ActiveCal™: Recalibrating For Trust and Confidence

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The leader in planting equipment for corn and soybeans, John Deere now aims to make a dent in the small grains air seeding market with the new C850 air cart. Part of their vision is to make confident, accurate seeding rates a differentiator with a new on-the-fly calibration feature, ActiveCal™.

Our challenge: transform a critical but challenging aspect of machine setup into an easy-to-use touch display feature meant for use during normal operation.

My Role:

I contributed problem definition for the C850 air cart's ActiveCal user interface for the John Deere Gen4 CommandCenter. I also created dynamic UI prototypes for stakeholder and customer feedback, authored goal-based scenarios for Deere's in-house usability task analysis, and co-led a 2 customer focus groups to inform and evaluate our designs. I collaborated with 2 internal designers at our agency, and our team collaborated directly with Deere product managers, product owners, system engineers and Deere's internal UX team.

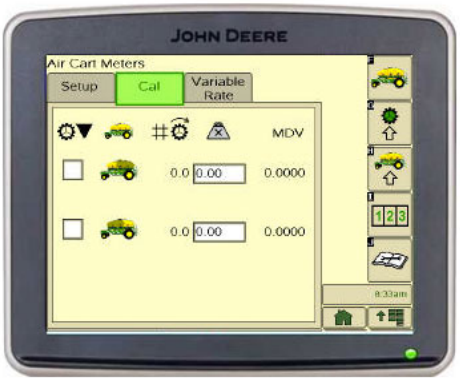
Discovery

Before we could design this solution, I wanted to understand the problem:

- Why does an air cart operator need to calibrate their air cart in the first place?
- What challenges exist with how they do this today?
- How do they typically resolve those challenges?
- What is the outcome we're designing for?
- What do we know about air cart operators that is relevant?
- What will operators stop doing when they start using this feature?

BACKGROUND RESEARCH

When we kicked off this project, very little context was provided aside from the legacy display screens for the manual meter calibration procedure, whose interface was described by Deere as "hard to use:"



I wanted to unpack the business case a bit more, but as a supplier to Deere we didn't have direct ad hoc access to customers to conduct research interviews yet, so instead I browsed some topic-specific forums looking for stories in the wild. A few keyword searches yielded a wealth of insightful anecdotes related to this meter calibration:

> "When I first got my drill, I had accidentally entered something wrong on the [display] setup, I went through calibration for fertilizer and seed, then seeded about 1/2 acre. Then I found out that I was dropping double rate on the seed and half rate on the fertilizer.

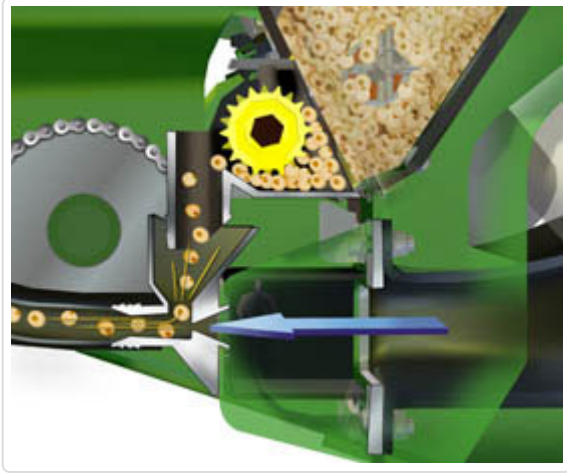
> “I’m guessing we could cheat and tell the monitor to apply 112 lb/ac (knowing that its over-applying 7-10%) so that we can get an actual 120 lb/ac. But surely there’s a way to get it to apply what the monitor is saying it is, isn’t there?”

I supplemented what I learned on the forums by looking at Deere product literature and dealer websites, synthesizing that into a 1-page design brief that included this problem statement:

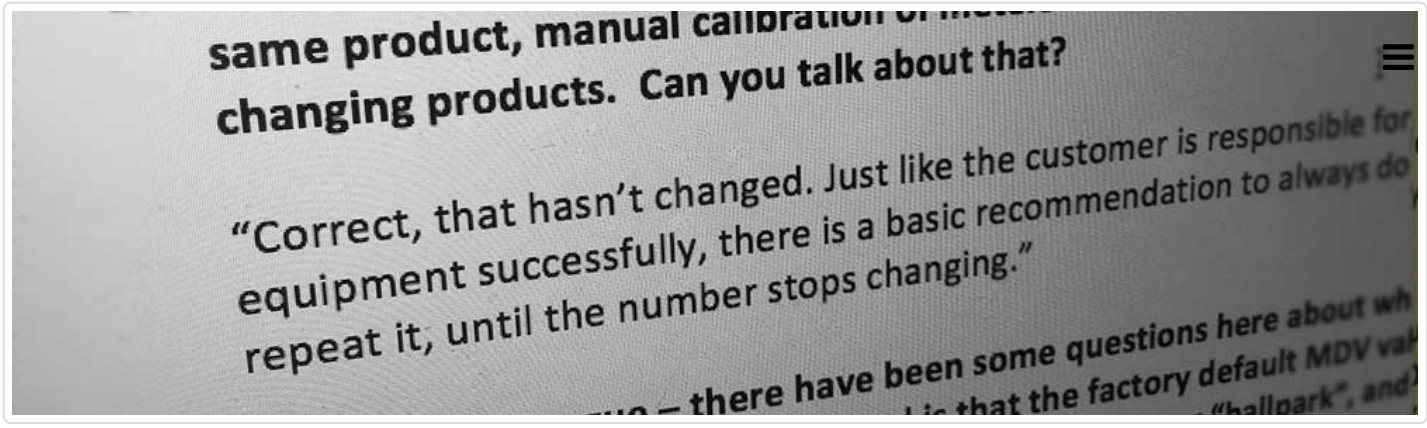
Need: Air cart operators need to apply product at the rates they enter in the display. Too little seed costs them yield, and too much fertilizer kills the crop.

Challenge: Differences in shape, density, particle size consistency and moisture content all impact how much product is displaced with each turn of the meter.

Resolution: For this reason, operators must recalibrate the meters each time they refill their commodity tanks, and then manually verify the rate by metering out commodity into a bag, weighing it, and comparing to an expected value.

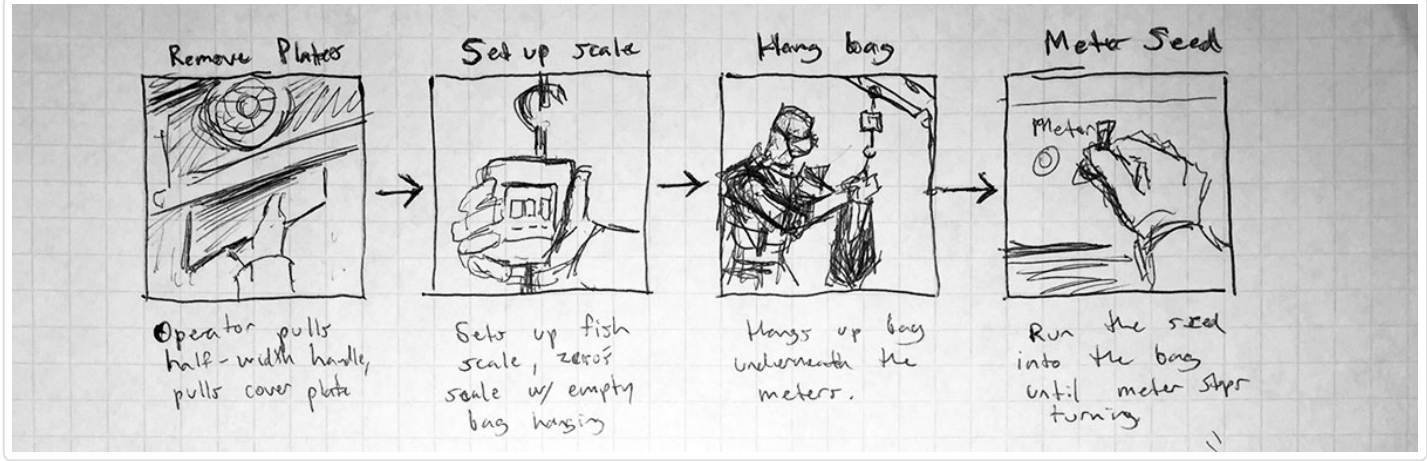


Once I had a better grasp of the problem domain and knew what kind of questions ask, I conducted 1-on-1 stakeholder interviews with the Deere team. My goal was to understand from a product marketing and support perspective how they were managing customer expectations for this procedure:



Conversations with Deere's test engineers provided an opportunity for some contextual inquiry, getting us out of the office and into the cab for ride-alongs at test sites where we could not only talk about the calibration but **have a chance to perform the calibration ourselves:**

As I learned more about setting up air carts, I began to sketch out a customer narrative for the manual version of this calibration procedure:



My storyboard blew up fairly quickly, as quickly identified **no fewer than 17 individual steps** in the manual version of this calibration, which goes something like:

1. Stop the tractor, climb out of the cab, go back to the card
2. Remove the meter cover and pull the half-width disconnect handle
3. Remove the cover plate from the meter
4. Climb back into the tractor cab
5. From any screen press SETUP
6. From the list given, choose Air Cart
7. From Air Cart Setup Page, press key F to advance to the calibration screen
8. Press key A to calibrate the front meter
9. Press G to continue
10. Climb back out of the cab, go back to the cart
11. Hang the empty collection bag from scale
12. Zero the scale with the empty bag
13. Hang the bag underneath the meter
14. Hold the toggle switch to meter out seed into the bag
15. Once the meter stops, remove the bag and weigh it
16. Climb back into the cab and punch in the amount of the sample
17. Tap “OK” to accept the new MDV calibration

We also made this topic part of our agenda at a customer focus group in North Dakota, using the critical incident question technique to direct conversations towards recent memory and actual events. We spent the day talking with 10 experienced small grains growers, and heard in **their own words** some of the frustrations they encountered trying to calibrate their machines with the existing touch displays:

> "We've had days where we can't get it calibrated, and they'll sit out there and fight that all day and not get anything done...It'd be nice to have it where you punched that (calibration value) in, and you could trust that. "

Between the secondary research, stakeholder interviews and customer feedback, we concluded the following:

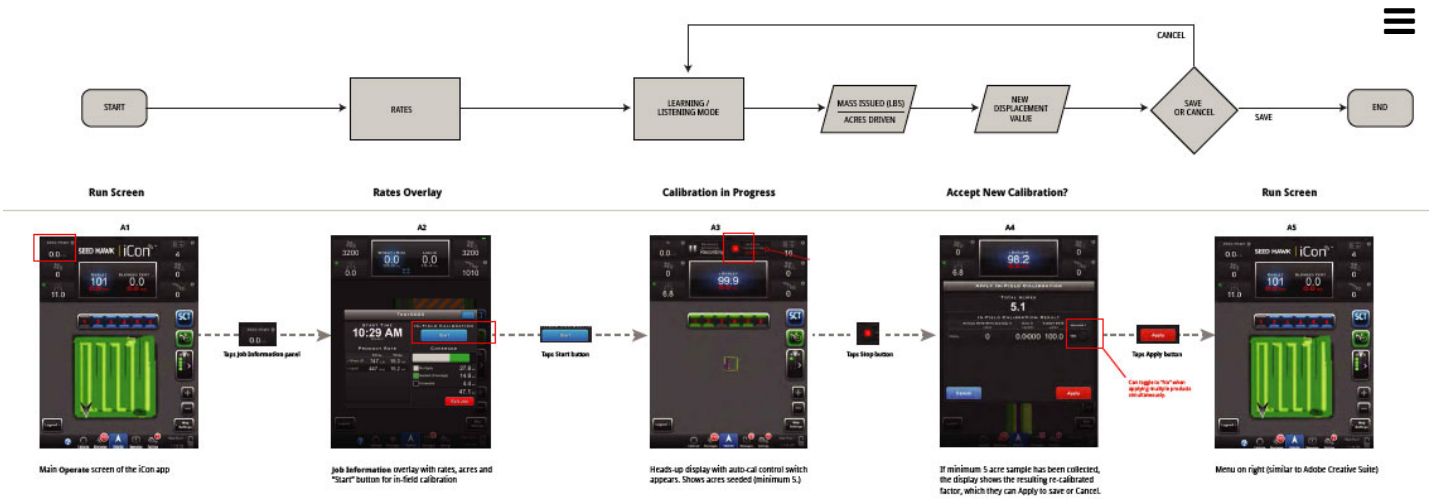
1. Of all steps in setup, meter calibration is arguably the most **important** one to get right.
2. It is one of the more **manual, time-consuming** setup procedures.
3. Due in no small part to the software interface, it is **very easy to screw up.**

ActiveCal, Deere's on-the-go rate calibration feature, would be a game changer. It wouldn't replace the manual calibration but it would make it far less important. We would combine electronic tank scales with intuitive touch-display controls to solve the same problem.

Deere would not be first to market with this kind of feature, but the stated goal was to become the best. To help them get there, I took a look at what else the market had to offer in terms of the same solution.

COMPETITIVE PRODUCTS

I studied competitive products in the market, analyzing them at a "boxes-and-arrows" level of abstraction to try and reverse-engineer some of the ideas that may have informed their designs, including the tablet app-based product from Seedhawk below:



In reviewing third party offerings, it became clear that the few in-field air cart calibration products out there shared the same basic inputs and same general theory of operation:

- The systems use a sort of “gear ratio” or calibration value that tells the meters how much product to dispense per unit distance in order to achieve a certain rate of application.
- This calibration value can be entered by the operator, or calculated automatically based on a mass of seed dispensed over a known distance.
- The systems’ tank scales compare the tank weights before and after seeding a known distance, producing a % difference and allowing the operator to make a judgement about accuracy.
- If they like what they see, they can update their calibration factor immediately.
- If they’re not confident in it, they can just continue seeding and gather more data.

At an abstract level, we confirmed the Deere air cart was wired up to work more or less by the same principles.

We also knew that we didn’t want to make this like other calibrations or setup features, buried in a menu and tucked out of the way behind 3 or 4 screen taps. **This would heavily inform our approach to ActiveCal as more of a performance optimization feature than a setup procedure.**

Synthesis

Deere’s product manager, an experienced farmer himself and former service technician, had a vision for ActiveCal as something operators would just “turn on in the background,” while they worked:

> "So you'll stop the cart, take a picture of the scale readings, and then you'll go seed a few passes, then stop. You take another snapshot of the tank weight, and then the display...it knows your tool width, it knows your target rate...so it just compares what went out of the tank and tells you how close you are. Then you hit accept and keep on seeding...I think once you put the technology in the customer's hands, most of them are going to auto-cal and never look back."
>
> — Product Manager

Using this as inspiration, I drafted a context scenario:

The context scenario is a hypothetical narrative meant to elicit feedback on our understanding of the customer need, and also **describe a specific solution - but without any design details just yet.**

- How do we see this feature working? How would it feel?
- What is the operator doing, thinking before during and after?
- What is the full context of machine states the operator is also managing?
- What's happening on the ground, with the seeding implement?
- What time span does this take place over?

The goal was to converge on a design target. We wanted to paint a picture of a human outcome we wanted to realize, and then execute our interaction design against that.

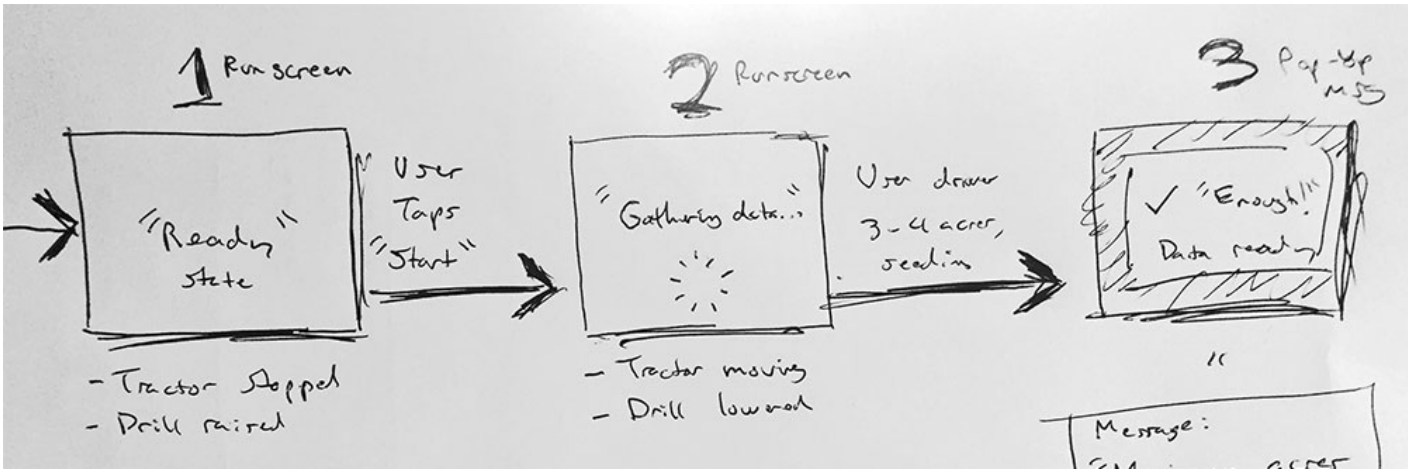
It was also in our best interest to **meet the Deere team's agile development workflow where it was at,** which meant characterizing the solution as user stories:

- "As an operator applying granular fertilizer that's different from one load to the next, I need to accurately calibrate each time I refill so that the cart puts down MAP at the rate I want."

- “As an operator with a lot of acres to seed and not a lot of extra personnel, I need to be able to do as many acres as possible as accurately as possible with as few trips up and down the stairs as I can.”
- “As an operator who has struggled with meter calibration in the past, I need an easier way to do this so that I can get seeding as quickly as possible and be confident in my application rates.”

Design

I kicked off the screen designs for ActiveCal in wireframe to help keep our ideas from getting too precious, too soon. We didn’t want to put finished-looking work in front of the client and bias them before they’d had a chance to react and course-correct our assumptions, if needed.



(I’d normally expect interaction designers to handle this part, but because of the subject matter they didn’t want to work from a blank canvas. As a compromise, I modeled the overall screen flow as sketches, which they then rendered and filled in with detail.)

While designers added fidelity from Deere’s pre-determined library of interaction patterns and embedded UI design conventions, I set about defining what “done” would look like for this interaction design specification.

Our standard deliverable was a mixed-fidelity mockup PDF with arrows and annotations connecting static screens, screens that were high graphic fidelity but not interactive. Without that interactive dimension to help developers relate the cause-and-effect intent, I felt it was necessary for us to work at a higher standard for content fidelity:

- **Would the screens make sense to someone who knows what they’re looking at?** Do the UI screens feature representative, realistic screen states and values for the subject

matter?

- **Does one hand know what the other is doing?** Do the implied action-response state changes accurately reflected across all elements onscreen?

Also as important as what our deliverable included was what we chose to leave out:

- Did our specification directly address the stated requirements?
- Did it prioritize the principal “bell curve” happy path use cases, front and center?
- Were edge cases limited, identified as such and deferred to the back of the document?
- Did we account for all the range of values and variations?
- Did we include all error or fault states?

With this extra bit of rigor, **we were able to improve upon a history of needless revision cycles and defect tickets resulting from developer confusion about design intent.**

PROTOTYPING

After a few iterations in low-fidelity, our interaction and production designers had finalized our individual screen designs. We still had not yet demonstrated a dynamic, interactive version of the proposed design, however.

To give Deere stakeholders a more realistic sense of how the proposed designs would play out interactively, I prototyped a series of "happy path" demos using Axure RP and Quicktime.

Deere's UI developers used similar short videos at sprint demos every 2 weeks, so **the format was very familiar and easily evaluated by their team.**

Using a series of short, story-specific happy path videos like this one, we were able to secure a final approval of the UI design from the Deere project team.

Testing

The scope of our team's contribution for this project was technically confined to the creation of user interface screens and screen flows describing the intended interaction, along with any supporting material such as system message text and component details.

Although any official usability testing for the interfaces will be conducted internally by Deere, we were able to solicit customer reactions to our design concepts at a follow-up focus group in Montana later the same year. I helped plan and lead the event, collaborating with Deere's air seeding product manager and the UI development product owner.

Getting customer feedback was a little problematic, however. Our team wasn't approved to bring an interactive prototype for 1-on-1 usability testing, and **the group dynamics and cognitive biases of 15 people in the same room would introduce too much experimental noise**

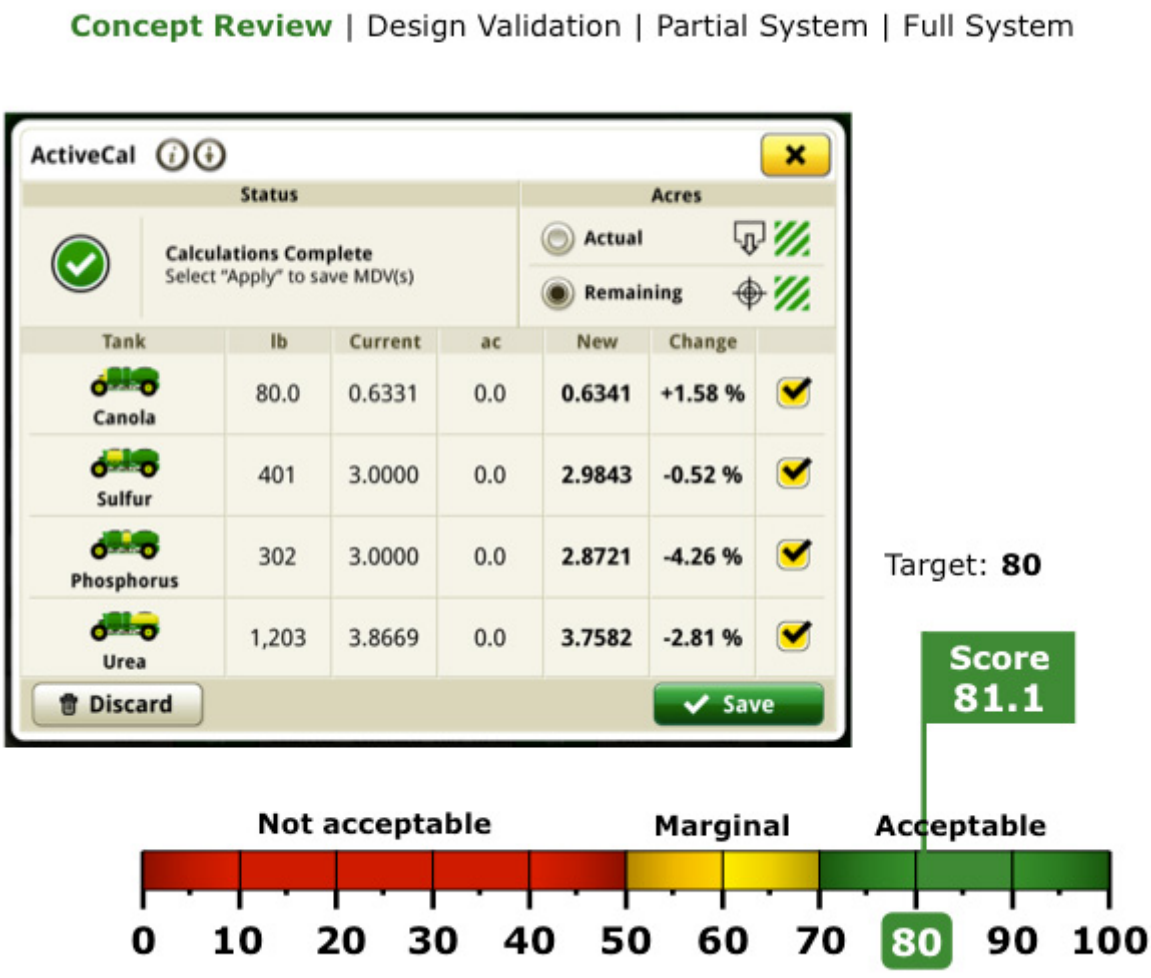
anyway.

So we had to take a slightly different approach:

Need: The project charter called for customer feedback on completed work, to be taken via System Usability Scale (SUS) indication as this was Deere's standard UX metric intended for uniform comparison across platforms.

Challenge: Due to the focus group format, characterizing our non-interactive screen review as validation would be problematic for longitudinal comparison with any SUS scores that were taken during actual 1-on-1 usability testing.

Resolution: Following a 90-minute review of 10 different screen concepts, including ActiveCal, we collected individual SUS scores whose average we then reported as a concept review. While not the ideal application of the method, qualifying our customer feedback as a concept review positioned it honestly and gave us a basis for future comparison to collect screen feedback in a systematic way under such constraints.



The John Deere C850 is now in production, marketed around faster, more accurate rate calibration with ActiveCal. Beginning in model year 2019, the C850 will be available with the Generation 4 Command Center touch display, where you'll see this interface design in action!

The buttons below are impossible to resist.

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