

Setting the Standard for Automation™

HMI Design: The Good, the bad, and the ugly (and what makes them so)

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- Safety Systems Specialist for 22 years
- ISA Fellow
- Member of ISA SP84 committee (20 years)
- Instructor for ISA’s courses on Safety Instrumented Systems (8 days of material)
- Co-author of ISA book on Safety Instrumented Systems
- Developer of commercial modeling software
- Registered Professional Engineer in Texas
- ISA 84 Expert

Why the concern about HMI's?



People who don't know better produce...



Gertrude's Piano Bar

STARTERS:
 GERTRUDE'S FAMOUS ONION LOAF - 8
 GAZPACHO OR ASPARAGUS-SPINACH SOUP - 7
 SUMMER GARDEN TOMATO SALAD - 8
 SLICED VINE-RIPENED YELLOW AND RED TOMATOES WITH FRESH MOZZARELLA AND BASIL BALSAMIC VINAIGRETTE
 HAMLET'S CHOPPED SALAD - 7
 CUBED CUCUMBERS, RADISHES, AVOCADO, TOMATOES, JARLSBERG CHEESE, AND ROMAINE LETTUCE TOSSED IN A LIGHT LEMON VINAIGRETTE
 CAESAR SALAD - 7
 HOUSE-MADE DRESSING, PARMESAN AND CROUTONS
 CARIBBEAN CEVICHE - 9
 LIME-MARINATED BABY SCALLOPS WITH RED PEPPER, ONIONS, CILANTRO, JALAPENOS, AND ORANGE JUICE
 SHRIMP COCKTAIL - 14
 FIVE LARGE SHRIMP WITH HOUSE-MADE COCKTAIL SAUCE
ENTREES:
 NEW YORK STEAK, 16 OZ - 27
 POTESSERO CHICKENS - 17
 FRESH FISH, 10 OZ - MARKET PRICE
 GRILLED SHRIMP - 24
 NEW ORLEANS LUMP CRAB CAKES WITH WARM VEGETABLE COLESLAW, MASHED POTATOES, SPINACH AND ROMESCO SAUCE - 18
 GRILLED PORTOBELLO MUSHROOM STUFFED WITH RICOTTA CHEESE, GARLIC, ONIONS AND SPINACH, SERVED OVER MASHED POTATOES - 18
 NEW ZEALAND RACK OF LAMB - 26
 BARBEQUED BABY BACK RIBS - 24
 AUSTRALIAN LOBSTER TAIL, 19 OZ - MARKET PRICE
 SURF & TURF
 AUSTRALIAN LOBSTER & SOZ FILET - MARKET PRICE

Contrast:
 Things that are different should look very different.

Repetition:
 Repeat visual elements

Alignment:
 Every element should have some visual connection with another.

Proximity:
 Things that belong together should be placed together. Those that are different, should not.

Source: The Non-Designers Design Book

Gertrude's Piano Bar

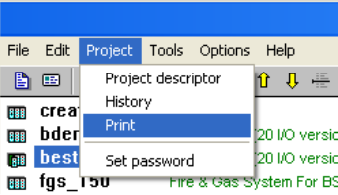
Starters

Gertrude's Famous Onion Loaf	8
Gazpacho or Asparagus Spinach Soup	7
Summer Garden Tomato Salad	8
<i>sliced vine-ripened yellow and red tomatoes with fresh mozzarella and basil balsamic vinaigrette</i>	
Hamlet's Chopped Salad	7
<i>cubed cucumbers, radishes, scallions, tomatoes, tomatoes, jacking cheese, and romaine leaves tossed in a light lemon vinaigrette</i>	
Caesar Salad	7
<i>house-made dressing, parmesan, and croutons</i>	
Caribbean Ceviche	9
<i>lime-marinated baby scallops with red pepper, onions, cilantro, jalapenos, and orange juice</i>	
Shrimp Cocktail	14
<i>five large shrimp with house-made cocktail sauce</i>	

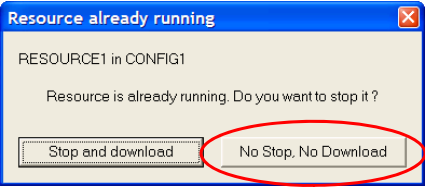
Entrees

New York Steak, 16 ounce	27
Roastbeef Chicken	17
Fresh Fish, 10 ounce	Market Price
Grilled Shrimp	24
New Orleans Lump Crab Cakes with warm vegetable coleslaw, mashed potatoes, spinach, and romesco sauce	18
Grilled Portobello Mushroom stuffed with ricotta cheese, garlic, onions and spinach, served over mashed potatoes	18
New Zealand Rack of Lamb	26
Barbequed Baby Back Ribs	24
Australian Lobster Tail, 19 ounce	Market Price
Surf & Turf: Australian Rack Lobster & 8 ounce Filet	Market Price

Not following convention...




“Print” belongs under the “File” menu.



Cancel!

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Situation Awareness




Three stages:




1. Being aware of the situation around you
 - Perception of needed data and the current situation
2. Understanding what the information means to you now
 - Comprehension of information and the current situation
3. Understanding what the information means to you in the future
 - Projection of future status

Source: Designing For Situation Awareness

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Demons of Situation Awareness











- Attention tunneling
 - Fixating on one set of information to the exclusion of others
- Memory trap
 - Relying on limited short-term memory
- Workload, anxiety, fatigue and other stressors
 - Reduction of a person's capacity to process information
- Data overload
 - Overwhelming amounts of data

Source: Designing For Situation Awareness 7

Demons of Situation Awareness

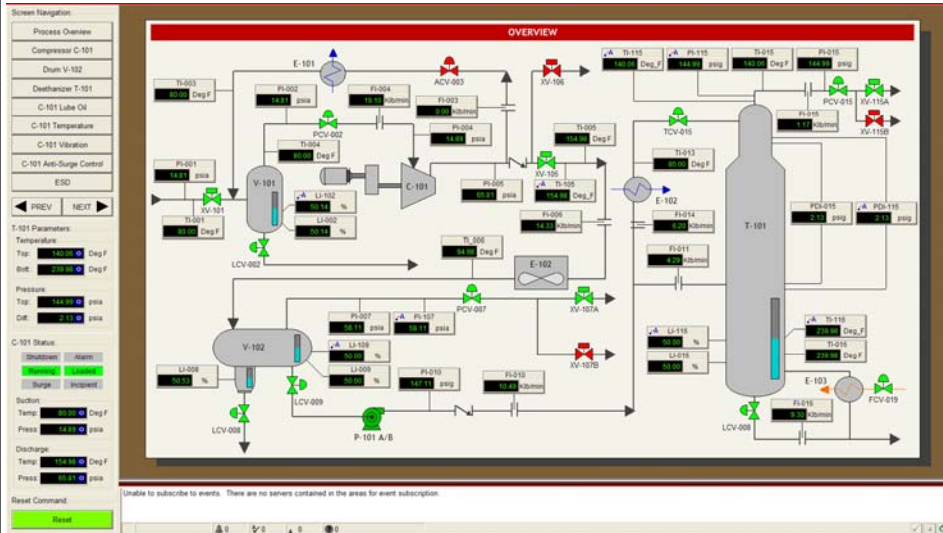


- Misplaced salience
 - Salience: the compellingness of certain information
 - Being drawn to the wrong information
- Complexity creep
 - Too many features make it difficult to develop an accurate mental model
- Errant mental models
 - Use of the wrong model leads to misinterpretation of information
- Out-of-the-loop syndrome
 - Automation can undermine SA

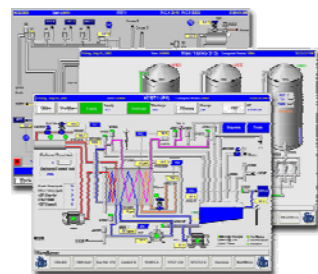
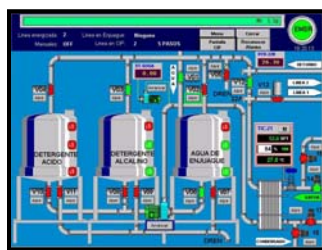
Source: Designing For Situation Awareness 8

Fewer colors, but is this really any different?



Is this process healthy? What *should* the values be?

So why have we developed things like this?



- User had no internal standard or guideline
- Vendor had no drawings other than P&IDs
- Vendor understood what the control system was doing
- Easiest solution was to display the PI&D with all the control system data
- No one ever asked the operators what their *goals* were (not tasks!)
- Few understand SA and its demons

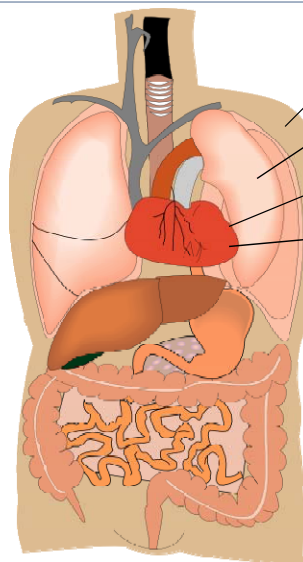
Poor HMI designs have:



- P&ID representation
- No trends
- Flashing/spinning graphics
- Bright colors, 3-D shadows
- Color coding of piping and vessel contents
- Measurement units in large, bright text
- Lots of crossing lines
- Alarm related colors for non-alarm related elements
- Inconsistent colors

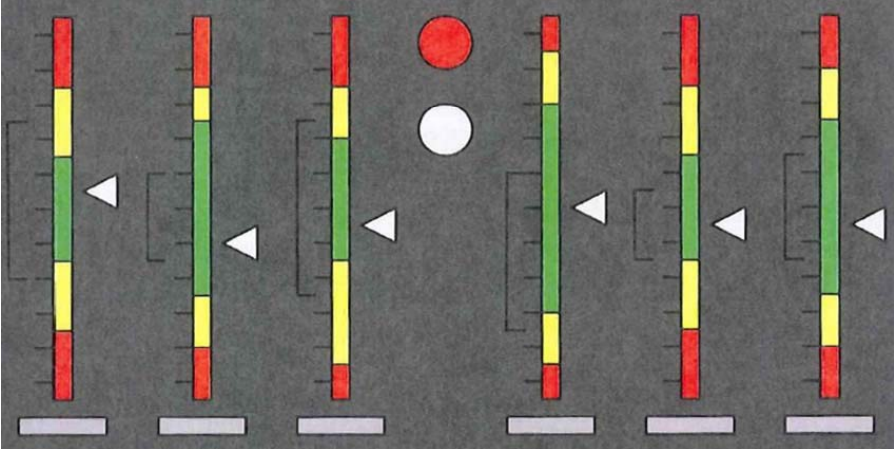
Source: The High Performance HMI Handbook

The medical equivalent: Is this person OK?



Temp	98.6 °F	98.0 – 99.5
B.R.	20 /min	16 – 24
Pulse	72 bpm	60 – 84
B.P.	120/80 mmHg	>130 / >85
Col	197 mg/dL	<200
HDL	52 mg/dL	>40
LDL	126 mg/dL	<130
Tri	100 Mg/dL	<150

Is *this* person OK?

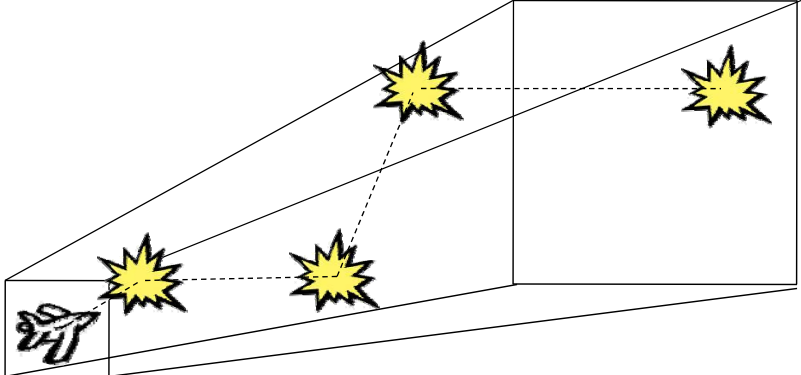


How far ahead of its time was this!!

Source: The High Performance HMI Handbook

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The Role of the Operator




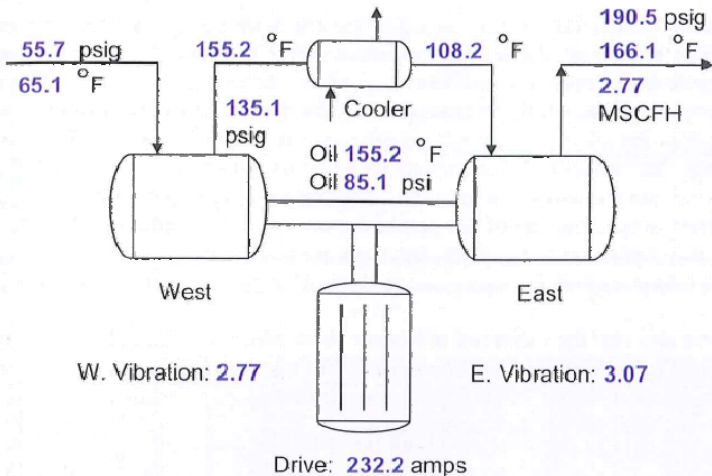
Source: The High Performance HMI Handbook

- The human in the loop should be predictive, not reactive
- The goal is to predict and prevent problems, not respond to them after they've happened

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Is this compressor running optimally?





W. Vibration: 2.77 E. Vibration: 3.07


Drive: 232.2 amps

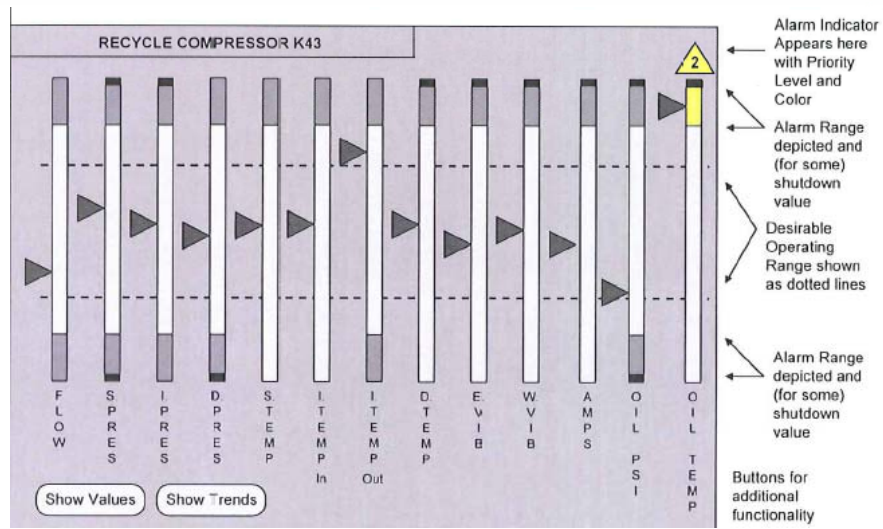
What *should* the values be?

Source: The High Performance HMI Handbook

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The compressor graphic is superfluous!





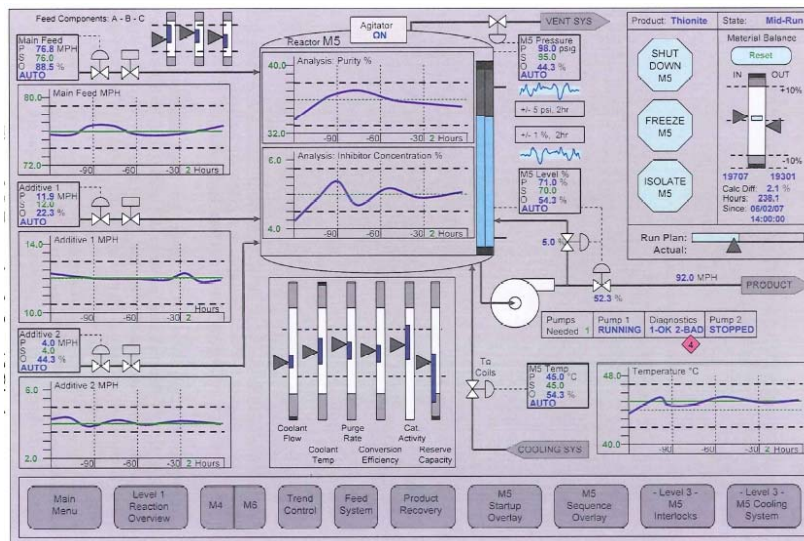
RECYCLE COMPRESSOR K43

Buttons for additional functionality

Source: The High Performance HMI Handbook

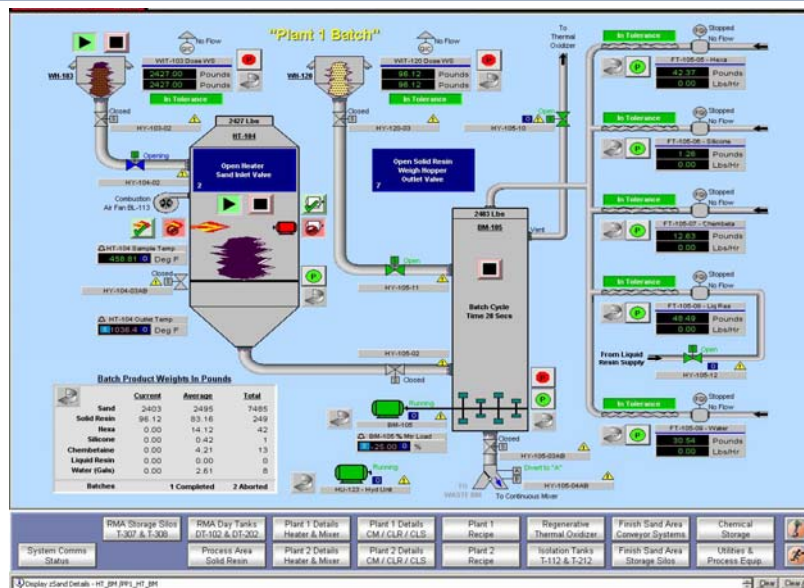
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A good example: status, trends, an alarm...

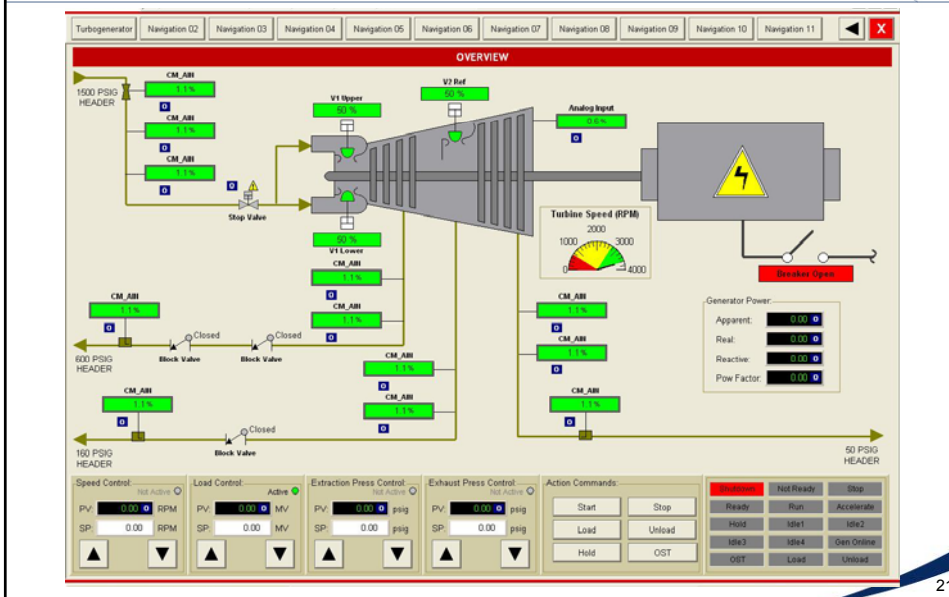


Source: The High Performance HMI Handbook

So what's wrong here?

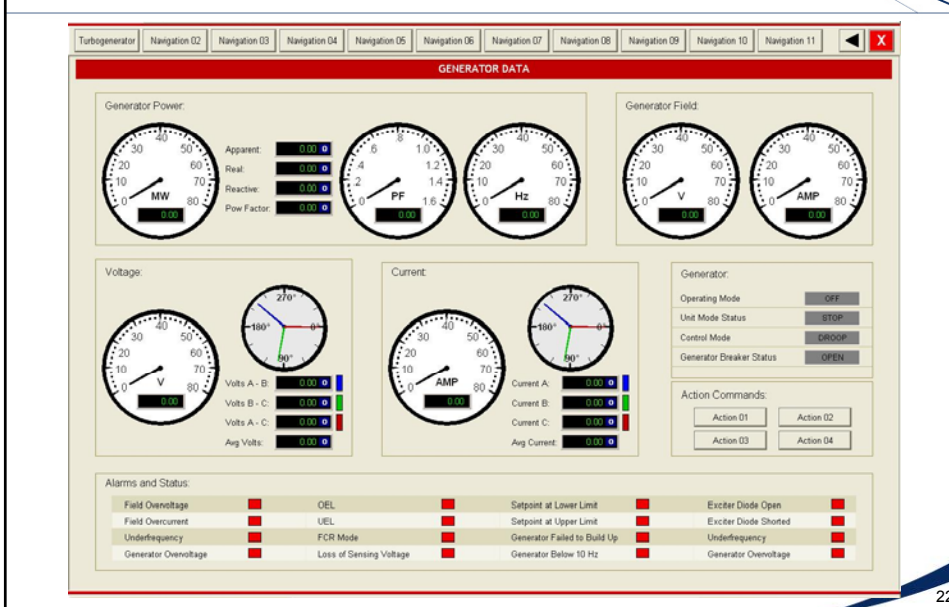


Is this compressor healthy?



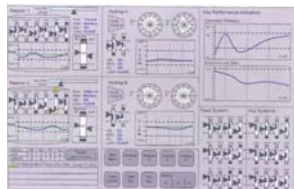
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What should these values be?



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Good HMI designs have:



- Depiction of process status and values as information, not numbers
- Layout consistent with operators model of the process (not a P&ID)
- Key Performance Indicators as trends
- No gratuitous information
- Gray backgrounds, low contrast
- Very limited use of color (for alarming)
- Consistent visual and color coding
- Gray process lines
- Measurement units in low contrast lettering, if used at all

Source: The High Performance HMI Handbook

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Change is difficult

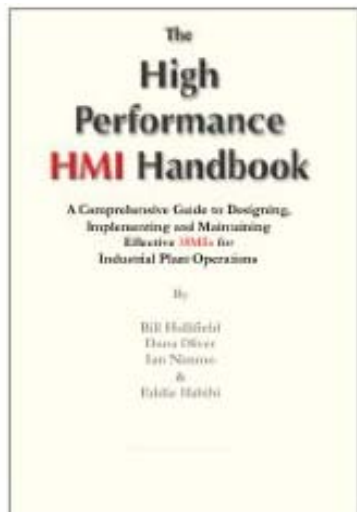


- Are you riding the same mule, but just sitting in a different saddle?
- “Human beings, who are almost unique in having the ability to learn from the experience of others, are also remarkable for their apparent disinclination to do so.” *Douglas Adams*
- Involvement and buy-in will be needed from management, technical staff, and operators

Source: The High Performance HMI Handbook

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For “the rest of the story”...

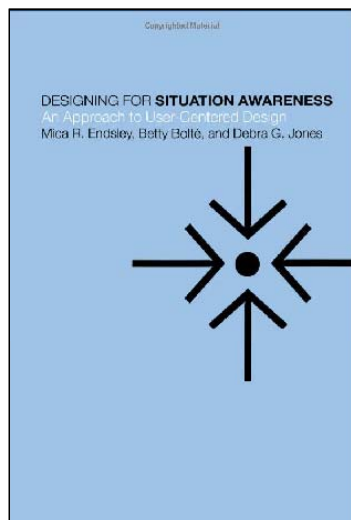


By Bill Hollifield ,
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Eddie Habibi

For more info, visit:
www.pas.com and
www.mycontrolroom.com

As well as the ASM consortium:
www.asmconsortium.net

For “the rest of the story”...



By Mica Endsley,
Betty Bolté, &
Debra Jones