



Runway Status Lights (RWSL) DFW THLs and SAN RELs Human Factors Results

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Outline RWSL

- Definition
- Motivation
- Operational concept
- High-level requirements
- Operational evaluation at DFW
- Human factors findings
- Summary
- Next Steps

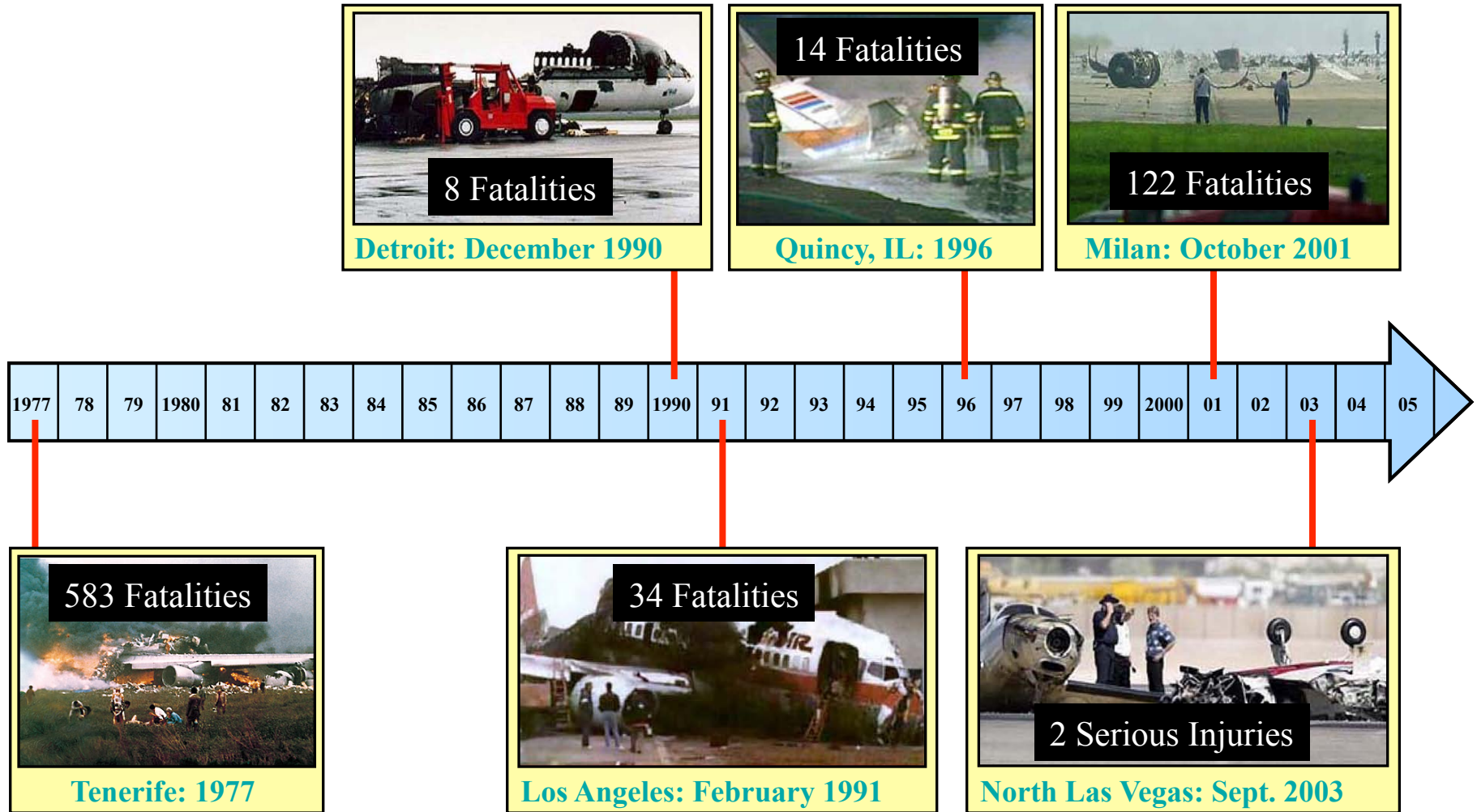


RWSL Defined and Supported

- RWSL consists of **Runway Entrance Lights (RELs)** and **Takeoff Hold Lights (THLs)**
- Purpose
 - Reduce frequency and severity of runway incursions
 - Prevent runway accidents
- RWSL increases situational awareness
 - RELs provide a *direct indication* to pilots when it is unsafe to cross or enter a runway
 - THLs provide a *direct indication* to pilots when is unsafe to depart from a runway
- Congresswoman Johnson, May 2006: “ *The FAA’s new technology will provide **direct warning capability** to flight crews and ensure safe movement of airplanes on the ground.*”



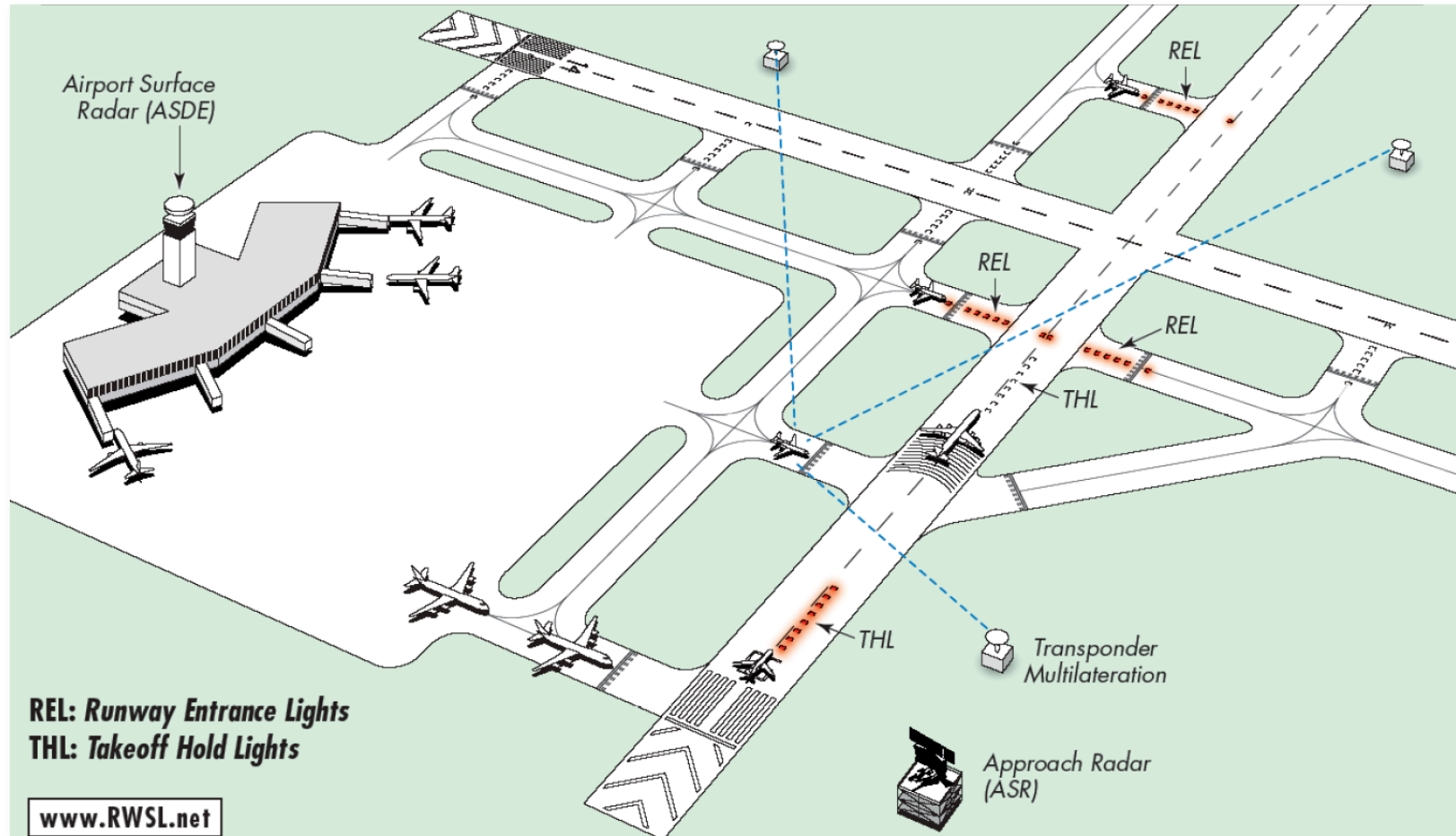
Motivation: Prevent Runway Accidents



Most runway incursions result from pilot deviations.



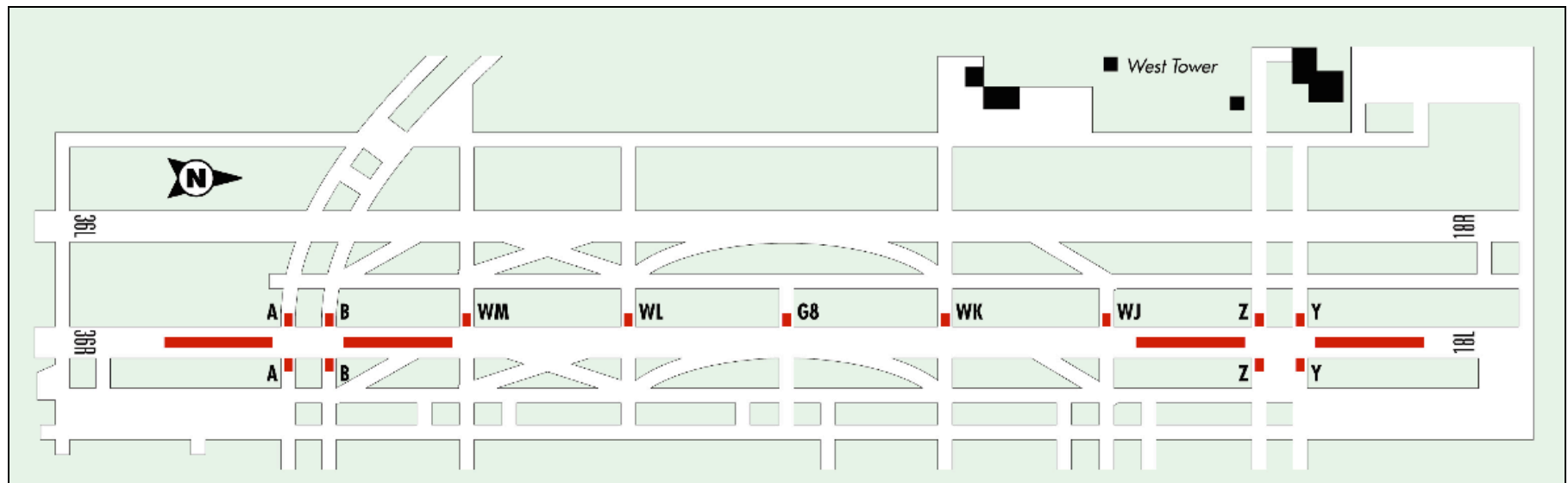
RWSL Operational Concept



- RELs and THLs turn on and off automatically, driven by fused multi-sensor surveillance
- RELs turn on when it is unsafe to enter runway; visible from taxi hold position
- THLs turn on when it is unsafe to takeoff; visible from takeoff hold position (and final)



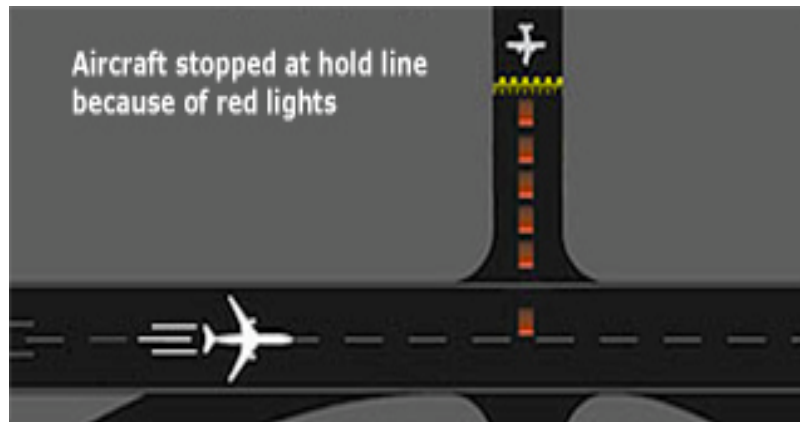
Operational Evaluation at DFW



- RELs and THLs are installed on west side of DFW
- RELs operate at selected taxiway intersections (as shown)
- THLs operate at full length and intersection departure positions



RWSL Operational Requirements



Runway Entrance Lights

- RWSL must not interfere with normal safe operations
- RWSL must operate automatically for each operation
 - No controller action required
- RELs must accurately depict that it is unsafe to enter or cross r/w
- RELs must have high-speed target “on” runway in order to turn **red**
- THLs must accurately depict that it is unsafe to takeoff
- THLs must have target in position for takeoff *and* target “on” runway in order to turn **red**

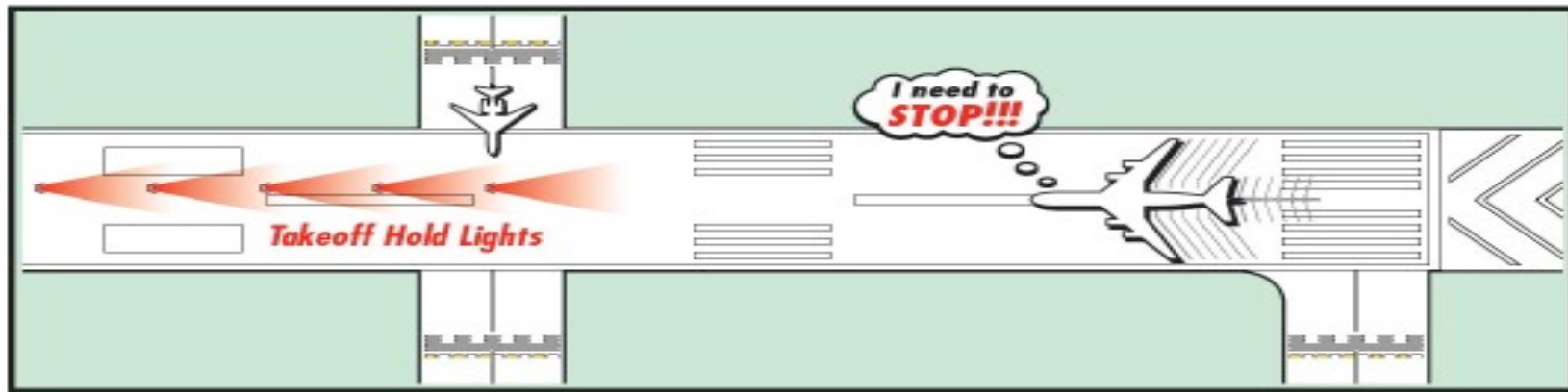


Takeoff Hold Lights



THL protocol

- THLs are directed toward the approach end of the runway
- THLs are visible to pilots
 - 1) in position for takeoff, or
 - 2) just commencing departure, or
 - 3) on final approach to land
- To be consistent in appearance with Runway Entrance Lights (RELs), THLs are placed longitudinally along the runway centerline
- An ATIS message will indicate when the THLs and RELs are operational
- Remember:
 - **LIGHTS TURNING OFF DOES NOT CONSTITUTE A CLEARANCE TO CROSS, ENTER, OR DEPART FROM A RUNWAY!**





Pilots' interaction with THLs

- If in position and holding on the runway and the THLs illuminate
 - crew should remain in position for takeoff
- If takeoff roll has begun and illuminated THLs are observed
 - crew should stop the airplane and notify Air Traffic that they are stopped because of red lights
- If aborting the takeoff is impractical for safety reasons
 - crews should proceed according to their best judgment of safety (understanding that the illuminated THLs indicate the runway is unsafe for departure) and contact ATC at the earliest opportunity
- If on short final and THLs are illuminated red
 - crews should inform ATC they are going around because of red lights on the runway.



RWSL website: RWSL.net

The screenshot shows the RWSL website interface. On the left is a vertical navigation menu with the RWSL logo at the top. The menu items are: Home, NEW RWSL In The News, Takeoff Hold Lights Survey, Pilot/Vehicle Operator Survey on Runway Entrance Lights, ATC Survey, THLs Training Briefing, RELs Training Briefing, How It Works, Notice to Airmen, Airport Traffic Information Service, About Us, and Contact. A red arrow points to the 'Takeoff Hold Lights Survey' item. The main content area has a blue header with the text 'Runway Status Lights' and a small graphic of a runway with an aircraft. Below the header is a section titled 'Runway Status Lights System' with a sub-header 'Runway Status Lights System'. The text below reads: 'Created on November 29, 2004. Updated on February 10, 2006. RWSL is a fully automatic, advisory safety system designed to reduce the number and severity of runway incursions and thus prevent runway accidents while not interfering with airport operations. RWSL is designed to be compatible with existing procedures. RWSL is comprised of Takeoff Hold Lights (new) and Runway Entrance Lights. The Problem: Aircraft taking off or taxiing across while runway is in use. The Solution: Part 1: Aircraft stopped at hold line because of red lights. Most runway incursions are caused by a lack of situational awareness. Runway Entrance Lights (RELs) illuminate red when a runway is unsafe to enter or cross due to a high-speed operation on the runway. [More...] The Solution: Part 2: Aircraft continues to hold for takeoff because of red lights. Takeoff-Hold Lights.



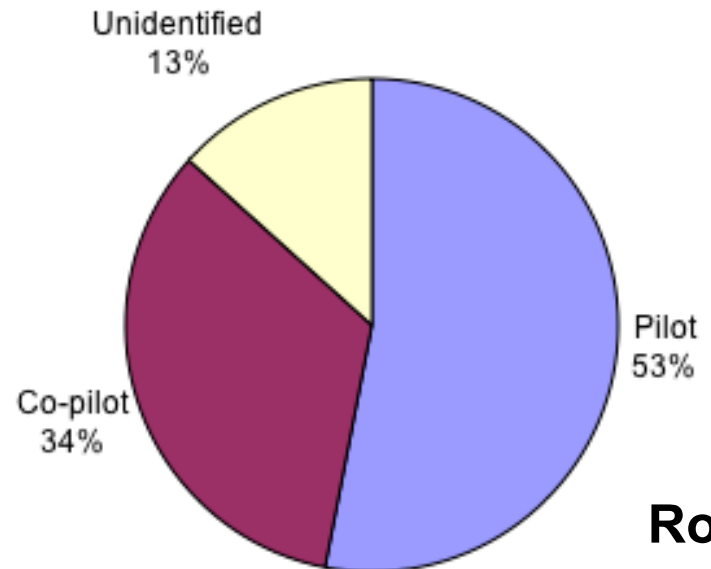
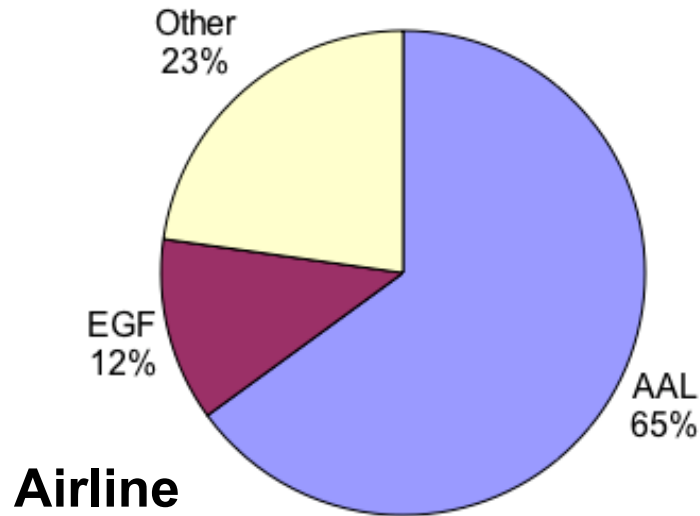
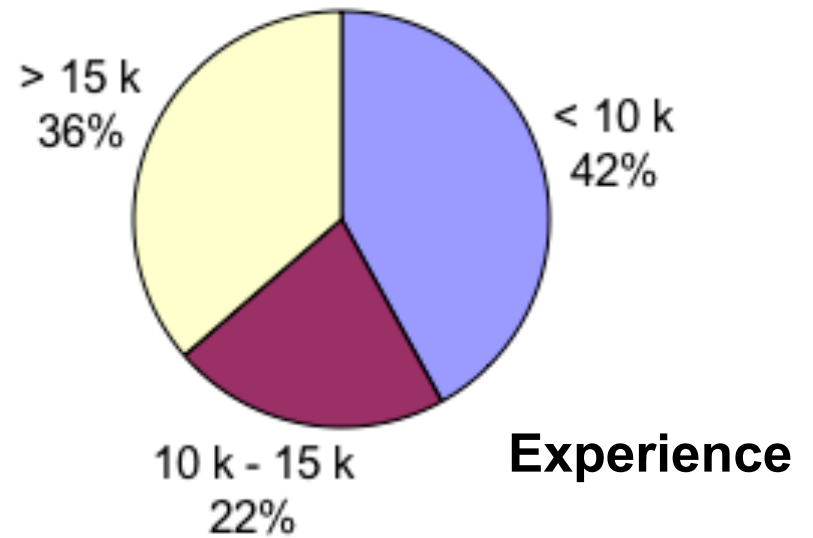
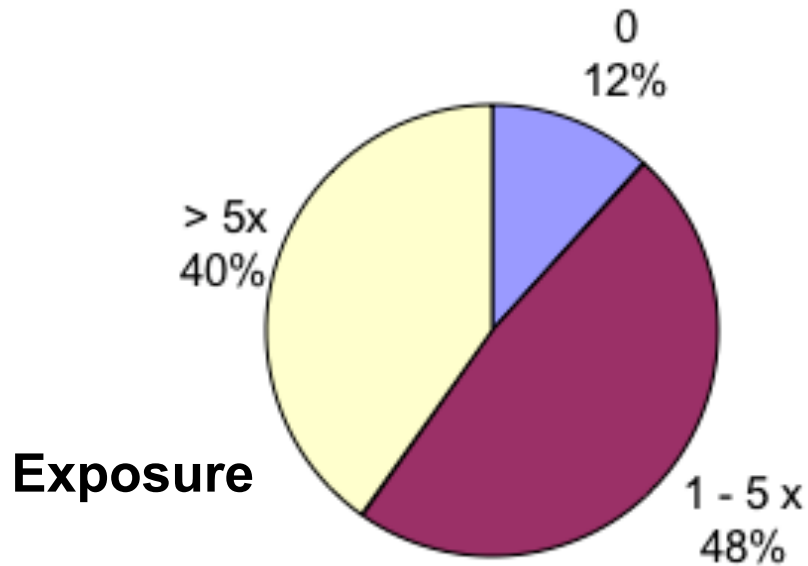
Survey Overview

#	Statement	Yes	No
1.	If cleared to depart from the runway, I will proceed through illuminated red Takeoff Hold Lights.	<input type="radio"/>	<input type="radio"/>
2.	I interpret Takeoff Hold Lights turning off as clearance to take off.	<input type="radio"/>	<input type="radio"/>
3.	I have observed Takeoff Hold Lights activate in response to traffic at least once.	<input type="radio"/>	<input type="radio"/>
If you answered Yes to #3, go to #4. Otherwise, skip to #16.			
4.	I have seen Takeoff Hold Lights activate on more than five occasions.	<input type="radio"/>	<input type="radio"/>
5.	I found the Takeoff Hold Lights were not conspicuous enough to serve their intended purpose.	<input type="radio"/>	<input type="radio"/>
6.	Takeoff Hold Lights operation was consistent with my clearance.	<input type="radio"/>	<input type="radio"/>
7.	My verbal response time to clearances increased due to Takeoff Hold Lights.	<input type="radio"/>	<input type="radio"/>
8.	My ability to complete normal cockpit duties was impeded by Takeoff Hold Lights.	<input type="radio"/>	<input type="radio"/>
9.	Takeoff Hold Lights enhanced my situational awareness.	<input type="radio"/>	<input type="radio"/>
10.	I thought that the Takeoff Hold Lights were not functioning.	<input type="radio"/>	<input type="radio"/>
11.	The Takeoff Hold Lights were on when they should have been off.	<input type="radio"/>	<input type="radio"/>
12.	The Takeoff Hold Lights were off when they should have been on.	<input type="radio"/>	<input type="radio"/>
13.	I was able to distinguish between Takeoff Hold Lights and end of runway centerline lights.	<input type="radio"/>	<input type="radio"/>
14.	I was compelled to continuing holding or to stop if rolling when I saw the Takeoff Hold Lights illuminate red.	<input type="radio"/>	<input type="radio"/>
15.	The Takeoff Hold Lights were distracting from my view on final approach to the parallel runway.	<input type="radio"/>	<input type="radio"/>
16.	I know of runway conflicts that Takeoff Hold Lights would have helped.	<input type="radio"/>	<input type="radio"/>
17.	Takeoff Hold Lights will help to reduce the number of runway incursions.	<input type="radio"/>	<input type="radio"/>
18.	I would recommend additional implementations of Takeoff Hold Lights.	<input type="radio"/>	<input type="radio"/>

- Survey comprised of 18 questions plus demographics
- Survey available on-line since February 2006
- Over 80 pilots have responded to date
- Four categories analyzed
 - Comprehension
 - Effectiveness
 - Acceptance
 - Suitability
- Results presented as function of category



Survey Demographics



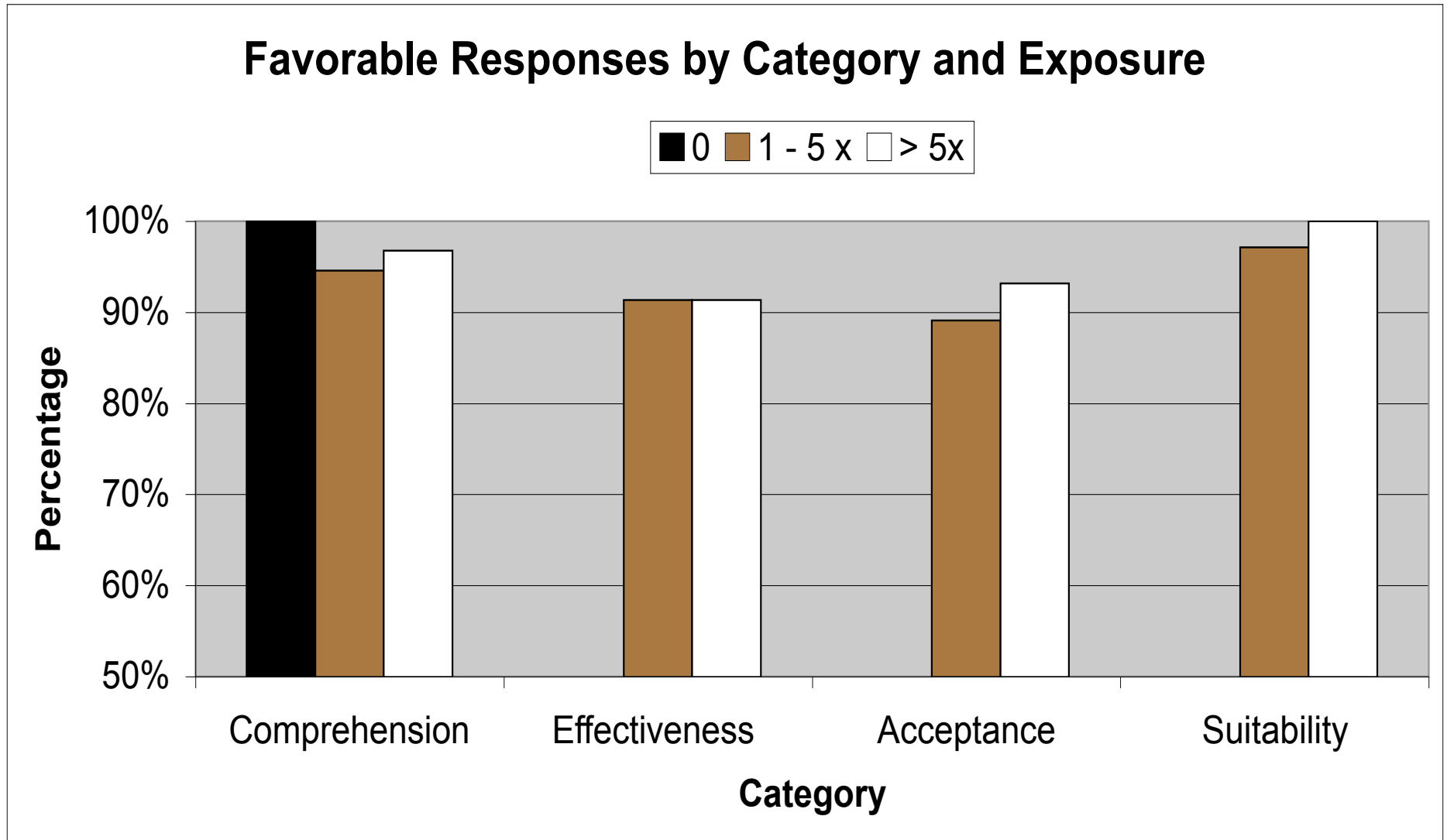


Survey Categories Defined

- Comprehension
 - 2 questions: **Stop** on **red**; “Off” is **not** clearance to go
- Effectiveness
 - 6 questions: Conspicuous; Consistent; Reliable; Distinct
- Acceptance
 - 3 questions: Situational Awareness; Safety Benefit; Support
- Suitability
 - 2 questions: Workload; Attention

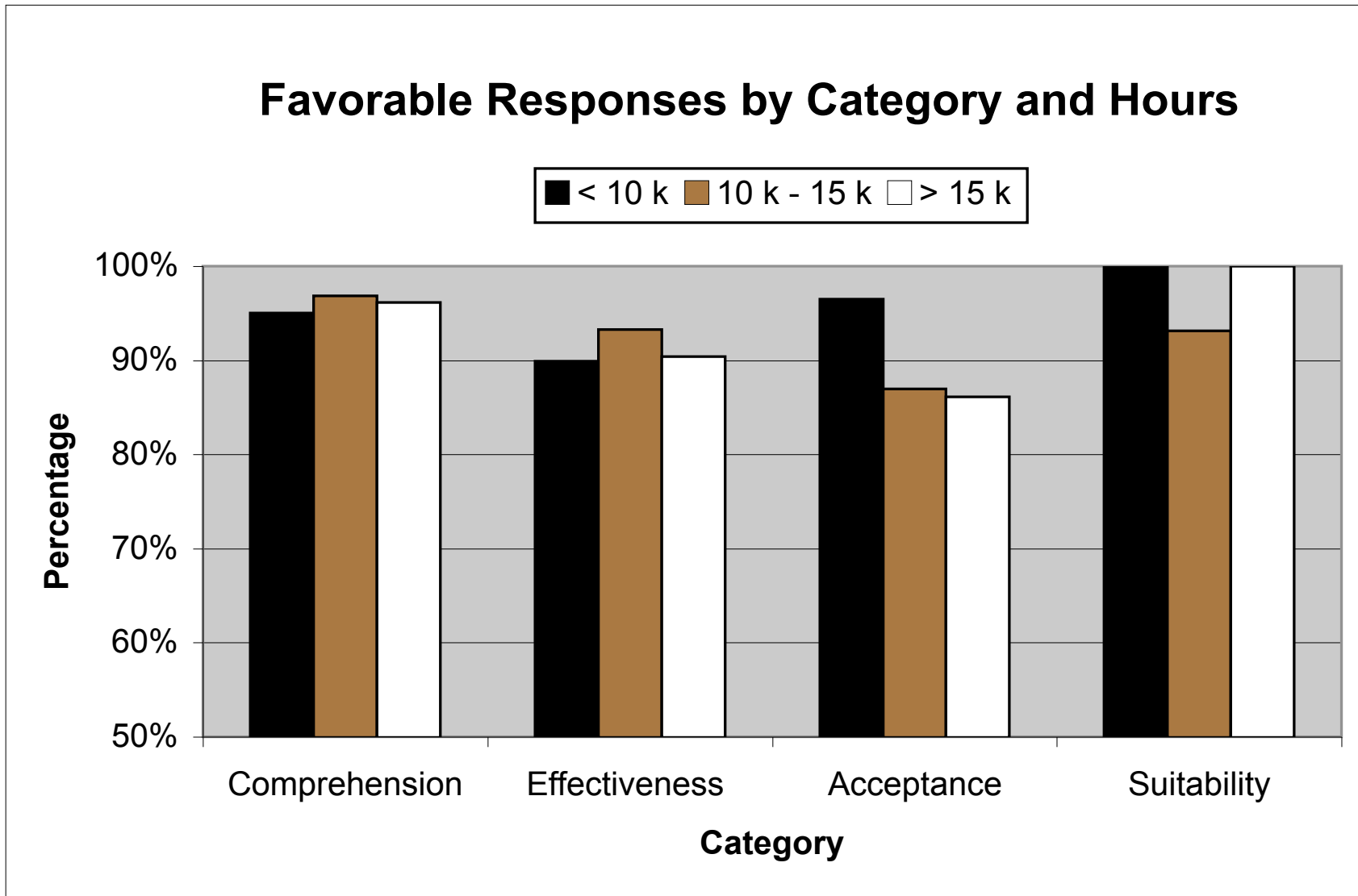


Survey Results: Category by Exposure



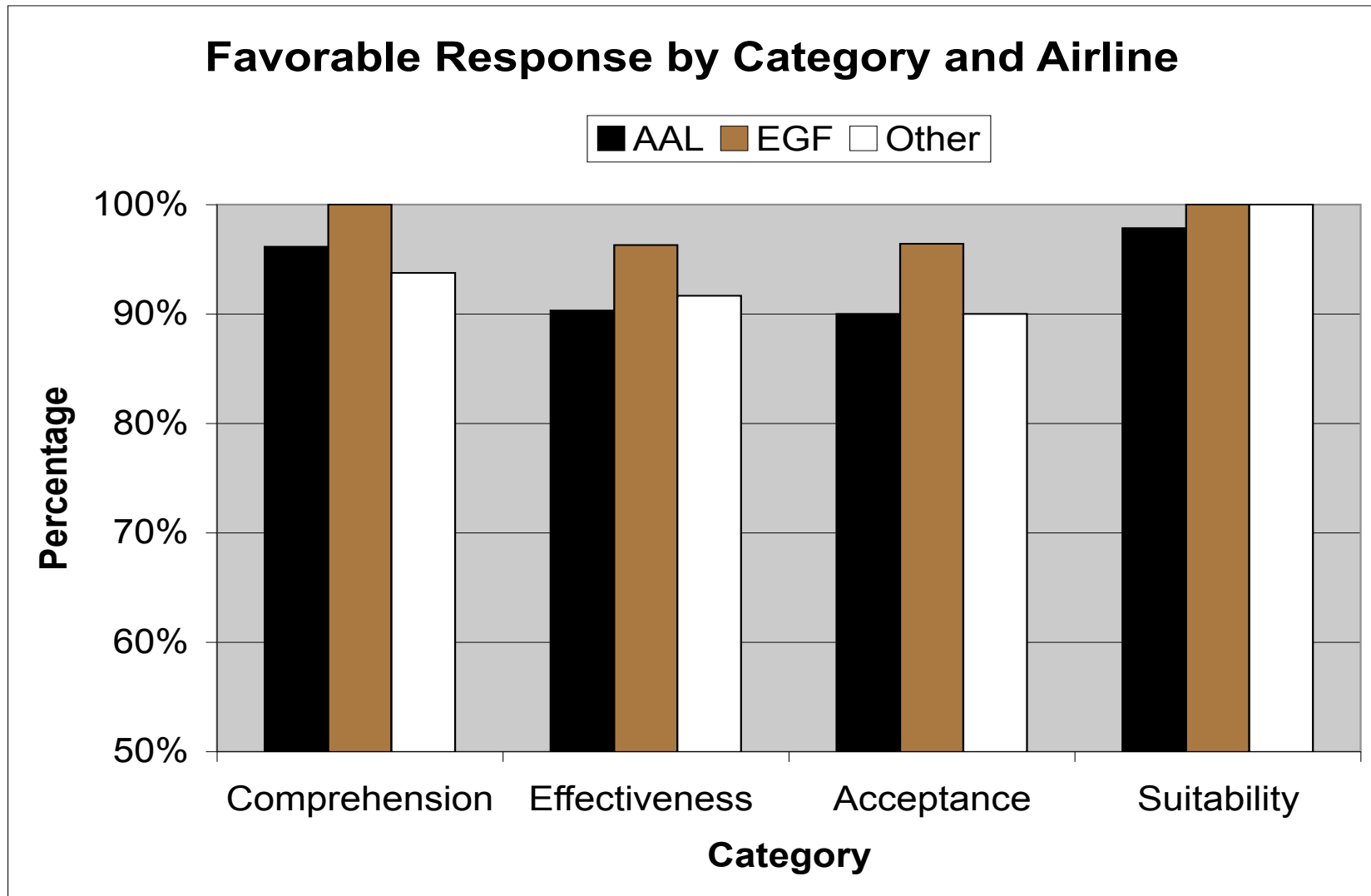


Survey Results: Category by Experience



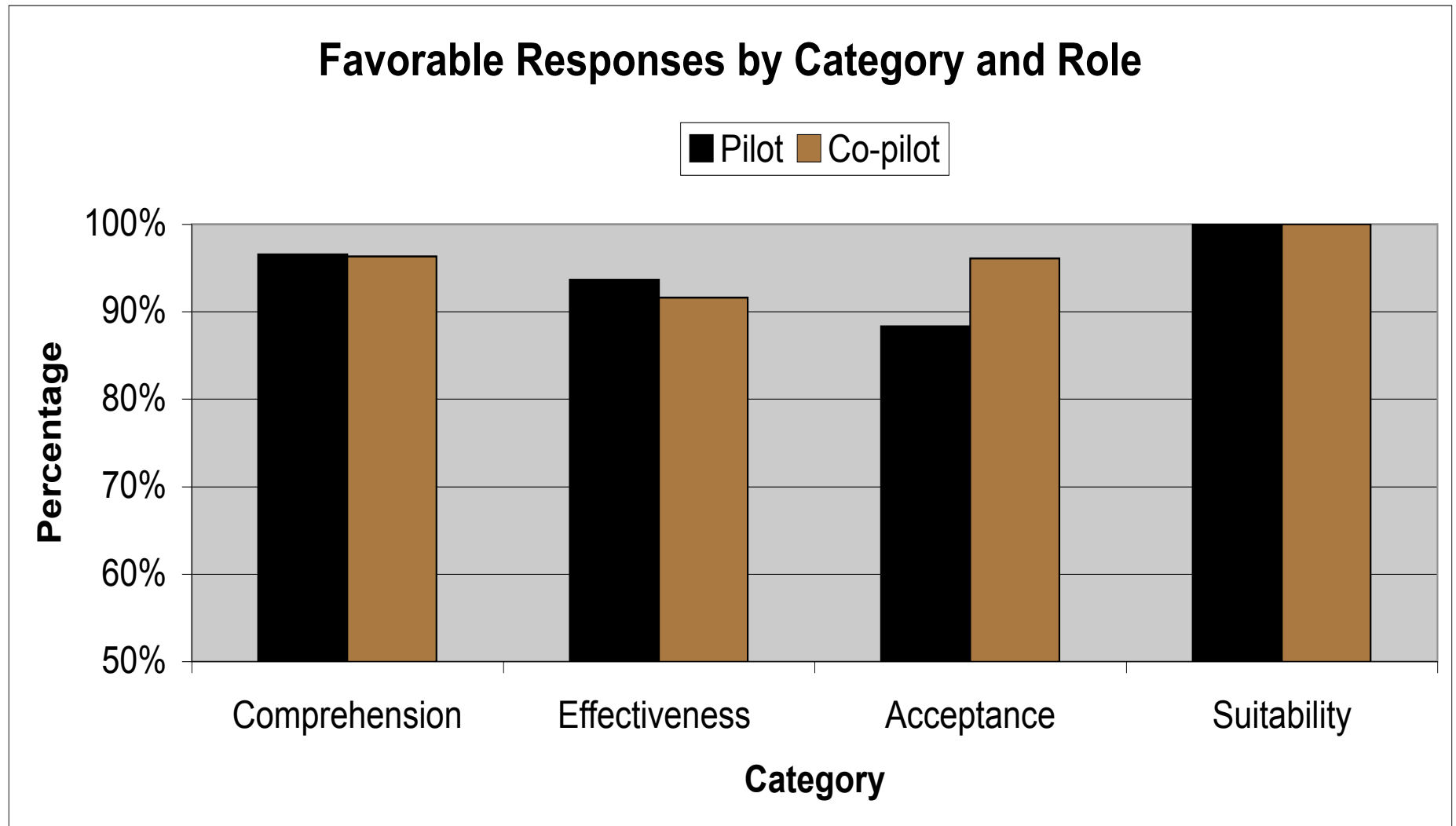


Survey Results: Category by Airline



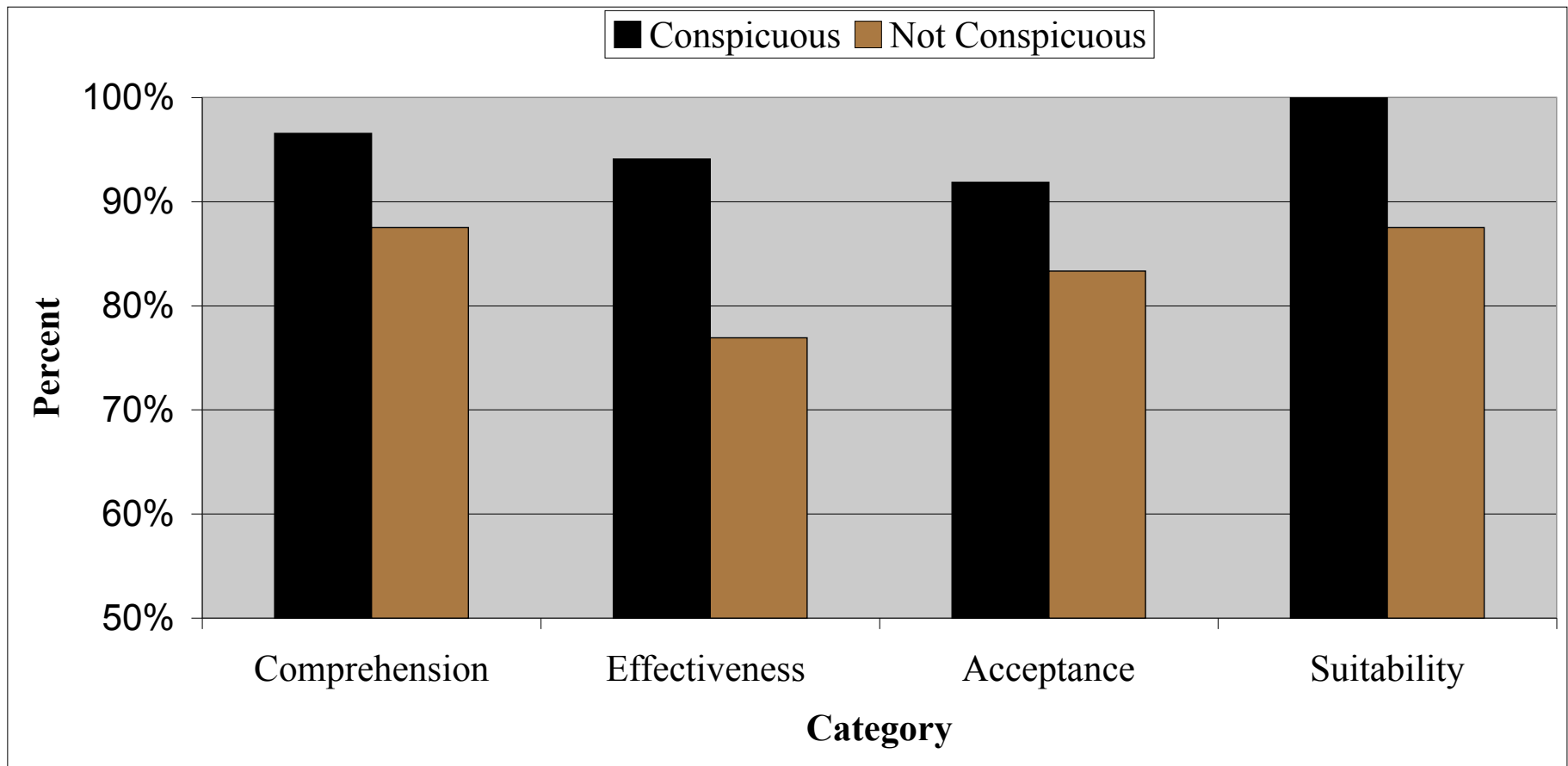


Survey Results: Category by Role





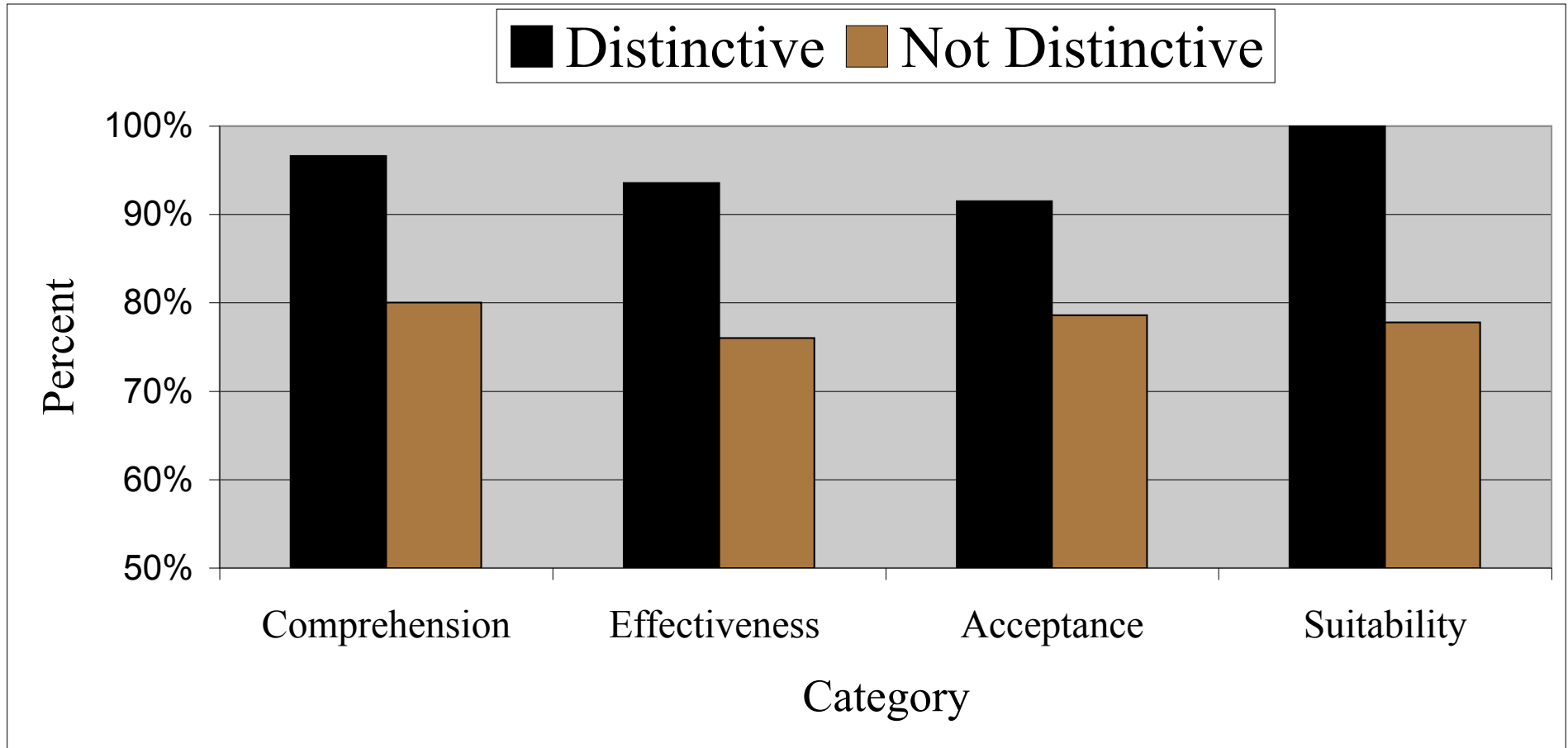
Survey Results: Category by Conspicuity



- Response as a function of answer to question on THL conspicuity.



Survey Results: Category by Distinctiveness



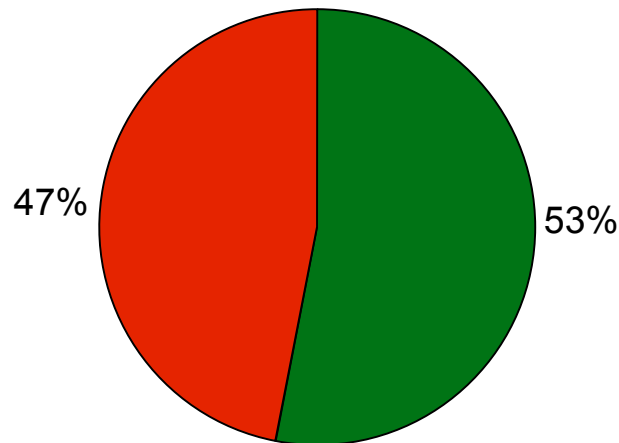
- **Response as a function of answer to question on ability to distinguish between Runway End Indicator Lights (REILs) and THLs.**



Survey Results: Comments Added

Responses to Date

■ Added Comments ■ Did not Add Comments



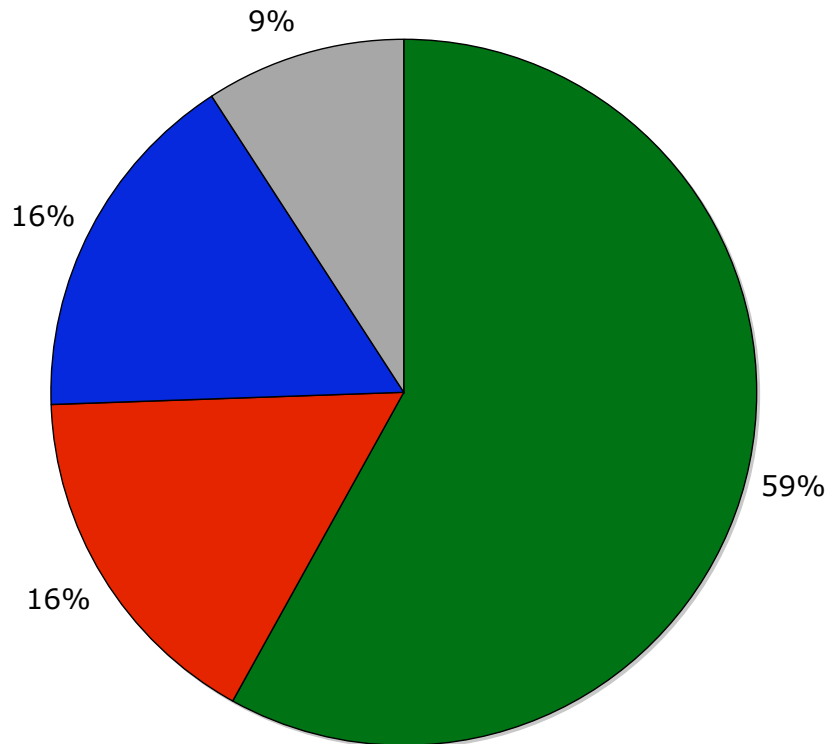
- Good rate of added comments
- Comments classified as:
 - Positive
 - Negative
 - Lighting Configuration
 - Irrelevant
- Classifications correlate with favorability of responses



Survey Results: Comments Classified

Added Comments

■ Positive ■ Negative ■ Lighting Configuration ■ Irrelevant

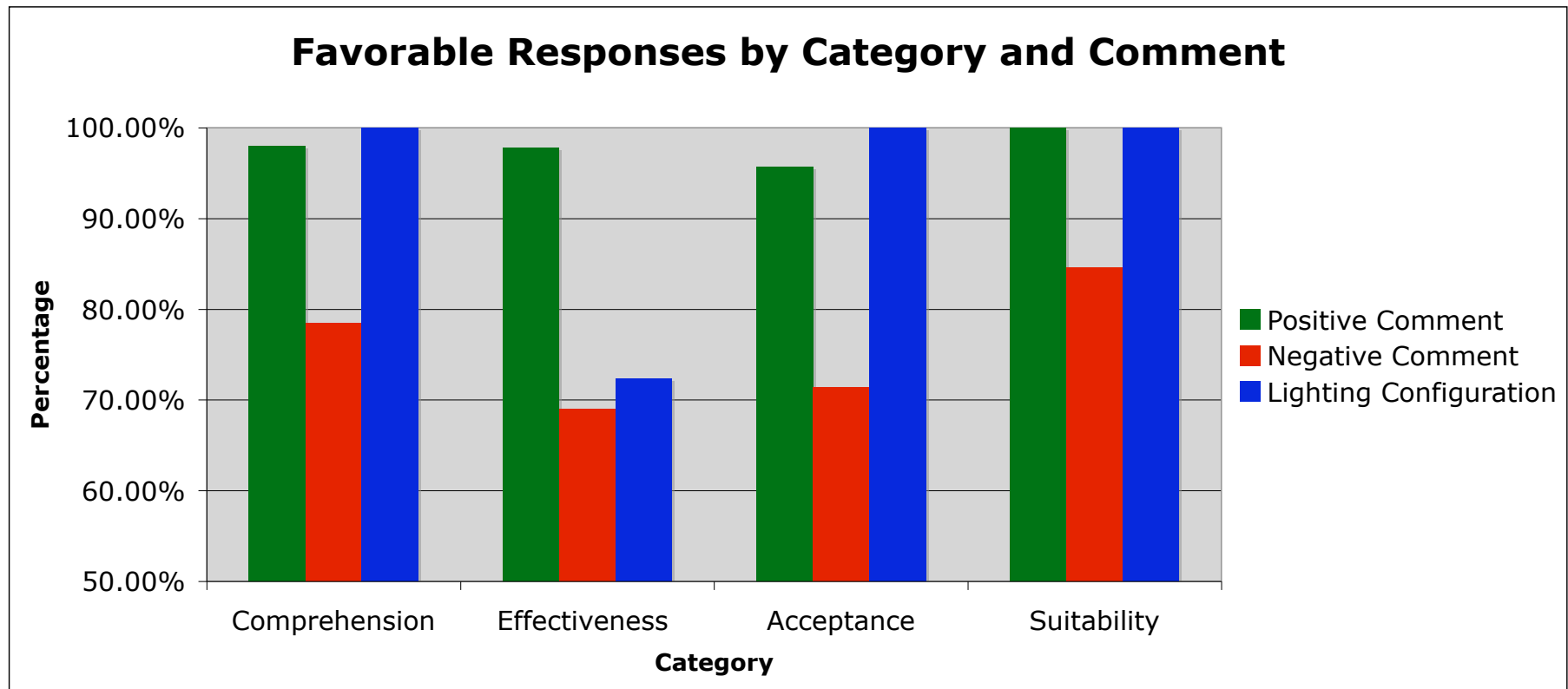


- Most comments are **positive**
 - High level of support
 - Calls for additional airports
- Some discussed **configuration**
 - 3/7 called for “cross bar”
- Some **negative** comments
 - Timing of lights
 - Conspicuity and proximity*

*** Note: Improvements for DFW East THLs include increased intensity at nighttime and an additional five lights**



Survey Results: Category by Comment



- Positive comments correlate with overall favorable response
- Negative comments correlate with overall less favorable response
 - Lowest responses on effectiveness and acceptance (but still almost 70 percent)
- Lighting Configuration comments correlate with low response on effectiveness
 - Configuration correlates with conspicuity (as was seen in REL OpEval results)



Survey Results Synopsis

- Results highly favorable, over 90 percent in aggregate
 - Lowest favorability was still above 60 percent
- Near or above 90% as a function of exposure, airline, role
- Above 85% as a function of experience
- Comprehension ranged from near 80% to 100%
 - Lowest when negative comment or rated THLs inconspicuous
- Effectiveness ranged from near 70% to 96%
 - Lowest when negative comment or rated THLs inconspicuous or indistinct
- Acceptance ranged from 71% to 96%
 - Lowest when negative comment or rated THLs indistinct
- Suitability ranged from 77% to 100%
 - Lowest when negative comment or rated THLs indistinct



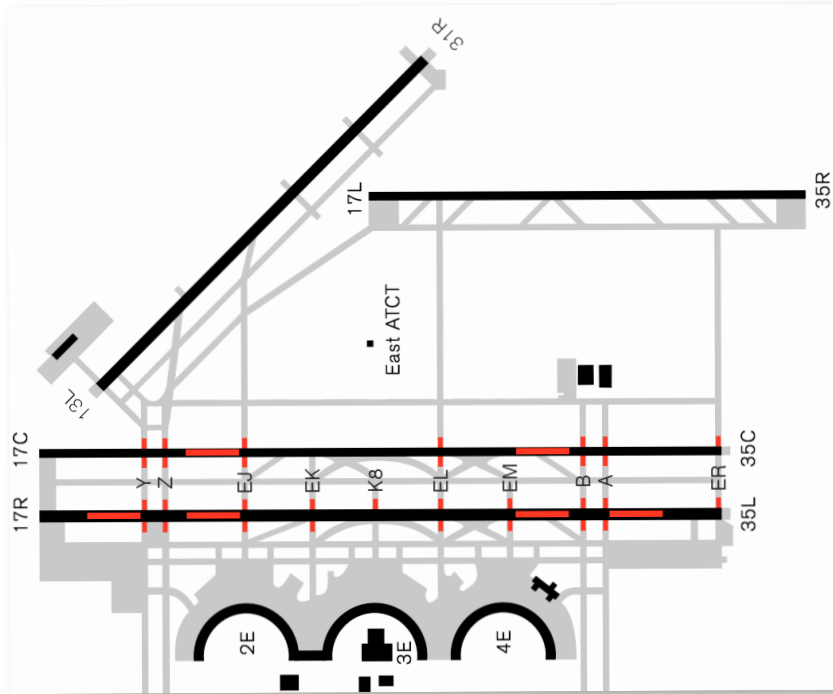
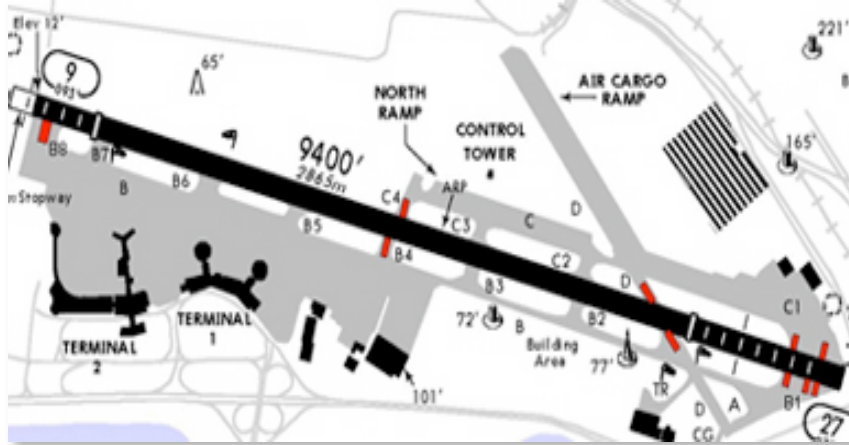
Summary

- DFW West operational evaluation of **RELs** went well
 - Extended OpEval ongoing
- DFW West **THL** OpEval proceeding successfully as scheduled
- Training and surveillance quality both critical to success
- Pilot survey results support RWSL operational concept





Next Steps



- At SAN, installed RELs will undergo an operational evaluation this autumn
- At DFW East, RELs and THLs are to be installed next summer
 - Improvements for DFW East THLs include increased intensity at nighttime and an additional five lights