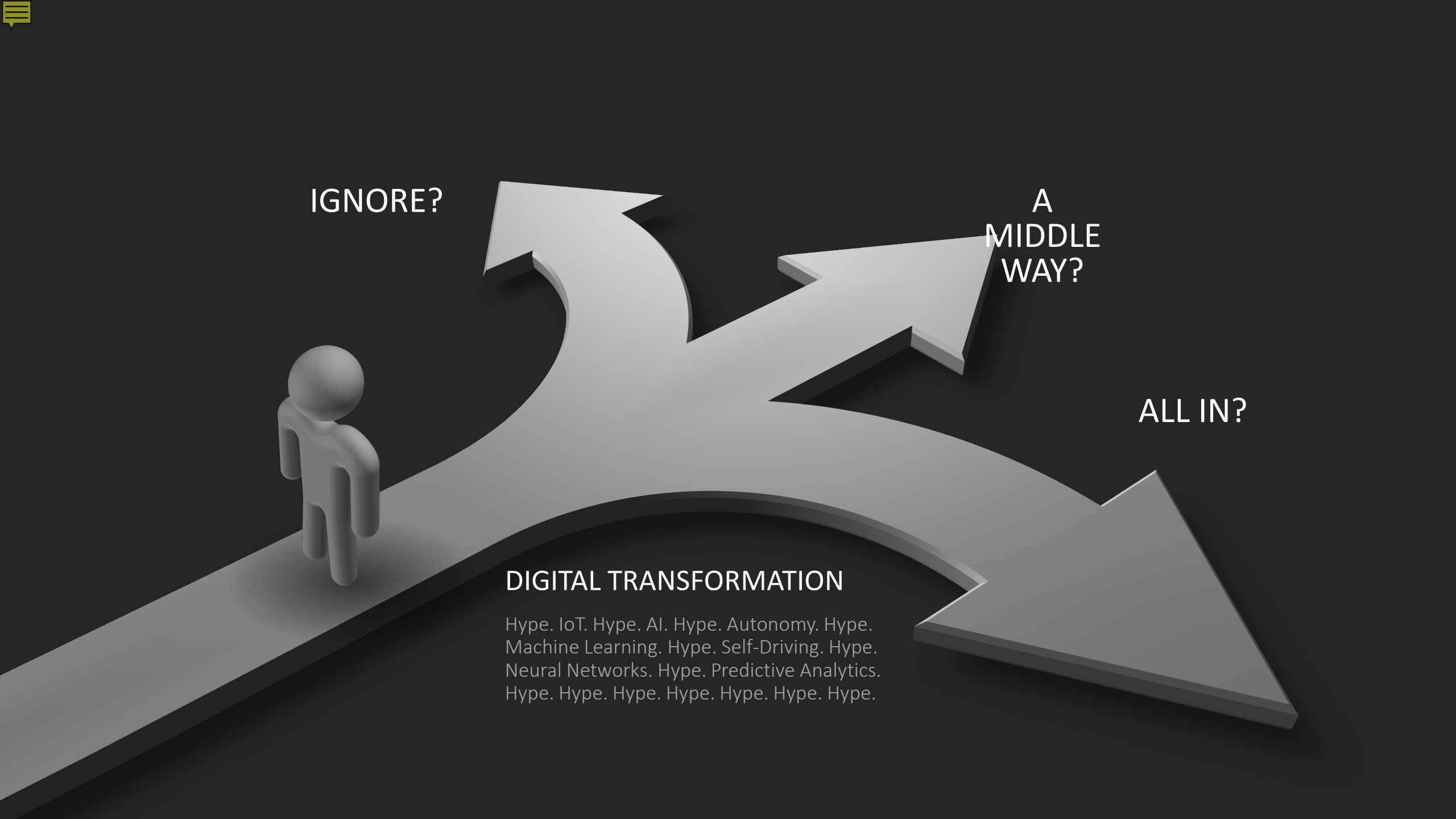
IT'S THE SPEED OF TRUST

What do we know, what don't we know, and what will it take to trust autonomous vessels?

GIBBS & COX
Maritime Solutions


IGNORE?
A MIDDLE WAY?
ALL IN?
DIGITAL TRANSFORMATION
Hype. IoT. Hype. AI. Hype. Autonomy. Hype. Machine Learning. Hype. Self-Driving. Hype. Neural Networks. Hype. Predictive Analytics. Hype. Hype. Hype. Hype. Hype. Hype. Hype.

The U.S. Navy seems to be choosing “Invest.”


Navy League

With billions planned in funding, the US Navy charts its unmanned future

By: David B. Larter May 6

A rendering of the Sea Hunter unmanned surface ship developed by the Defense Advanced Research Projects Agency. (DARPA)

WASHINGTON — With the U.S. Navy poised to dive headlong into a future of robotic ships, the surface fleet is preparing to map out how best it can employ new unmanned sidekicks against potential adversaries Russia and China.

DEFENSE NEWS

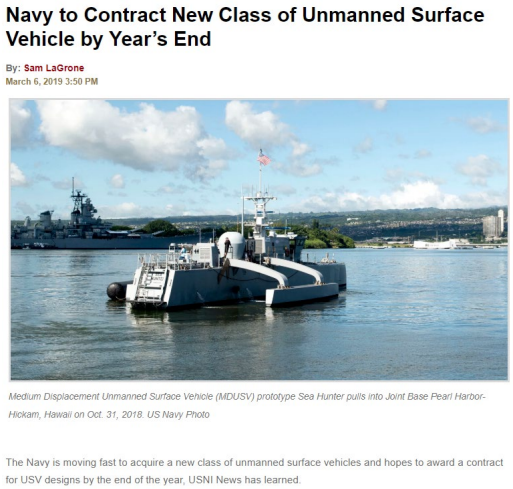
“With billions planned in funding, the US Navy charts its unmanned future.”

May 6, 2019

UNMANNED SYSTEMS

“Budget Confirms Navy UxV Boost”

July-August 2019


Navy to Contract New Class of Unmanned Surface Vehicle by Year’s End

By: Sam LaGrone
March 6, 2019 3:50 PM

Medium Displacement Unmanned Surface Vehicle (MDUSV) prototype Sea Hunter pulls into Joint Base Pearl Harbor-Hickam, Hawaii on Oct. 31, 2018. US Navy Photo

The Navy is moving fast to acquire a new class of unmanned surface vehicles and hopes to award a contract for USV designs by the end of the year, USNI News has learned.

USNI News

“Navy to Contract New Class of Unmanned Surface Vehicles by Year’s End”

March 6, 2019

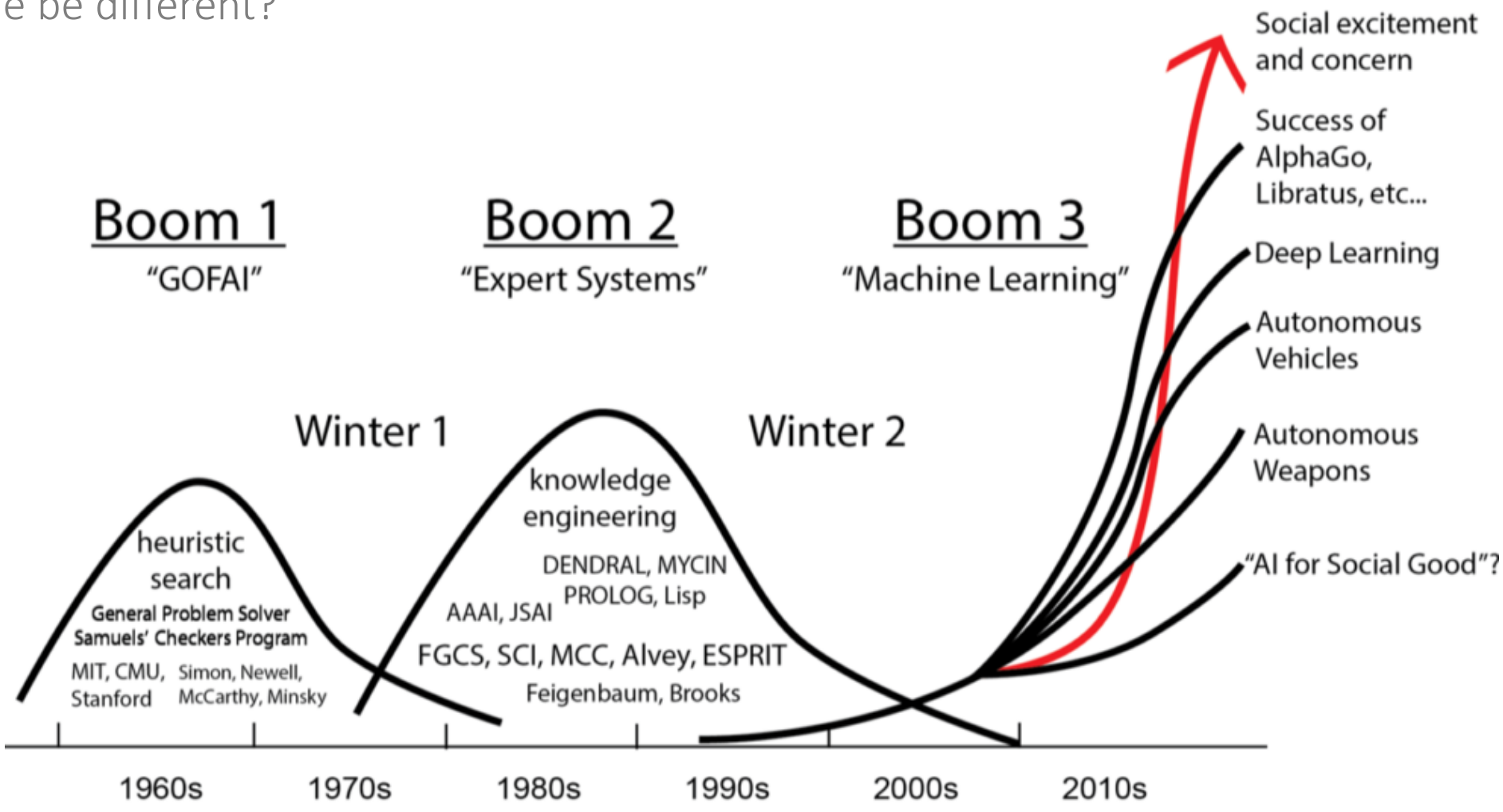
VADM MERZ (N9)

“With respect to the technology, we [the Navy] are ‘all in.’”

May 15, 2019

But, it's also true that we've seen this before.

Will this time be different?



https://www.technologystories.org/ai-evolution/

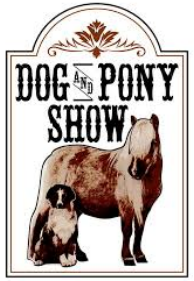
So, what drives the boom/bust cycle?

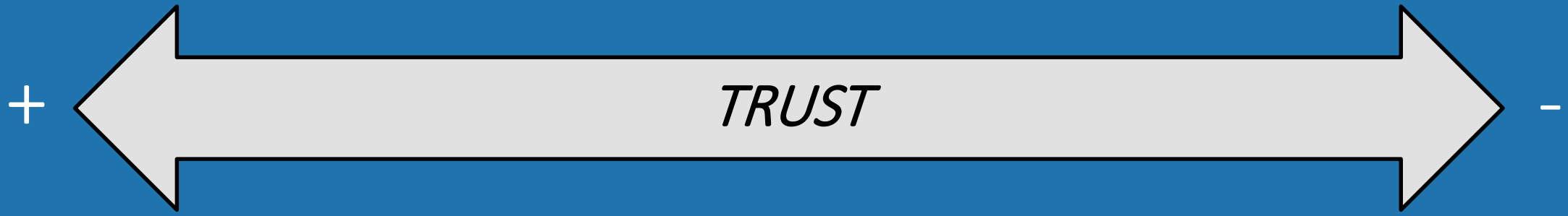
ALL IN: Inappropriate "Positive Trust"

- Assuming that "the government wouldn't let them sell it if it wasn't safe."
- Assuming that because a system is good at one thing, it is good at something else

IGNORE: Inappropriate "Negative Trust"

- "Machines can't do that."
- "Regulators will never allow that."
- "Never again."

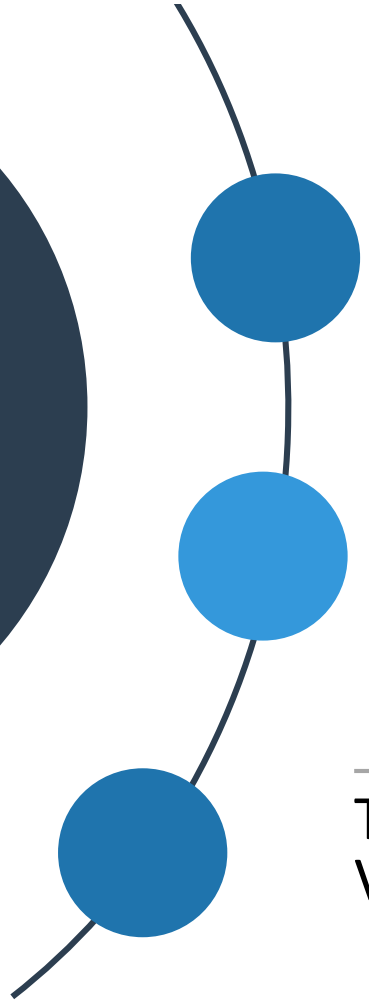




It’s the speed of trust.

What do we know? What don’t we know? And, what will it take to trust autonomous vessels?

So, How Do we REPLACE INAPPROPRIATE Trust WITH APPROPRIATE TRUST?



THE INSIDE VIEW — *How do autonomous vessels trust themselves?*

THE OUTSIDE VIEW — *How do autonomous vessels trust other vessels?*

THE HUMAN VIEW — *How do we learn to trust autonomous vessels?*

Before we go any further…

…let's set some expectations.

- Who is Gibbs & Cox?
- Why can't I sell you (or even talk about) specific autonomous vessel solutions today?
- When I say *What do we know?,* who do I mean by "we?"

Gibbs & Cox is the largest independent and privately-owned Naval Architecture and Marine Engineering Firm in the United States, and has been serving government, commercial, and recreational markets worldwide since 1929.

Let’s Level-Set

Incorporating Automation & Autonomy into the Architecture

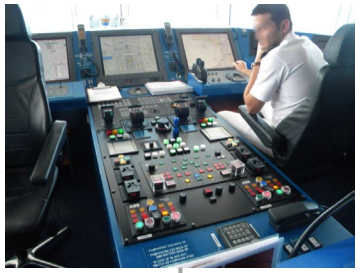
Architecture

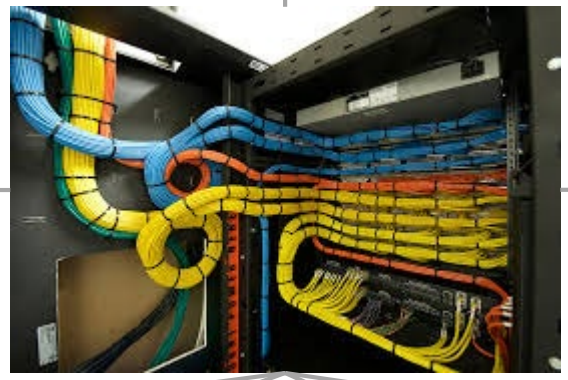
Operator Layer

Network Layer

Device Controller Layer

Device Layer





PLC PLC PLC PLC

Propulsion Steering Energy Storage Etc.

Let’s Level-Set

Incorporating Automation & Autonomy into the Architecture

Architecture
Operator Layer
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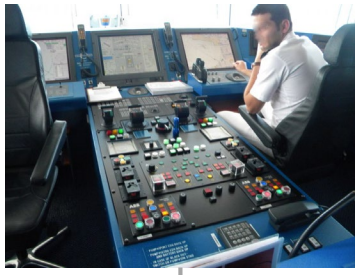
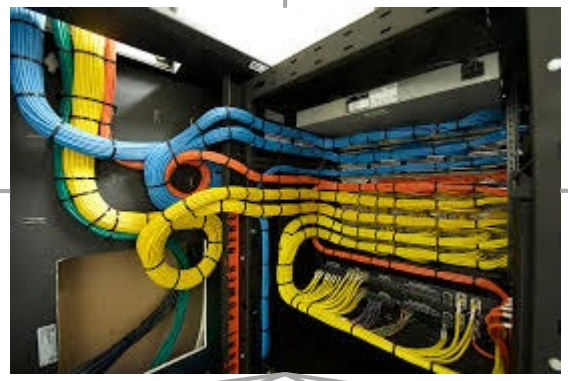




PLC | PLC | PLC | PLC

Propulsion | Steering | Energy Storage | Etc.

Crudely speaking…

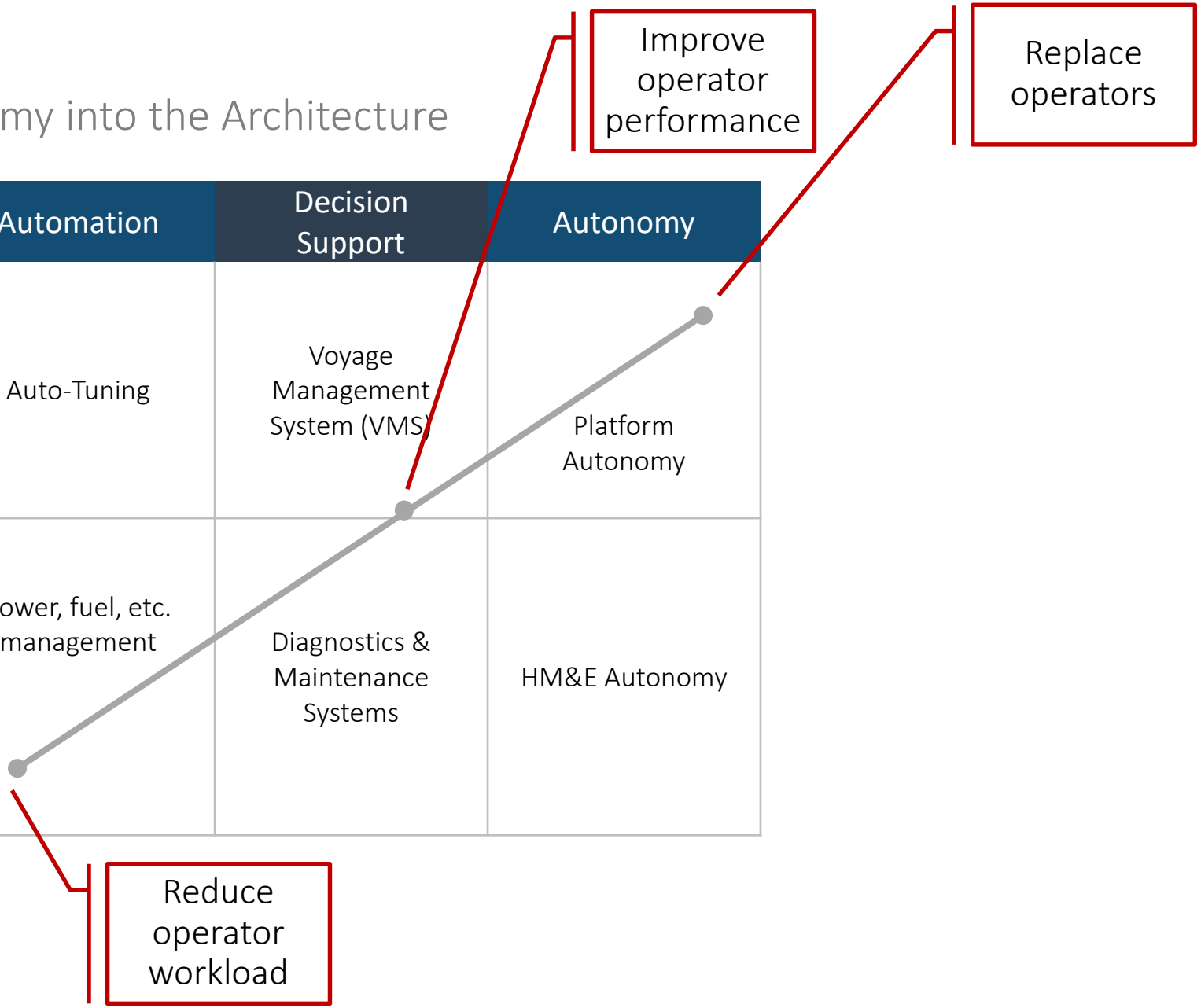
…we add AI **here** to get “autonomy”

…we add sensors, remote actuators, etc. **here** to get “automation”

Let’s Level-Set

Incorporating Automation & Autonomy into the Architecture

Architecture	Automation	Decision Support	Autonomy
Operator Layer	Auto-Tuning	Voyage Management System (VMS)	Platform Autonomy
Network Layer	Power, fuel, etc. management	Diagnostics & Maintenance Systems	HM&E Autonomy
Device Controller Layer			
Device Layer			

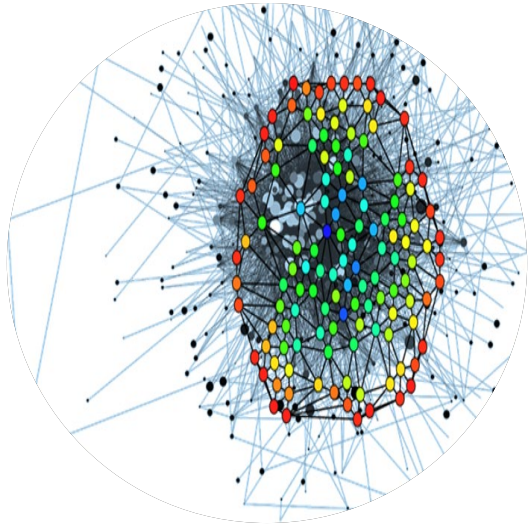


Inside View: How do autonomous vessels trust themselves?

Dealing with trust issues at the Platform Level

RELIABILITY PART 1

Sometimes it's cheaper to over-engineer than to automate.

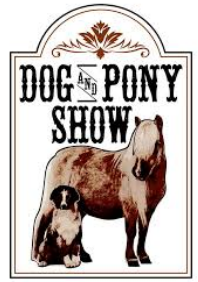


REALIABILITY PART 2

- Condition Based Maintenance (CBM) and other applications of Machine Learning (ML)
- Watchdog Systems (D.D.S.O.P.)

GIGO (Data Quality)

Deciding "what is" is a more challenging problem than deciding "what to do" about it.



Inside View: How do autonomous vessels trust themselves?

Dealing with trust issues at the Platform Level

CYBERSECURITY (c.f. IMO MSC-FAL.1/C

No Electronics	No threat
SOME Electronics	Threat to disable navigation aids
HIGHLY AUTOMATED	Threat to disable you.
AUTONOMOUS	Threat to commandeer you.

The Outside View: How autonomous vessels "trust" other vessels

Sharing the Water: Good Actors

- **Not surprisingly,** rules-based systems are actually very good when everyone is following the rules.

Sharing the Water: Bad Actors

- **Best Case**: They just don't follow the rules.
- **Worst Case**: They exploit behaviors to "herd" an autonomous vessel.
- Implies the need for connectivity / infrastructure to **escalate** to remote control stations
- Implies the need for **high-level autonomy** when connectivity isn't possible / jammed.
  - …to re-prioritize "the mission"
  - …to break the rules to save the rules (COLREGS Rule 2)

Sharing the Water: Interoperability Problems

- Autonomous vessels come with the promise of truly **optimized traffic flow**… if they can all work together
- **Standards** can help, but are not a perfect solution
- **Fortunately**, autonomous vessels could bring some new tools to the game (c.f. *Noblis "Pieces of Eight (Po8) Orchestrated Autonomy Concept"*)

The Human View: How do *we* learn to trust autonomous vessels?

Machines Do Some Things

Where we've been.

Machines Do MOST Things

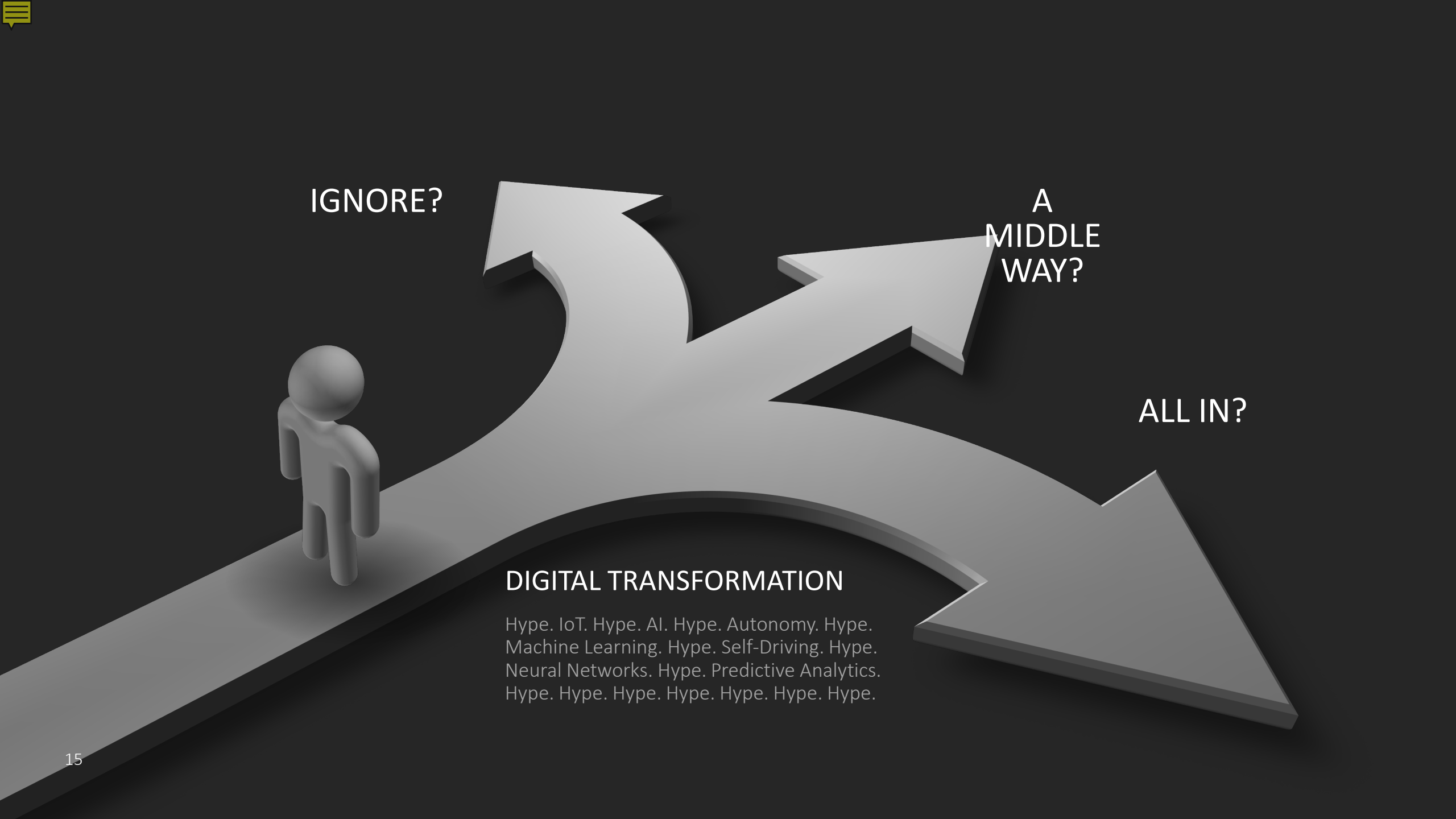
Where we were yesterday: HM& Automation, Auto-Pilot / VMS, etc.

OPERATORS & Machines Do Things TOGETHER

Where we are today (whether in the name of safety or efficiency / convenience): Predictive Maintenance, Weather Re-Routing, auto-docking, etc.

OPERATORS GIVE ORDERS, UNMANNED VESSELS DO THE WORK

…a destination that we will arrive at at the speed of trust.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DEVELOP / TAILOR A FRAMEWORK THAT IS HOLISTIC & Lifts the CURTAIN ON THE

GIBBS & COX
Maritime Solutions
Joshua.Wallick@gibbscox.com

CONSIDER THE VALUE OF AN INDEPENDENT SYSTEM INTEGRATOR

BUILD TRUST WITH INCREMENTAL ADOPTION