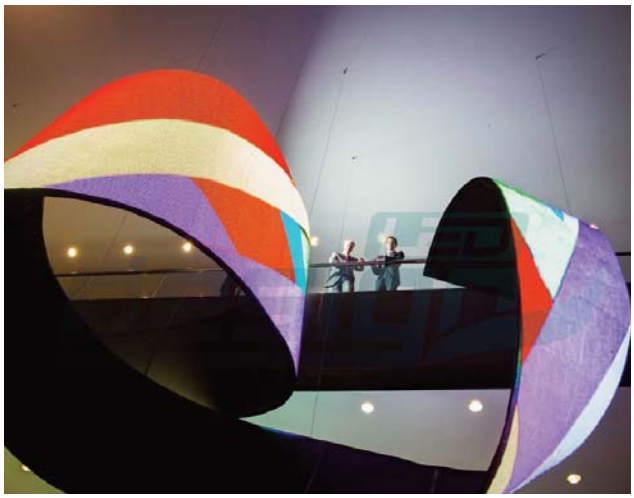
Retail Display
LED

Back-to-back
LED

Staircase LED

Flexible LED





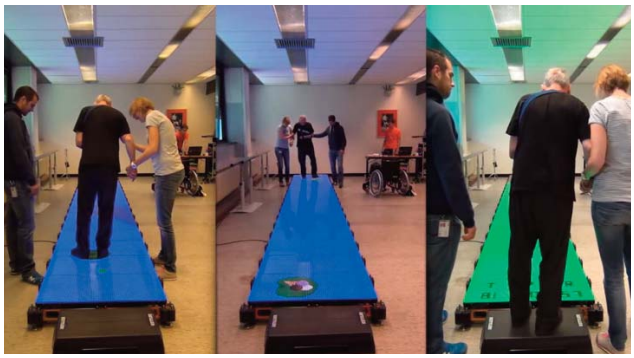
LED displays with 2 way flexibility not only allow the realsation of smoothly produced, uniformly curved shapes like canisters or circles, but can also twist to helical shapes. This opens up many more possibilities for a designer to be creative.

Pliable LED can be used up close for things like TV studio set design, or be used at a greater viewing distance such as being suspended on wires in an atrium. The brightness specification needs to vary accordingly. Atrium signage has to be brighter to compete against the daylight, and the up close variety needs to be toned down for viewing comfort.

One of the best things about pliable LED is that it is lightweight in comparison to standard indoor LED construction. This allows it to be suspended successfully without much difficulty in engineering and be deployed in places that would otherwise have no usable location for LED. Foyers without vacant wall space, for example, can be brought to life in this way.

Floor LED

An interactive walkway



LEDGO gait correction application for hospitals

Floor LED can be a great deal more than just a colourful dance floor. Integrated with the right technology it can be interactively interesting. This interaction might be for the sheer joy of visitor engagement, for education purposes such as at a museum, or for rehabilitation purposes such as at a hospital.

Ceiling Tile LED

With LEDGO ceiling tiles, "having a blue sky outlook" can be made literal in the boardroom

Developed by LEDGO a Dutch company who specialise in developing new uses for LED, these LED tiles can turn an ordinary section of suspended ceiling into something rather extraordinary. They are exclusive to Ci in Australia. This clever technology allows ceilings to be put to more productive use. In retail and civic environments they afford more display space. In corporate environments they enable spaces to be made more lively and interesting.

Below is a link to a video

https://vimeo.com/209377758

Retail space example

Airport traveller information example

Pre Packaged LED Modules

Pre Packaged LED systems make really good sense under certain circumstances. A multi outlet retailer wishing to put roadside signage outside all their premises, for example, would be well served by a self contained two way LED sign that could easily be installed on a pylon or pole. Installation would be streamlined and the project overall made far more affordable.

Another example would be retailers wanting the "get me noticed" brightness of LED in their front window or shop entry. A pre-packaged system that was self contained and portable would let them deploy such signage as needed around the store, or possibly share such signage with other stores.

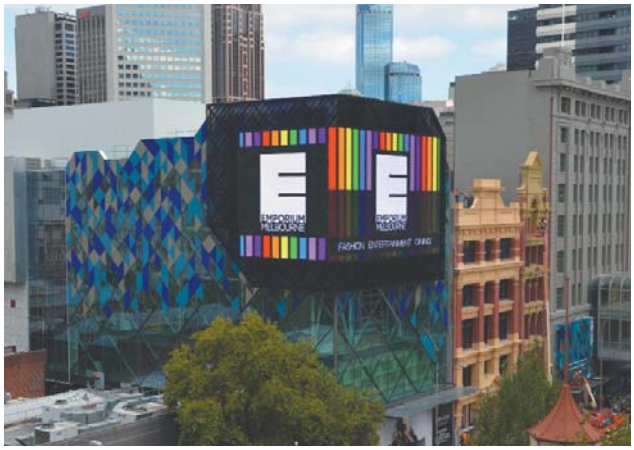
Curtain/Rooftop LED

Outside Curtain LED

Outdoor curtain LED is designed to answer the challenges posed by certain locations. A large LED sign on a rooftop for example can face problems of wind resistance and noise. Similarly a large LED sign on a carpark may disrupt ventilation to the point where the air quality inside the carpark becomes compromised. Curtain LED allows both air and light to pass through, enabling LED screens to be successfully deployed in more places.

Light Transparent LED

Light Transparent LED from inside



Light Transparent LED from outside

Light transparent LED allows windows to retain their window function while at the same time adding imagery to the outside of the building.

Media facades of this kind will transform the outward appearance of many buildings in the years ahead. The example shown is the giant LED screen created on the Emporium Melbourne corner. When viewed from the outside you see impressive screen content, but when viewed from the inside looking out your view to the outside world remains largely uninterrupted.

This allows giant screens to be installed on the sides of buildings without denying the building occupants on the floors immediately behind a decent view. No one should design a media façade without some expert input. Previous projects of this kind in Australia to date can offer some excellent insights.

Retail Display LED

Retail is already one of the most significant users of LED globally and it will become even more so in the years ahead. Designers who are clever about it will look to tailor LED specification to location, even within the same project. An LED located high above a stairwell might be specified at a 6mm pitch, and a screen closer to eye level at a 4mm pitch. The trick is to choose product from within the same manufactured series in order to match colour temperature and brightness levels. Companies like VideroLED, for example, offer a family of indoor LED products for this purpose.

There are so many ways in which LED can be applied to retail and this is true for other display and AV integration technologies as well. If you have a retail project in search of ideas it would be worth asking experts what's possible. The variety of LED on offer only scratches the surface.

Back-to-back LED

There are many purposes for which two-sided LED displays are required. Roadside premises signage, for instance, visible from both directions, or signage hung in voids with vantage points either side. Usually it is not just a matter of putting two screens back to back. Further specialised integration and packaging is involved. Shrouds, for example, might be needed to ensure the sign is presentable when viewed edgeways. Combining display technology with such fabrication is a specialised undertaking. Not every installer has the necessary skills.

Staircase LED

Staircase LED is one of the more popular applications of LED to architectural detail. However it is by no means the only one. With LED it is possible to customise displays to be very site specific. So rather than have a standard screen shape imposed on a space, it is feasible with customised LED to have the screen made to a shape that better suits the architectural lines.

The lifetime commitment

Taking many of the aspects raised so far into consideration, it is clear the value of mission critical LED display needs to be evaluated over its lifetime. For an LED product choice to succeed you need a supplier that will be around to support it, replacement product available to support it, and the upkeep of the screen to be economical.

It is therefore helpful when the product warranty goes some way to keeping the upkeep cost down. The best LED products come with a decent warranty because they were actually built to last. For mission critical LED three years warranty should be considered a starting point, with the possibility of adding more years if needed. Better suppliers offer a warranty of up to six years as standard.

The track record of the supplier will give you some indication of longevity. How long have they been in business, what projects have they done and what projects do they currently support?

Why go to the bother?

LED display allows built environments to become more productive. This might be on a commercial basis through the generation of advertising revenue or the value added to tenancies. Or it might be on a less commercial basis such as successfully providing a new artistic or civic medium.

LED display will doubtless become more prevalent in the years ahead, and architects should therefore get involved in order to protect the design integrity of their buildings. As a designer it is much smarter to make LED part of what you offer upfront and seek some expert technical assistance in your endeavour.

Time is not on your side

Standard practice with building design is to develop a series of specifications and drawings, document what's required and put the whole thing out to tender. While this method probably works out fine for building materials, furniture finishes and construction detail, it is less likely to work out well for LED display. This is because LED display is still an emerging technology and moving at a fast pace. It is therefore better to treat LED display as a separate package and make the call on specification much closer to the realisation date. Nothing is sadder than an LED screen being installed that is effectively already out of date on the day of installation. Sometimes it happens on a very large scale.

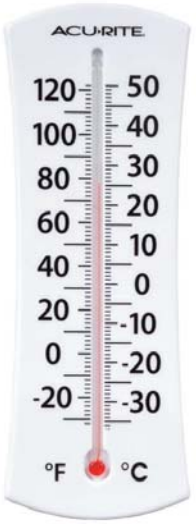
Power Consumption

Every architect these days understands the importance of reducing power consumption, not just for economy but also for the green credentials of a building. You need to consume power for LED display. It is unavoidable. However you need to get the balance right between the display imperative and the power necessary to achieve it. Brighter displays consume more power. The best of them, however, do so more efficiently. What you don't want to do, however, is specify a screen that is good for power consumption but not good for display in its chosen location.

Heat Dissipation/Management

All screen display involves light sources and light sources generate heat. This is true not just for LED arrays, but for LCD screens and projection. How this heat aspect is managed needs to be taken into consideration when documenting the design. Merely noting LED screen on a floorplan does not stipulate you need a 'no fan' design in this location because otherwise the noise of the fans will drive people crazy.

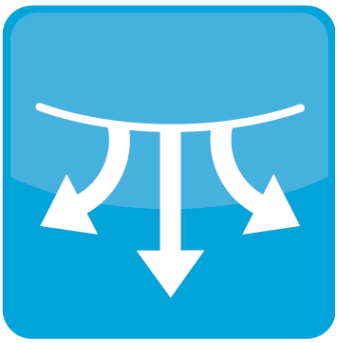
Some LED screens do need fans in order to function, but these are usually located where the noise of the fan is not a problem, such as high up on a building exterior or on a billboard gantry well away from people.



Wellness Factors

Airflow

Airflow is an important consideration in many locations. Carparks for example need sufficient ventilation in order to let exhaust fumes escape. This means that an LED screen located on the outside of such a carpark should not compromise the level of airflow necessary.



Let there be light

We have heard of property owners discouraged from putting an LED screen on the side of their building because they have been advised that such a screen will block out the natural light to the occupants on the three floors behind it. Such advisors have clearly never heard media facades.

At Emporium in Melbourne the building occupants behind the giant corner screen are able to look outside. Around 70% of the natural passes through the sign to the building interior, and likewise the view from inside is largely unimpaired.

Everybody knows architects love light. A knowledgeable advisor can help you preserve it with LED products appropriate to the task.

How to read a specification sheet

Pixel Configuration
This identifies whether it is a single light source (SMD) or RGB cluster (DIP) configuration.

Pixel Pitch
This measures the gap between individual LEDs. The lower the number, the denser the LED array will be.

Pixel Matrix per panel
This numbers how many pixels are on the smallest replacement panel module.

Module dimension
This is the size of the smallest replacement panel module.

Enclosure Dimension
This refers to the size (or sizes) of enclosure the panels are supplied in. An enclosure might house a number of panel modules, as appropriate to the likely size of screen being constructed. Panels for big outdoor LED, for example, come in big enclosures.

Enclosure Material
The usual choice is aluminium or steel.

Enclosure Weight
This weight is inclusive of the LED panels being enclosed. Multiplying it by the number of enclosures necessary to reach the required screen size gives you the screen's overall weight.

Colour Greyscale (BIT)
The more bits on offer the more natural the image and colour accuracy.

Grey Scale per Colour (Level)
Higher specifications for this aspect offers greater colour accuracy and finer control. This affords more display possibilities without the problem of colour banding.

Refresh Rate
This measures the frequency at which the screen image is refreshed. You need this number to be high enough for a smart phone pic of the screen to look good. A lot of screens will fail this test.

Driving Type
This refers to the level of IC control.

Signal Transmission Distance
This measures the distances at which a signal from a source can be carried to the screen depending on the cable selection.

Brightness
This measures how brightly the screen can illuminate as a maximum.

Colour Temperature
A higher colour temperature means cool colours can become more vibrant.

Colour Contrast Ratio
The higher the ratio, the better the colour contrast will be. This aspect is affected not just by the choice of light emitting diode but also the housing.

Optimal Horizontal Viewing Angle
This identifies the area forward of the screen that will offer a vantage point for viewing.

Optimal Vertical Viewing Angle
This identifies the area above and below the screen that will offer a vantage point for viewing.

AC Input Power Maximum Value
This indicates the maximum power consumed per sqm as measured in watts.

AC Input Power Typical Value
This indicates the average power consumed per sqm as measured in watts.

Storage Temperature
This indicates the temperature range at which the product can be safely stored.

Operating Temperature
This indicates the temperature range at which the product can be safely operated.

Storage Humidity
This indicates the humidity range at which the product can be safely stored.

Operating Humidity
This indicates the humidity range at which the product can be safely operated.

IP Rating (Front/Rear)
This gives the IP rating noting any difference in rating between the front and rear of the enclosure.

Lifetime Typical Value
This gives the expected mean time to failure (MTF) for the product, expressed as hours of use.

Installation Type
This indicates whether the installation cabinet type is fixed or portable.

Ci are serious about supporting designers

At Ci we realise in the years ahead Australian architects and designers will be conceiving of many LED projects. Although Ci invariably end up working on the more technically challenging of them like Yagan Square in Perth and Emporium in Melbourne, Ci want to contribute to the effort on a much broader scale. You can therefore get Ci involved with very simple LED projects as well. Sure Ci welcome large LED projects like the MCG and shopping centres, but there is also interesting LED work to be done in boardrooms, at schools, at hospitals and in public places. The application of LED to public art is largely untouched in this country and Ci really want to see it happen. Interactive uses of the technology are also worthy of designer exploration.

The Ci LED Design Competition

The designer responsible for the best of the individual LED projects we get to deliver over the course of a year will be awarded a business class trip to San Francisco to see some of the most imaginative examples of LED lobby art in the world. Such an award will apply to a maximum of four categories. E-mail us for a registration page URL.

Best LED Digital Art Project

Best Civic application of LED Display

Best commercial application of LED Display

Best architectural application of LED Display

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