

# LED Lighting and Workplace Productivity

There are a number of studies that have covered the subject of lighting and workplace productivity, most of which were done in the mid-to-late 90s. The findings of the mid-to-late 90s studies are widely known and referenced, but pre-date current high performance LEDs. Frequently mentioned productivity killers are flicker, lack of focused light, inability to control brightness, and mood inhibitors caused by unnatural color temperatures all of which have been addressed in LumaStream's intelligent low-voltage LED solution.

Much of the recent research continues to cite these older studies as a basis of support for improved productivity using LED. Particularly common is a reference to "Triple Bottom Line," which is an assessment of financial benefit of adopting green technology like LED lighting. This measurement considers energy savings, reduced environmental impact, and employee productivity improvements as compared to the costs of implementing green technology.

Let's move on to the studies and specifics.

## Study One | "Effects of Four Workplace Lighting Technologies on Perception, Cognition, and Affective State" | 2010

This 2010 study compared fluorescent lighting with three different LED lighting values. LED outperformed fluorescent lighting.

**Key Finding** | "LED supports positive mood, extended wakefulness and speeded performance"

- 8.3% improvement in visual and cognitive tasks
- Faster reaction times
- Reduced fatigue
- Increased vigor/activity
- Lower rates of depression

### Summary

"The present results indicate that recent increases in the number of LED technologies being incorporated into industrial lighting applications may be justified given the positive implications for worker performance. Relative to traditional fluorescent technology with relatively low color temperature, LED appears to support positive mood, extended wakefulness, and speeded performance on both visual perceptual and cognitive tasks."

**Source:** "Effects of four workplace lighting technologies on perception, cognition and affective state" (see attached .pdf file - not available online)

## **Study Two** | “Building Investment Decision Support for Six Energy Efficient Lighting Retrofits – Recommendations for “Triple Bottom Line Savings” | 2013

**Key Finding** | “Vertically integrated” LED light fixtures, occupancy sensors, daylight harvesting, task lights, blinds, and high performance fixtures with automation systems all produce “triple bottom line” savings.

Vertically integrated LED light fixtures paired with dimming and IP control lead to:

- 8.34% improvement in work performance (cites above study)
- 33% improvement in mood ratings with LED
- 33% mood improvement translates to 5.76 work efficiency increase
- 3<sup>rd</sup> bottom line cumulative ROI equals 289%

### **Summary**

The human benefits that have been identified in BIDS research studies relate to the value of LED light quality for productivity at task. The third tier calculations are based on field studies that demonstrate improvement in occupant productivity. Hawes et al. (2012) identified an 8.34% improvement in work performance at visual and cognitive tasks with the introduction of LED lighting with high color temperature and adequate illuminance level, as compared to traditional fluorescent lighting (see Figure 41). In another study, Hoffmann et al. (2012) identified a 33% improvement in mood ratings due to the use of daylight simulating lighting (dimming and color modified) as compared to regular fluorescent lighting. In a 2007 study by Braun-LaTour et al. (2007), a 33% improvement in positive mood ratings would translate into to a 5.76% work efficiency increase (Figure 42).

The combination of economic, environmental and human benefits of vertically integrated LED fixture installations, demonstrate paybacks of less than one year. Given that up to 20% of office floors still have T-12 fixtures with magnetic ballasts, and over 50% of office floors exceed 2.5 watts/sq. foot of lighting energy use during the daytime, this retrofit measure can save up to 85% of a medium size office building’s total lighting energy.

**Source:** “Building Investment Decision Support for Six Energy Efficient Lighting Retrofits- Recommendations for ‘Triple Bottom Line Savings’” [\[download study\]](#)

## Study Three | “Green Building and the Bottom Line” | 1994/1998

This is one of the most frequently referenced studies on the issue of lighting and workplace productivity. Eight businesses from various industries were studied before and after a lighting retrofit, and were measured for real world – real dollar – productivity improvements. This study effectively demonstrates the advantages of better lighting, but predates the higher quality LED lighting of today.

**Key Findings** | “Will just any energy retrofit produce gains in productivity? No, only those designs and actions that improve visual acuity and thermal comfort seem to result in these gains.”

### Productivity Improvements Measured

- 15% decreased absenteeism [Lockheed and ING Bank]
- 25% decreased absenteeism [Pennsylvania Power & Light]
- 16% increase in claims processed [West Bend Mutual]
- Improved product quality worth \$25,000 yr. [Hyde Tools]
- 20% improvement in defect rate [Boeing]

### Summary

Clearly, there is a need for further research; however, the results of these few case studies indicate that the economic benefits of energy-efficient design may be significantly greater than just the energy cost savings. That energy efficiency provides numerous benefits has long been known. That it can lead to productivity gains far exceeding the energy savings gives it a new imperative.

Source: “Green Building and the Bottom Line” [\[download study\]](#)