



Issues with the Use of Airfield LED Light Fixtures

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Background

- ◆ Technological advantages of LEDs:
 - › Durability and longevity (when designed properly)
 - › Wide range of available colors
 - › Narrowband output – saturated color appearance
 - › High efficacy – low energy requirements
 - › Immediate “switch-on/switch-off” time
- ◆ Questions about LEDs:
 - › Lack of heat/infrared output
 - › Compatibility with electrical infrastructure
 - › Cost/return on investment

Airport Cooperative Research Program



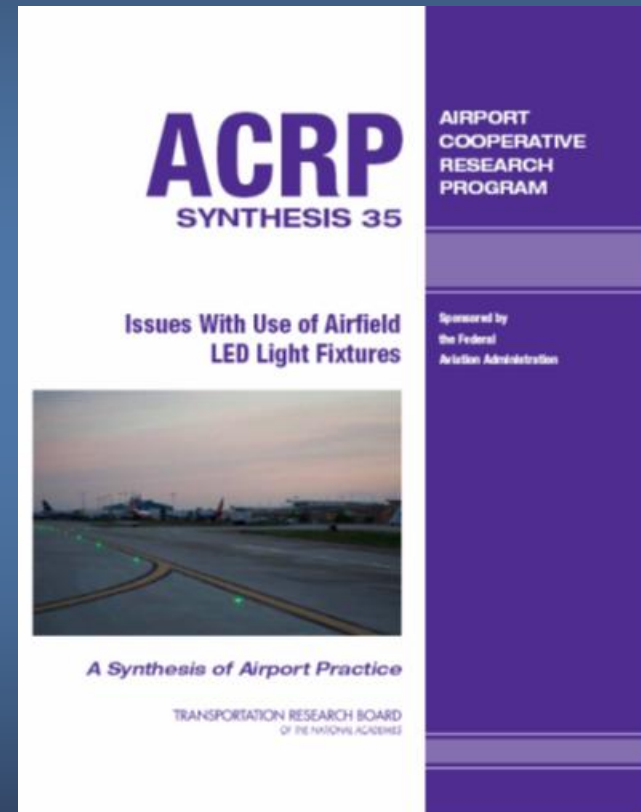
- ◆ Transportation Research Board (TRB) of the National Academies commissioned a synthesis study
 - › Funding from Federal Aviation Administration (FAA)
 - › Overseen by topic expert panel from industry, academia and government (FAA and airports)
 - › Review literature and published findings about airport experience with LEDs
 - › Survey airports with LED experience to (hopefully) corroborate literature
- ◆ Provide a resource for airports considering LEDs to help set expectations and ensure they ask the right questions

The TRB Process

- ◆ Topic expert panel members are instrumental
 - › Develop preliminary scope of work
 - › Select contractor
 - › Review outline and survey materials
 - › Review initial and subsequent drafts
- ◆ TRB reviews final report for “sensitive statements,” editing and final production
- ◆ Report is published in hardcopy and PDF formats

Report Outline: ACRP Synthesis 35

- ◆ Methods
- ◆ Current practices and challenges
- ◆ Installation issues
- ◆ Operation and maintenance issues
- ◆ Economic issues
- ◆ Future outlook
- ◆ Resources for airports



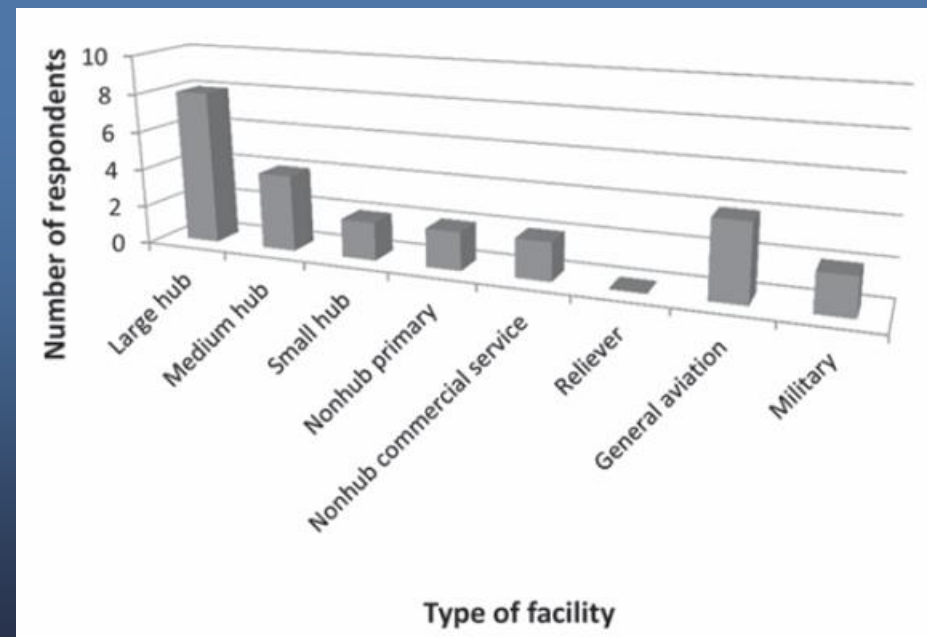
Methods

◆ Literature review

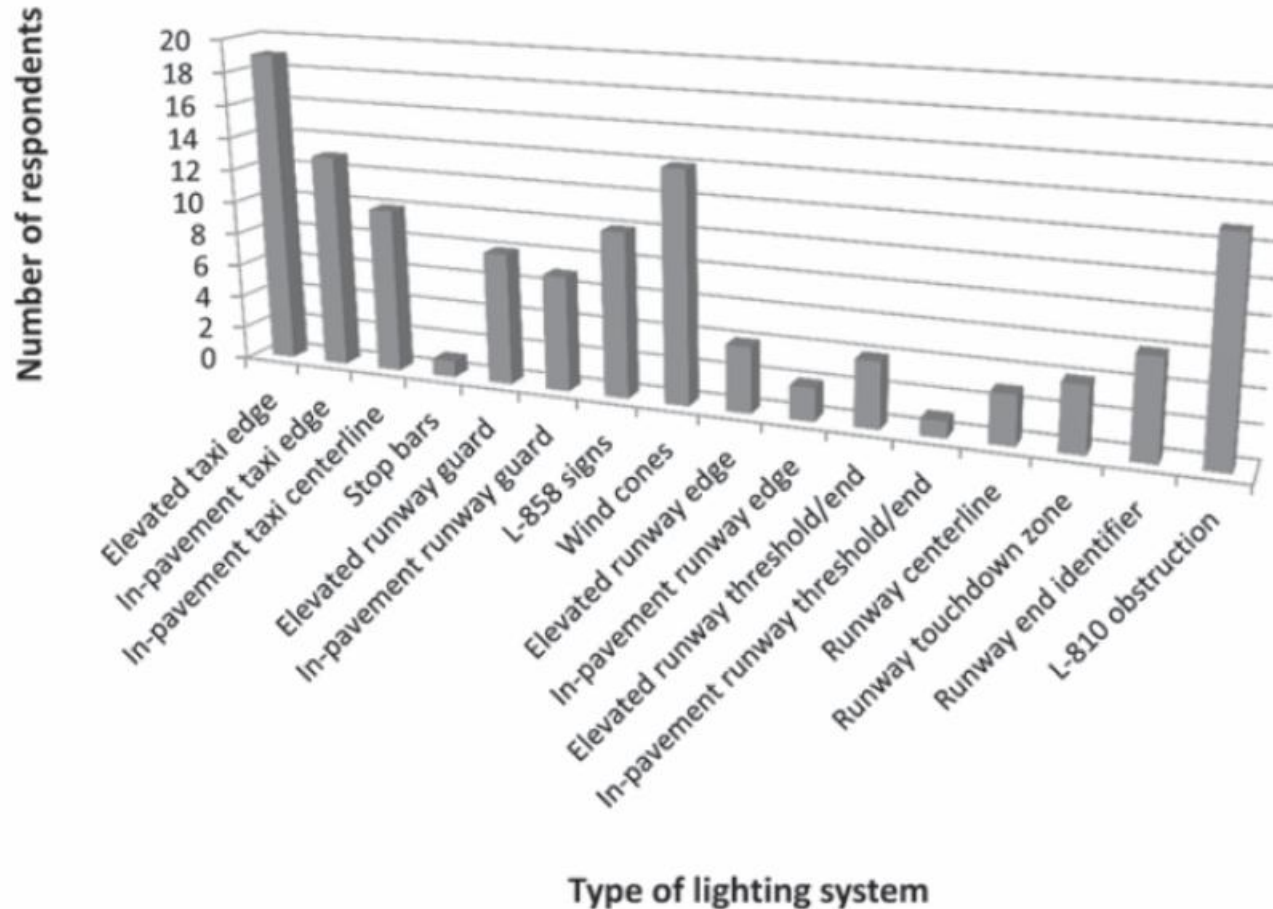
- › IES Aviation Lighting Committee conference presentations
- › Transport Research International Documentation (TRID) database maintained by TRB
- › Trade press: *International Airport Review*, *Airport World*, *Aviation Week and Space Technology*, etc.
- › Newswires: *TendersInfo*, *States News Service*, etc.

◆ Survey of 22 airports/aviation agencies with LED experience

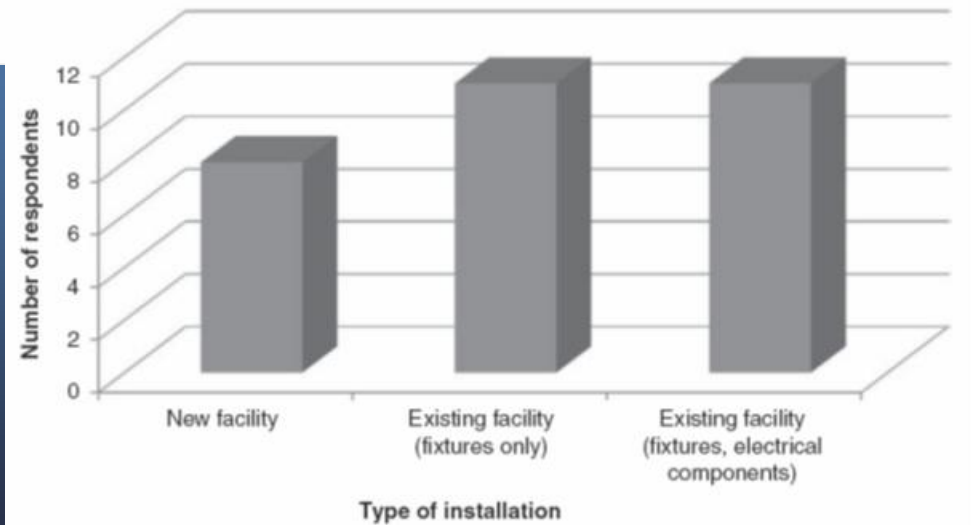
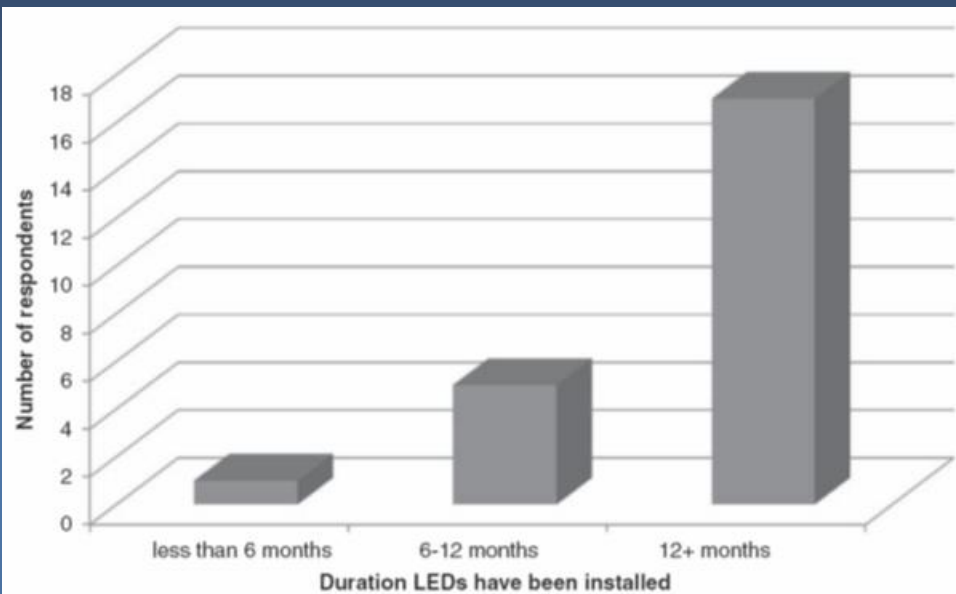
- › Input from topic expert panelists to identify respondents



Current Practices: Types of Systems

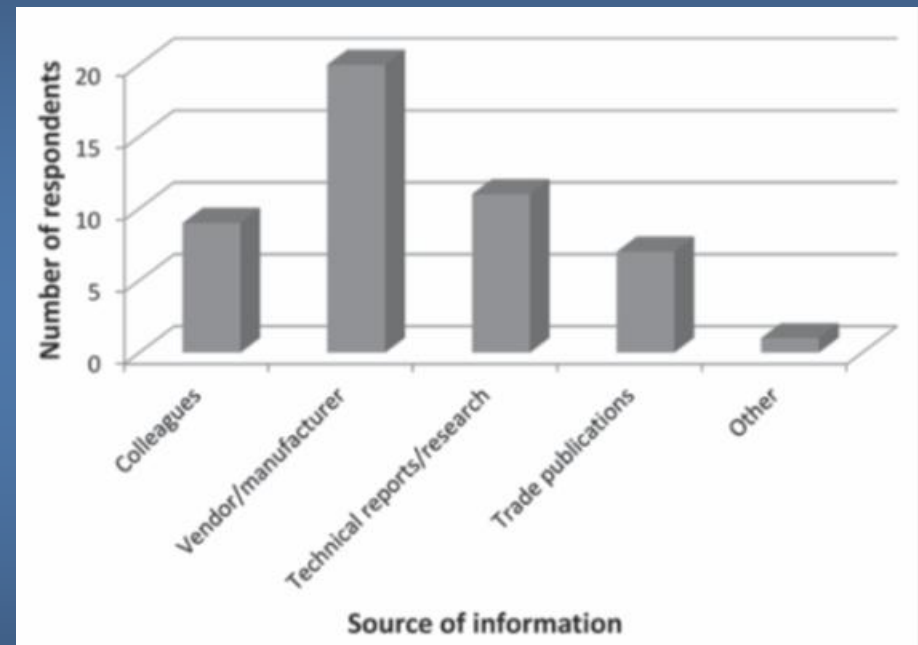


LED System Experience



Perceived LED Challenges

- ◆ Electrical compatibility
- ◆ Questions about heat/ice build-up
- ◆ Higher initial costs
- ◆ Finding objective technical information



Installation Issues: Expectations

- ◆ Primary reasons for LED installation:
 - › Reduce maintenance costs (20)
 - › Reduce energy use (18)
 - › Improve visibility (13)
- ◆ Not concerned about incandescent lamp availability following Energy Independence and Security Act (EISA) of 2007
 - › EISA exempts rough service lamps and certain applications such as airfield lighting

Installation Issues: Ease

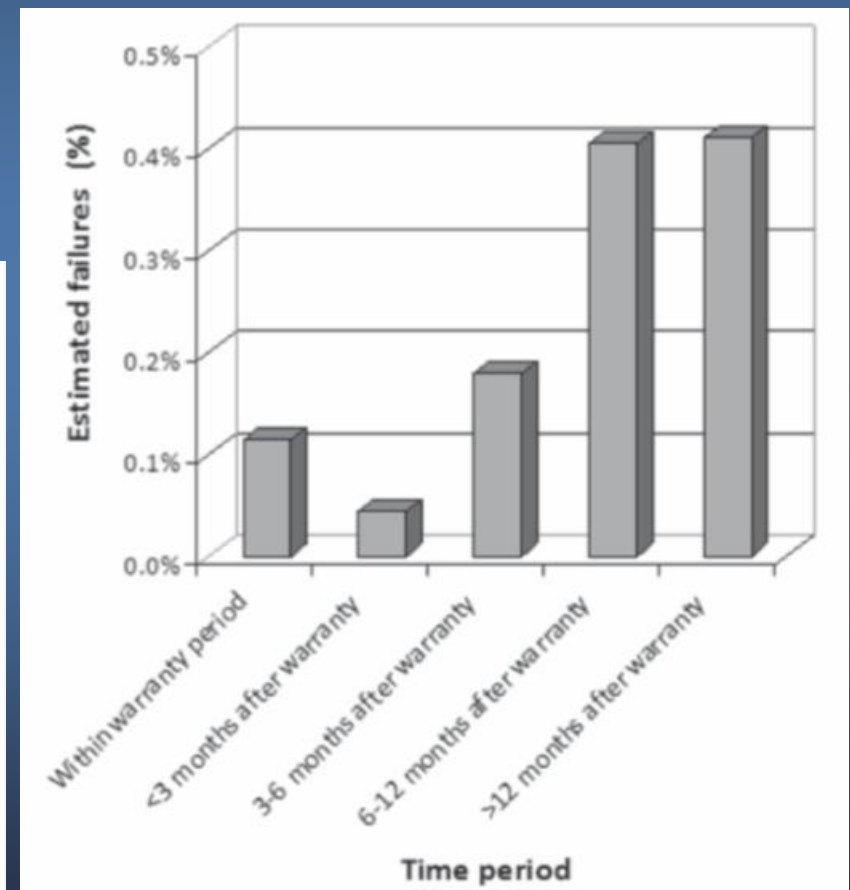
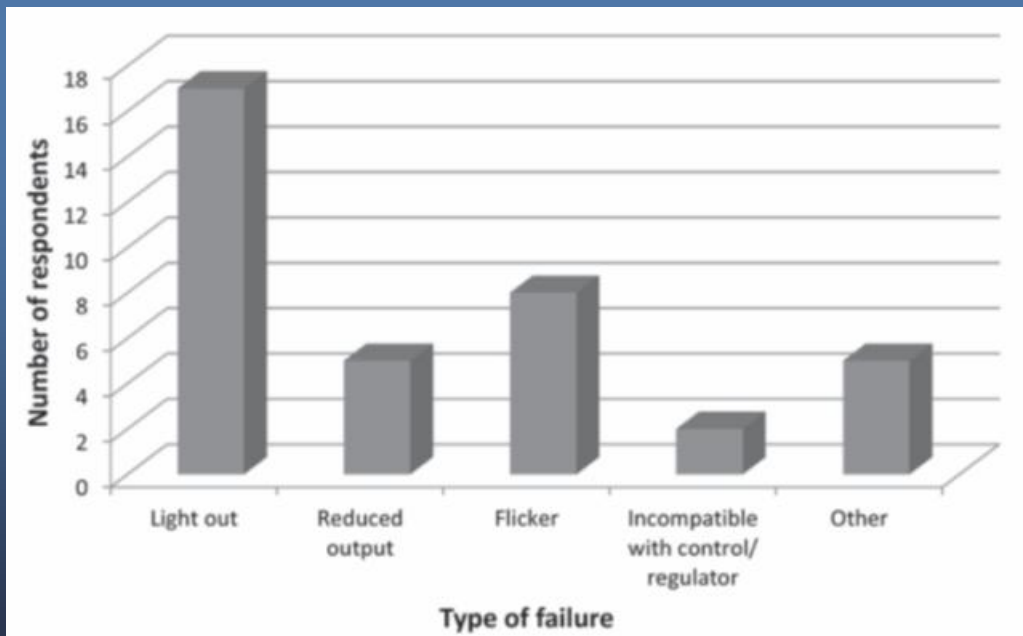
- ◆ Most survey respondents (16) reported that LED installation was easy
 - No special tools/training necessary
 - A few mentioned modifications to improve compatibility with thyristor-type constant-current regulators (CCRs), or replacement of some transformers
- ◆ Installation led by contractors (18) with some assistance (10) by airport staff

Installation Issues: Compatibility

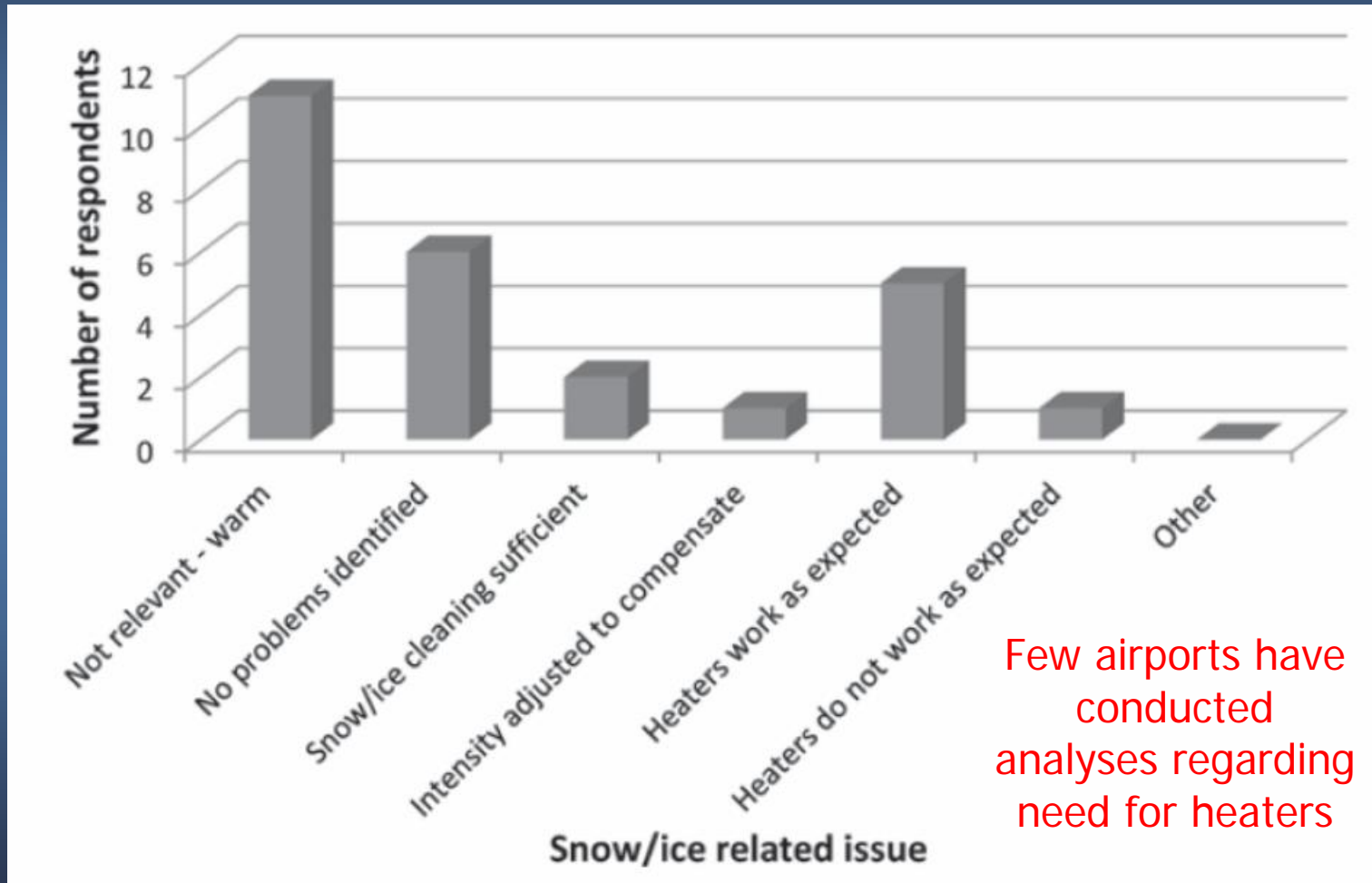
- ◆ Most respondents (19) reported compatibility with existing infrastructure
 - Minor issues with silicon controlled rectifier (SCR) regulators (replaced with ferroresonant regulators to improve compatibility)
 - One respondent adjusted regulators to correct flickering upon installation

Operation and Maintenance (O&M) Issues

- ◆ Failures were relatively infrequent
 - In comparison, most common annual failure rates for road traffic signals were <1% and 1%-5% (Urbanik 2008)

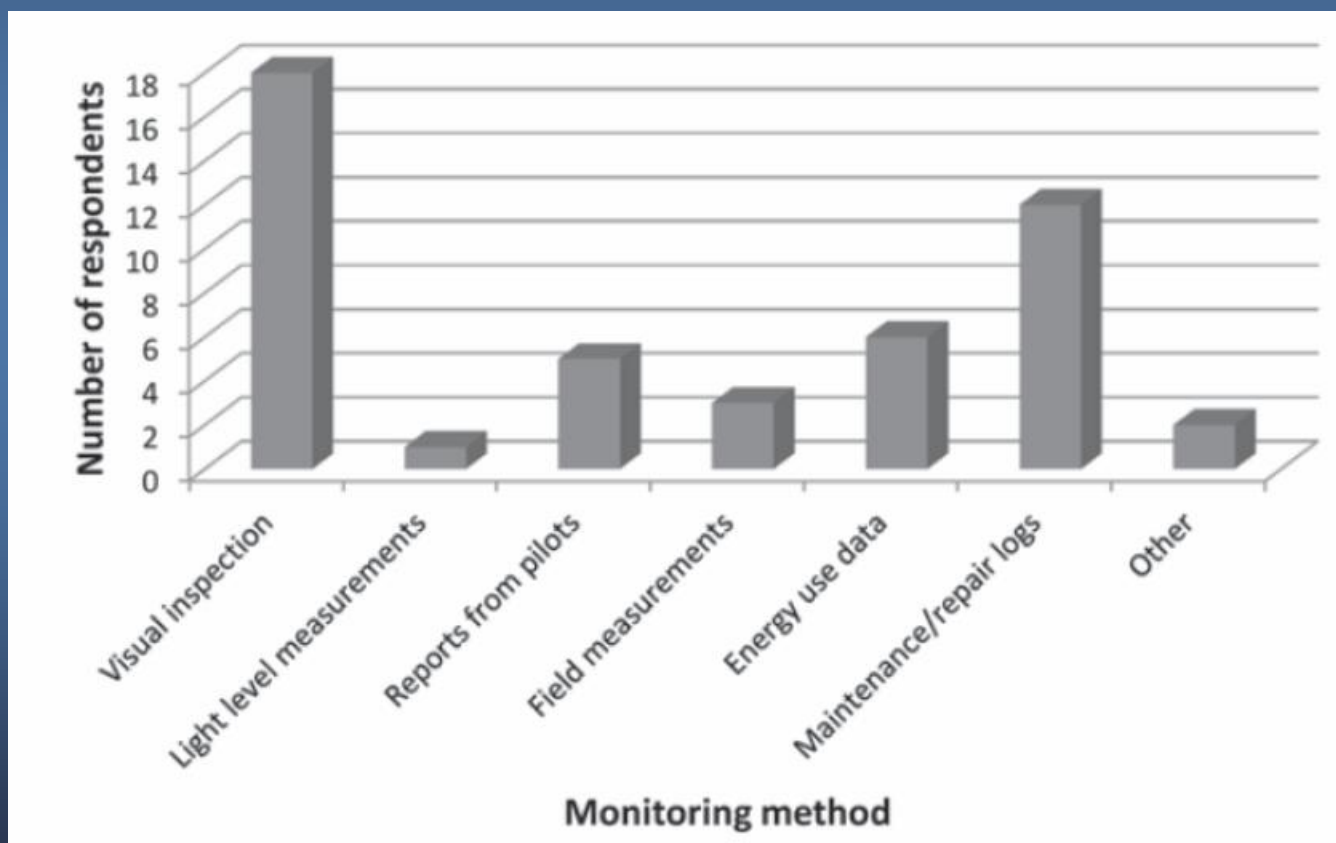


O&M Issues: Weather



O&M Issues: Monitoring

- ♦ FAA guidance requires fixtures to maintain 70% of initial light output, and no more than 25% of LEDs within a lighting fixture to fail (Eng. Brief 67D)



O&M Issues: Other

- ◆ Maintenance issues such as water/fluid ingress and broken fixtures from plowing/sweeping are no different than incandescent systems
- ◆ LED systems use substantially less energy and require less maintenance
 - › Energy savings with lower-current circuits could increase energy savings from 50% to nearly 90%
 - › Maintenance cost reductions are not documented precisely or on a widespread basis
- ◆ LED airfield lighting is often judged brighter or more visible

Economic Issues

- ◆ Half of survey respondents (11) conducted an economic analysis prior to LED installation
- ◆ Initial cost of fixtures was reported as higher than conventional lighting (20)
- ◆ Most (14) reported similar labor costs
- ◆ Three airports reported that they recovered initial costs within 3 years, five expected to recover within 2-10 years

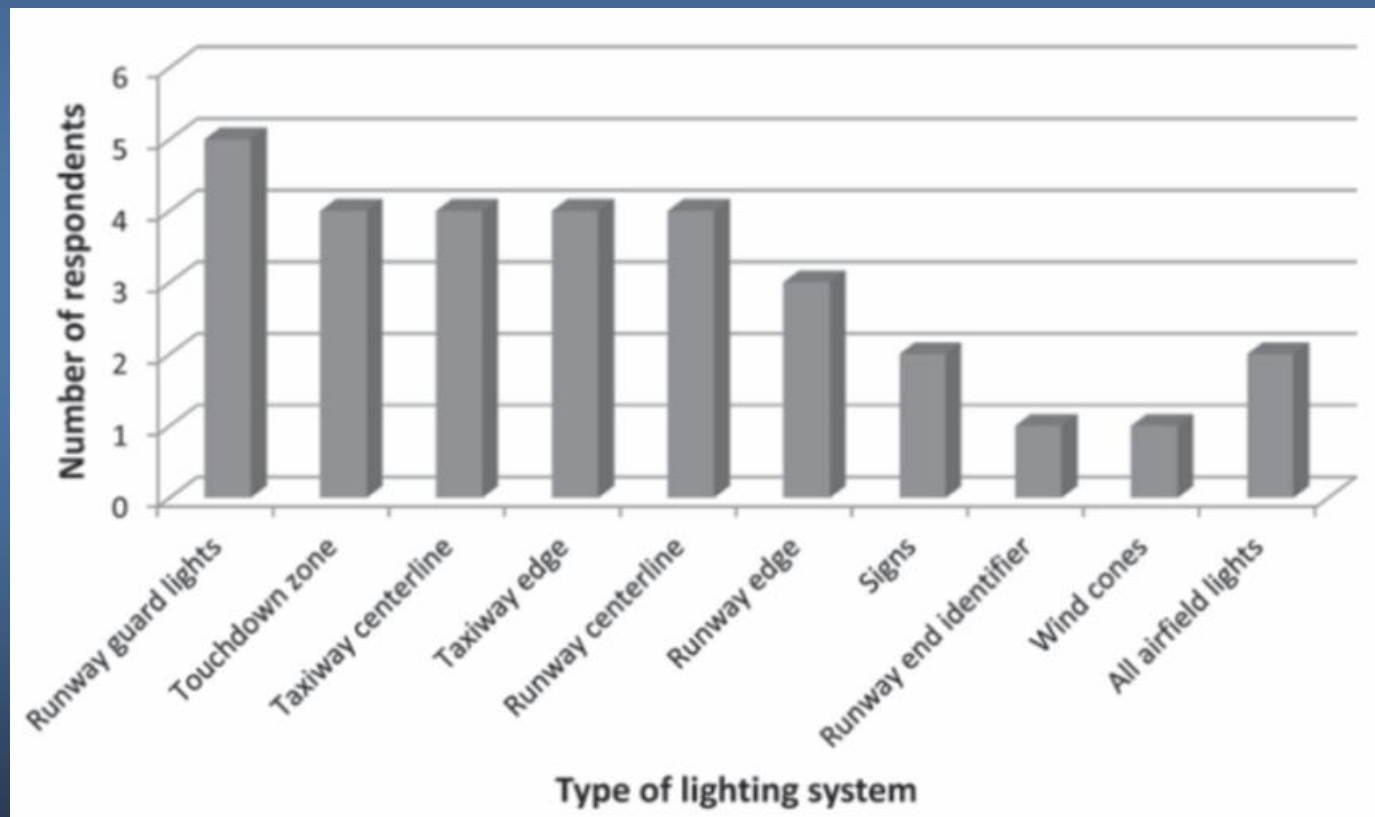
Economics: Energy and Maintenance Costs

SUMMARY OF REPORTS OF EXPECTED OR REALIZED ECONOMIC COST SAVINGS ASSOCIATED WITH LED AIRFIELD LIGHTING

Airport and (Author Date)	Airfield Lighting System(s)	Savings (Expected or Realized)
Prescott Municipal Airport (<i>U.S. Fed News Service</i> 2006; Klein and Napit 2007)	Taxiway lights (one taxiway)	\$9,800/year: energy and maintenance (expected)
Raleigh–Durham International Airport (Pittman 2010)	Airfield lights	\$400,000/year: energy and maintenance (realized)
Tulsa International Airport (Stewart 2011a)	Taxiway edge lights	\$25,000/year: energy (expected)
Vero Beach Municipal Airport (<i>TendersInfo</i> 2010e)	Taxiway lights (one taxiway)	\$7,700/year: operating costs (expected)
Will Rogers World Airport (Hough and Gilbreath 2010; Brus 2011)	Airfield lights (800+)	\$60,000/year: energy and maintenance (expected)

Future Outlook

- ◆ Most (18) respondents planned future LED installations
- ◆ But not major electrical infrastructure work (19)



Conclusions

- ◆ LED airfield lighting systems for taxiway and runway lighting are available and functional
 - › FAA guidance (EB 67) continues to evolve to address issues found in earlier installations
 - › FAA maintains a list of certified LED airfield lighting fixtures through Advisory Circular (AC) 150/5345-53
- ◆ Lower energy and maintenance costs offset higher initial costs within a few years
 - › Most savings come from reduced maintenance

Conclusions (cont'd.)

- ◆ No special equipment or training is needed for LED installation, and reliability improves with each product generation
- ◆ Current electrical power infrastructure is not optimized for LED energy savings, nor reliability
 - › FAA is currently investigating through its Electrical Infrastructure Research Team (EIRT)

Information Gaps

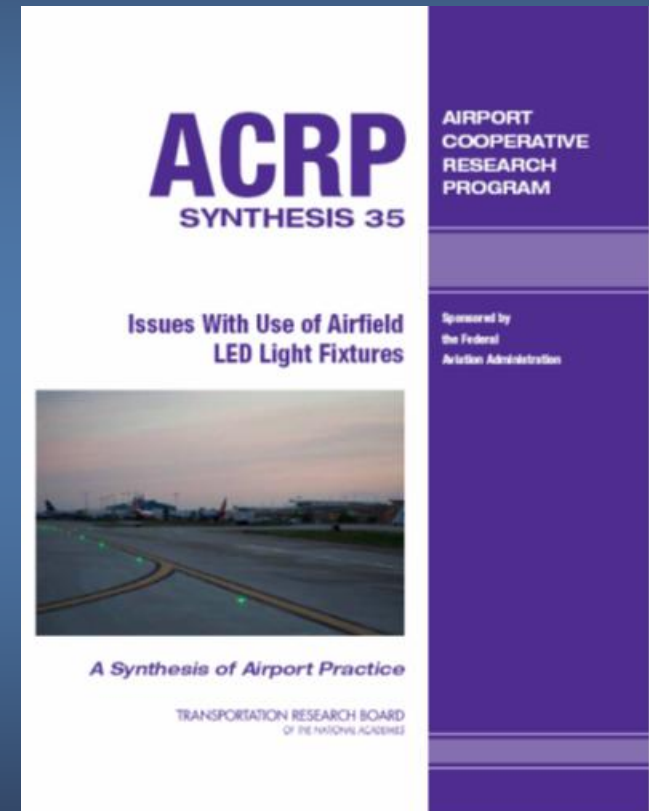
- ◆ Long-term LED fixture performance data are rare
- ◆ Impacts on maintenance costs are scarce although they likely are the primary source of savings
- ◆ Analysis methods for identifying if/when LED fixture heaters are needed are lacking
- ◆ Characteristics of electrical infrastructure for optimizing energy and reliability need to be identified

Additional Resources in ACRP Synthesis 35

- ◆ 80+ bibliographic reference citations
- ◆ Technical overview of LED lighting systems
- ◆ Detailed survey responses
- ◆ List of 50+ airports with LED airfield lighting
- ◆ List of FAA guidance and resources
- ◆ Pointers to technical resources (including IESALC)
- ◆ Links to economic analysis tools

Acknowledgments

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Thank You!

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