



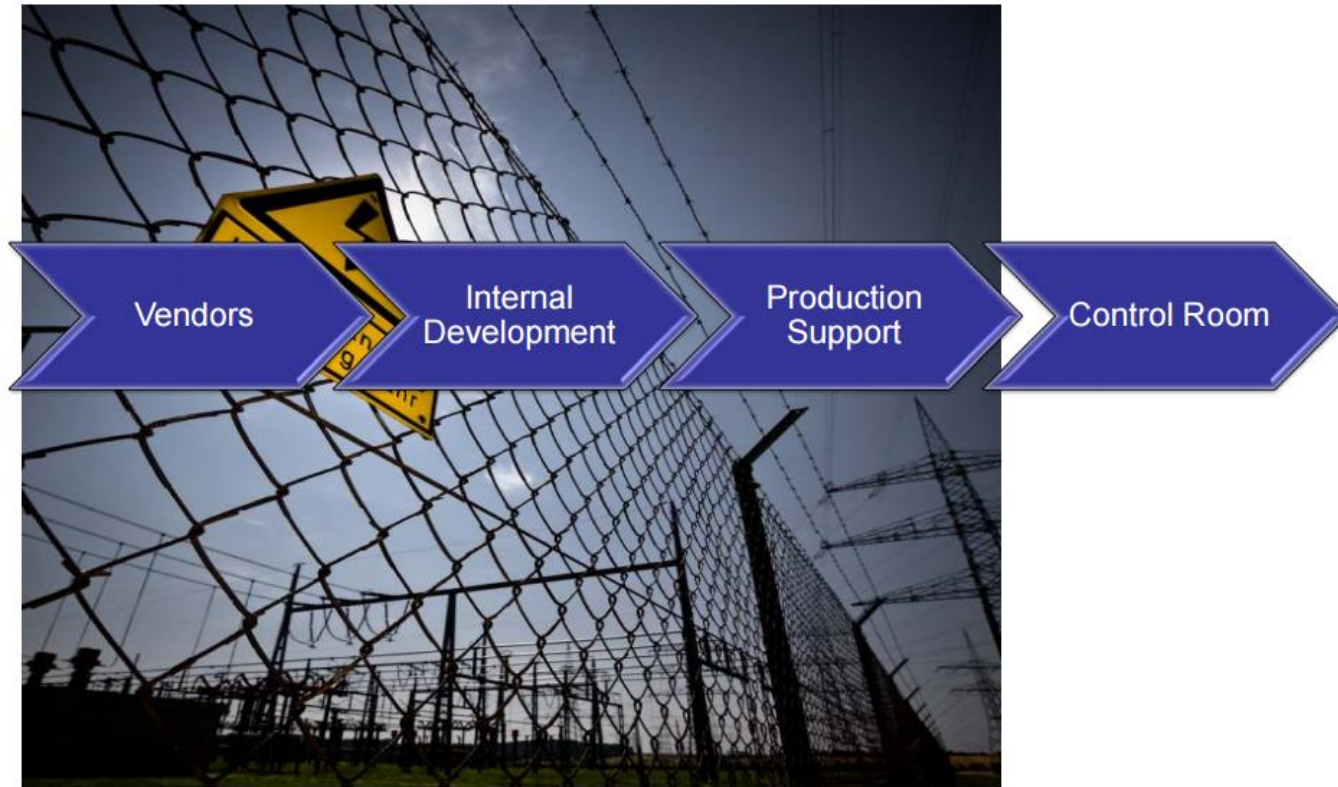
**Designing For Excellence:  
Building Software, Relationships, Culture and  
Hope – A Five-Year Retrospective**

Mike Legatt, Ph.D.  
Principal Human Factors Engineer

March 30, 2016  
[Michael.Legatt@ercot.com](mailto:Michael.Legatt@ercot.com)

# Year One: Situation Awareness

## Common Scenarios – “Over the Fence”

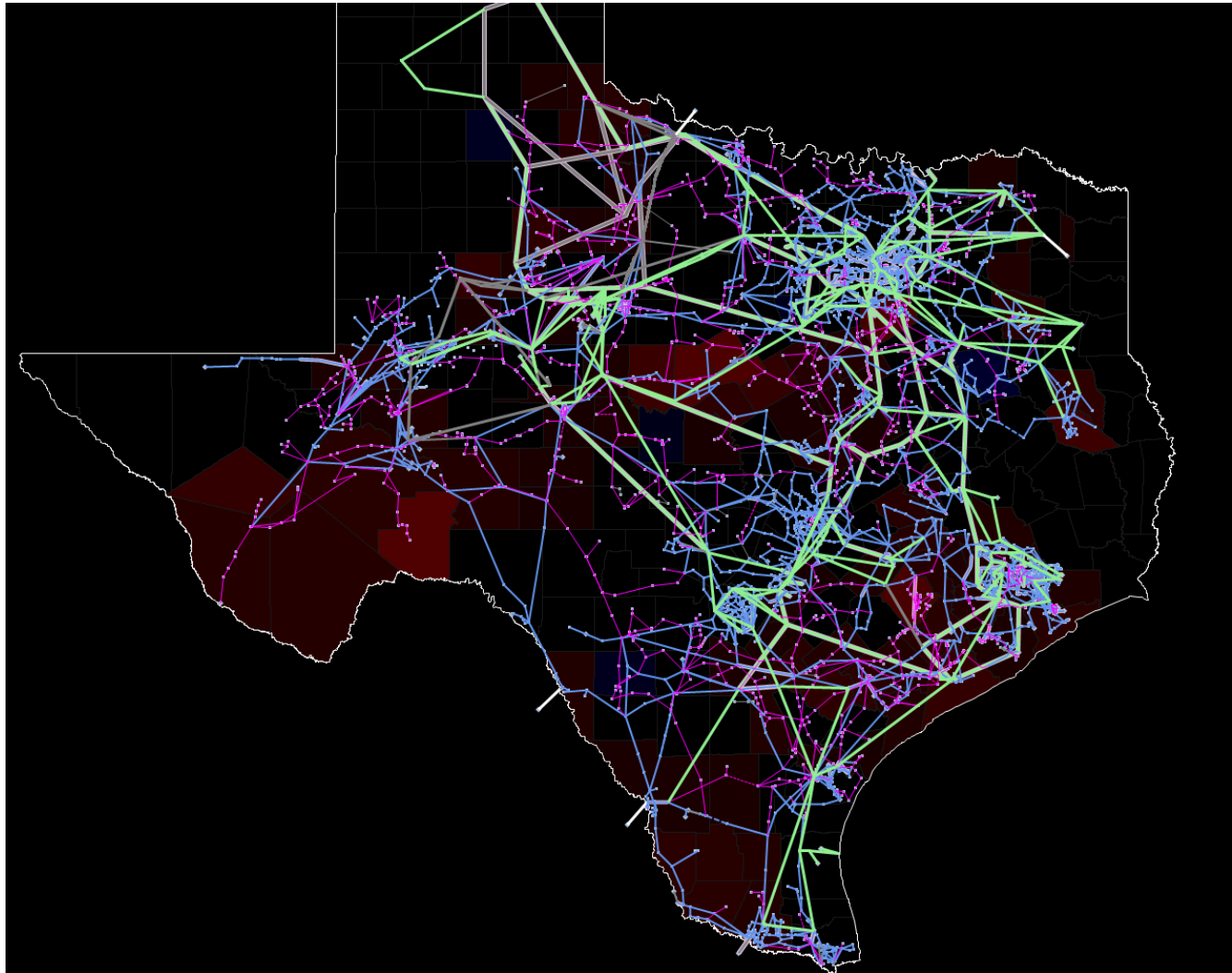


March 29, 2012

4

NERC 2012: Improving Human Performance  
on the Grid

## Year One: Situation Awareness

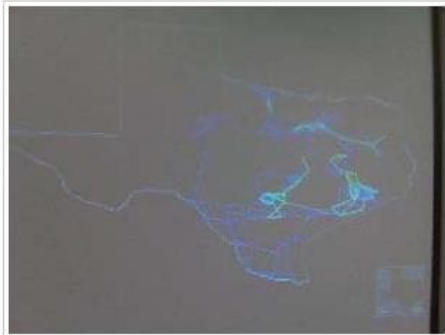


# Year One: Situation Awareness

## Macomber Map®



Set a new Black Start record!



Mobile Uploads

Unlike · Comment · Share · March 15 at 11:57am via BlackBerry ·

You, [name] and [name] others like this.



March 29, 2012

9

NERC 2012: Improving Human Performance on the Grid

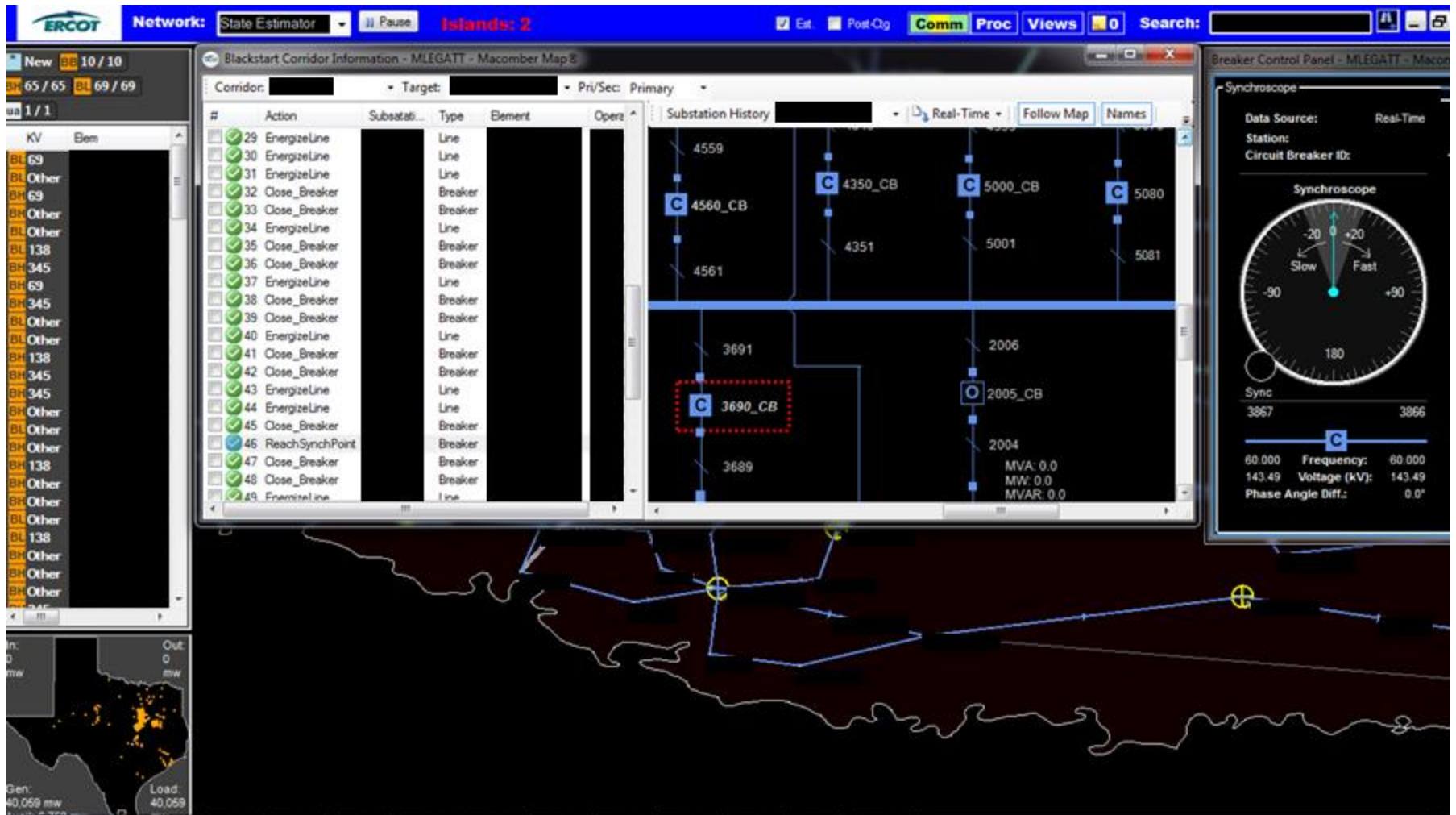
## Year Two: Improving Human Performance in High-Stress Control Room Situations

### ERCOT Black Start Training

- TOs and ERCOT operators use Macomber Map to see wide area views and control only their equipment
- Participants each perform their roles against ERCOT's EMS training simulator
- Simulation of severe weather event, many transmission lines unavailable.



# Year Two: Improving Human Performance in High-Stress Control Room Situations



## Year Two: Improving Human Performance in High-Stress Control Room Situations

### Interesting facts

- TO behavior patterns different between 2012 and 2013.
  - In 2012, with just one-line displays, operators moved more quickly and had more island collapses
  - In 2013, using Macomber Map, operators moved more methodically, making significantly fewer switching errors.
  - However, existing human errors still occurred likely due to fatigue/circadian rhythm.



## Year Three: Looking at Corporate Culture

**Mike Legatt**

Operator Awareness and Engagement

In many ways, human beings are like components on the grid. They each have their tolerances and optimal ranges of function.

If you interconnect them well, you can build a strong, reliable and self-healing system. Conversely, you can create sub-synchronous resonances by incorrectly interconnecting them: in this you create inefficient circuits that waste energy and time, and create heat, risk and cost.

Managing people is no more and no less than being an organizational reliability coordinator.





# Year Three: Looking at Corporate Culture

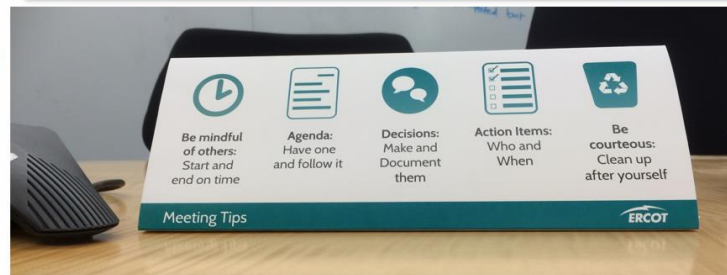
**Mike Legatt**

Operator Awareness and Engagement

## Culture/Engagement Initiatives

*Respect what people do and respect their time:*

*“Don’t just call a meeting; respect start and stop times, have an agenda, talk and listen with respect.”*



# Year Three: Culture

Friday, March 14 2:03 PM

Today in 

## E-Wire Headlines

The 2014 Events Calendar is on E-Wire

Spark-E's Brigade needs YOU!

Books Are Fun Book Fair coming to a lobby near you...

## CIC

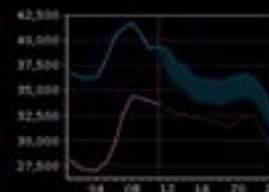
The United Way of Williamson County needs your help making funding decisions

## Company News

The annual SSAE-16 Audit is coming soon..., are you ready?

*"I've noticed that even people who claim everything is predestined, and that we can do nothing to change it, look before they cross the road."*

--Stephen Hawking



FREQ: 60.022 Hz  
LOAD: 33,393 Mw  
WIND: 4,146 Mw  
PRC: 4,506 Mw

Normal Conditions

Today	Mon 17	Tue 18
72° F 60° F	63° F 45° F	70° F 48° F
<p>Colorectal Awareness Month</p> <p>9 - 10 AM STTF Market Call</p>	<p>9:30 AM - 4 PM RDWG Meeting</p> <p>1 - 4 PM COPS Meeting</p>	<p>12 - 2 PM Back Start Training Special Session</p> <p>4:00 - 5:05 PM ERCOT TOASTMASTERS</p>

# Year Three: Looking at Corporate Culture

**Mike Legatt**

Operator Awareness and Engagement

## Culture/Engagement Strategies



Save the Date...

### 2013 Health and Wellness Family Event

Saturday, October 5<sup>th</sup>

10:00 a.m. to 3:00 p.m.

Old Settlers Main Hall

Complimentary biometric screenings and flu shots, an array of health and wellness vendors and so much more. More details to come!



*Let's Beat the Heat!*  
*Employee Events Committee*  
*is serving*  
*Blue Bell Ice Cream*



Thursday, May 30<sup>th</sup> - T2 Peace Room, 2:00 - 3:00 p.m.



Drumsticks, Cookies and Cream / Vanilla Ice Cream Sandwiches, Strawberry Fruit Bars, Fudge Bars & a Sugar Free Option



**Year Four:  
“Blackout Fried Chicken”**

## Early Blackstart Simulations

- Operators used one-line displays and tabular overviews.
- Typical behavior pattern: quickly moving through the system.
- Frequent island collapses, due excessive load close-in and other errors.
- Operators reported difficulties maintaining frequency and voltages due to detailed (one-line) views.



## Year Four: “Blackout Fried Chicken”

### Bringing the map to transmission

- The map was enhanced to support switching actions, and transmission operators began to use it.
- Definite changes in operator behavior:
  - Corridor rebuilds were slower and more methodical.
  - Highly significant reduction in breaker clearing errors.
  - Intentional load-shedding prior to island tie-ins were observed – a new behavior.



## Year Four: “Blackout Fried Chicken”

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## Year Four: “Blackout Fried Chicken”

### Serotonin

- Serotonin is a neurotransmitter (traveling between nerve cells)
- Low serotonin levels lead to clinical depression
- Excessive serotonin leads to extreme feelings of well-being and happiness
  - Serotonin syndrome
  - Serotonergic neurotoxicity

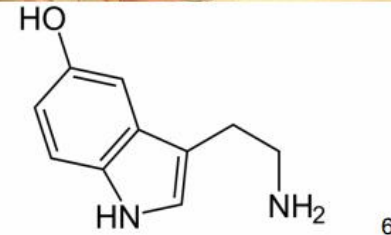
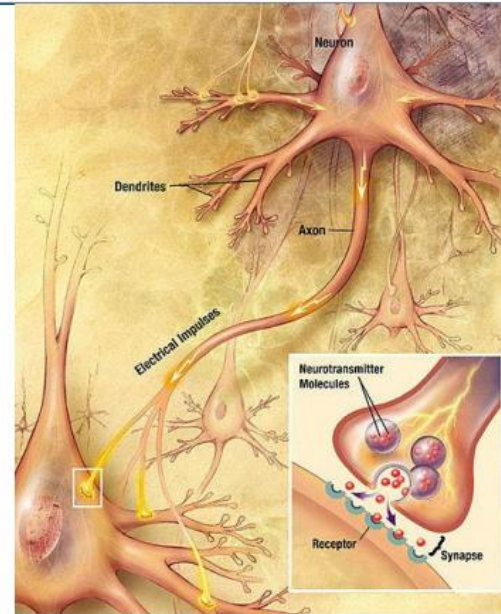


Image Sources: Wikipedia

## Year Four: “Blackout Fried Chicken”

### Results

- For the first time in training history, ran the full simulation day (7 A.M. – 5 P.M.) without a single identified switching error.
- This was during the dry run – presumed to have had the highest risk of error:
  - It was a year since the last training
  - Operators were not yet observing other operators from their companies attending the training.

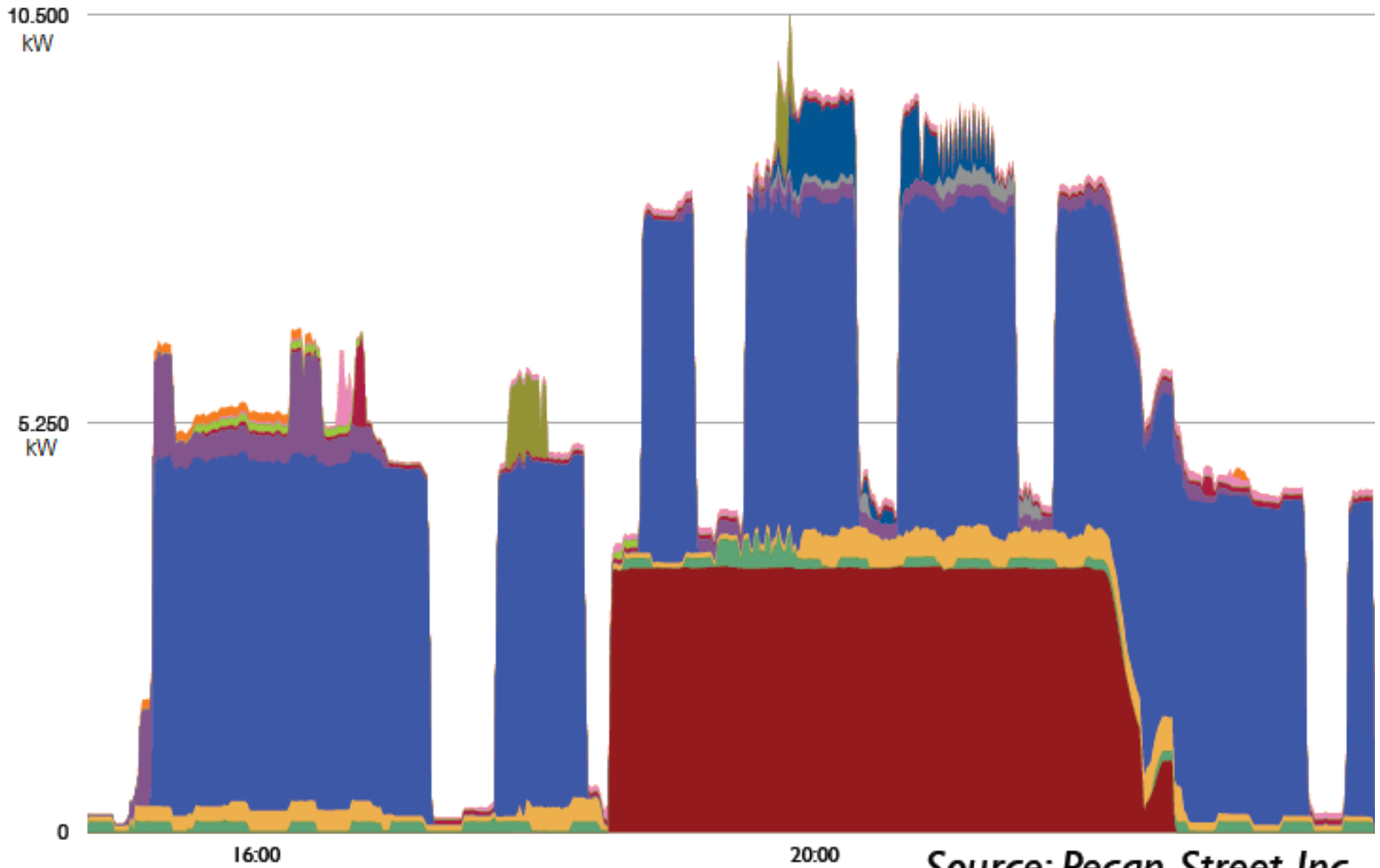




## State of the grid

- Faster-moving and more data: signal to noise ratio changing.
- Controllable and uncontrollable load and generation.
- IT/OT convergence.
- Retiring workforce, millennials and workplace diversity.
- Greater dependence on expertise and reliance on humans to understand “the big picture”

# Behavior Scales...



Source: Pecan Street Inc.



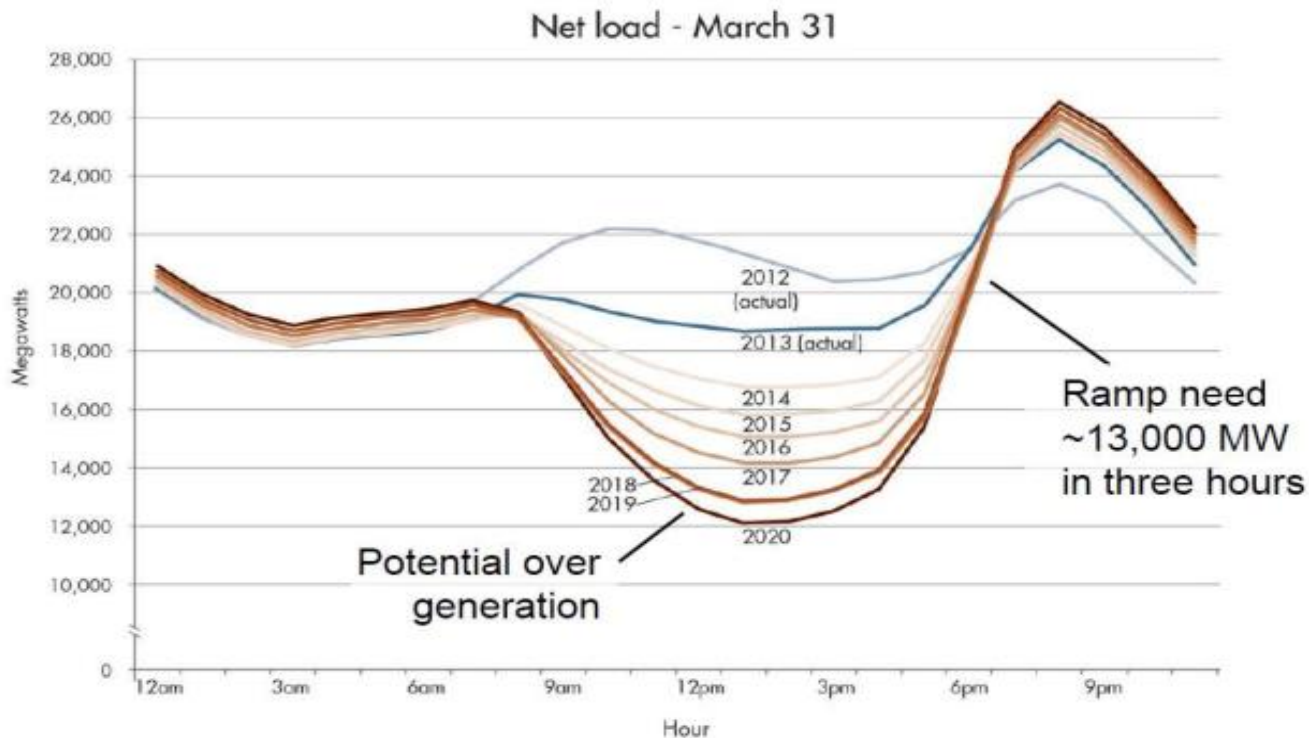
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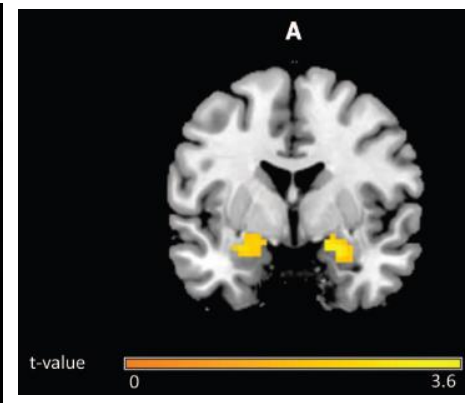
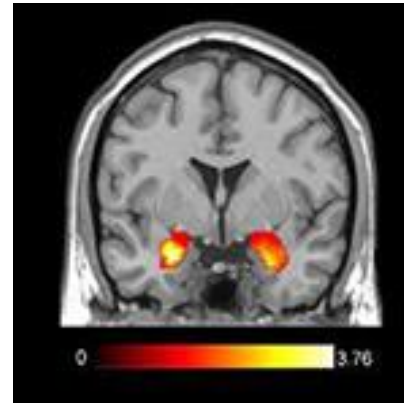
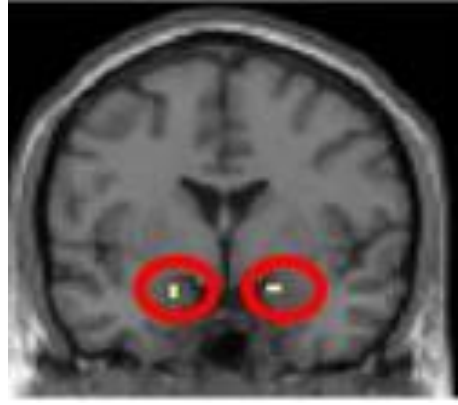
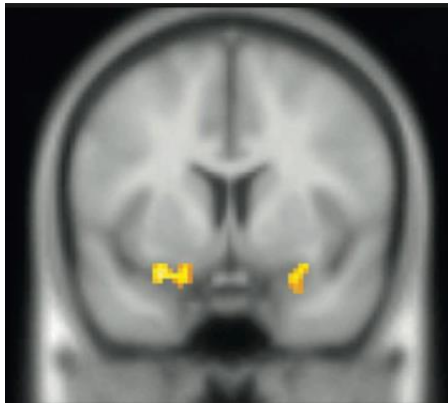
Pecan Street Inc.

# Behavior Scales...

Non-summer months — Net load pattern changes significantly starting in 2014

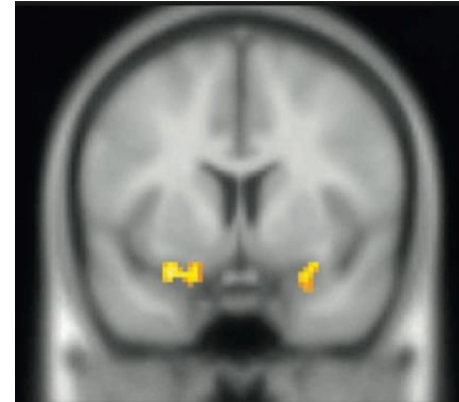


# Information Processing



# Information Processing

- Most difficult to process information under extreme stress
- Ego depletion
  - Exhaustion of self-control leads to limited processing



[dreamstime.com](http://dreamstime.com)

# Managing Human Beings and Organizations

- “What you can manage is what you can measure.”
- “If you measure it, you can manage it.”



W. Edwards Deming  
(1900-1993)

Source: deming.org

# Managing Human Beings and Organizations

“It is wrong to suppose that if you can’t measure it, you can’t manage it – a costly myth...

It is the relationship with people, the development of mutual confidence, the identification of people, the creation of a community.

This is something only you can do. It cannot be measured or easily defined.

But it is not only a key function. It is one only you can perform.”



W. Edwards Deming  
(1900-1993)

Source: deming.org

# Human Error





# Human Error: IoT devices

## New security flaws found in popular IoT baby monitors

Even internet-connected baby monitors aren't immune to hacking, including some flaws that are easy to exploit.



By Zack Whittaker for Zero Day | September 2, 2015 -- 13:54 GMT (06:54 PDT) | Topic: Security



A popular Fisher-Price 'smart bear' failed to properly authenticate the device's user.

*Image credit: Amazon*

## Princeton researchers find security flaws in IoT devices

engadget

Nest thermostats were leaking zip codes on the internet, for example.



Billy Steele , @wmsteele  
01.21.16 in Home

Shares

## It's Time to Pay Attention to Connected Car Cyber-Threats

By Wayne Rash | Posted 2016-03-20 Print



# Thoughts on Human Error

“The single greatest impediment to error prevention... is that we punish people for making mistakes”

Dr. Lucian Leape  
Professor, Harvard School of Public Health  
1999 Testimony before congress

“All organizations are perfectly aligned to get the results they get.”

Arthur W. Jones

# Situation Awareness



# Situation Awareness: Macomber Map



Open Source at <http://www.macombermap.com>

# A Changing Grid



Feb. 18, 2016 Wind Records: 14,023 MW, 45.14%

# Organizational Culture



## Interconnecting Organizations

- In many ways, human beings are like components on the grid. They each have their tolerances and optimal ranges of function.
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