5 Things You Aren't Considering (But Should Be) For Your AMR Installation

Presented by:

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"Of the 3.5M new jobs created in manufacturing over the next decade, 2M will likely go unfilled."

- Deloitte

Meanwhile consumer expectations are rising

- Locally produced
- Personalized
- Low cost
- Same-day shipping
- Free shipping
- Free returns

And competition is fierce

$22bn in industry sales transferred from large to smaller companies in North America between 2011 and 2016.

34 of the world's 50 biggest consumer companies are suffering either from slower sales and profits growth, or both.

No surprise here...

The Autonomous Mobile Robot Market Is Taking Off Like A Rocket Ship

Steve Banker Contributor ⓘ

Transportation

I cover logistics and supply chain management.

1 robot ≠ 10 robots

10 robots ≠ 100 robots

100 robots ≠ 1000 robots

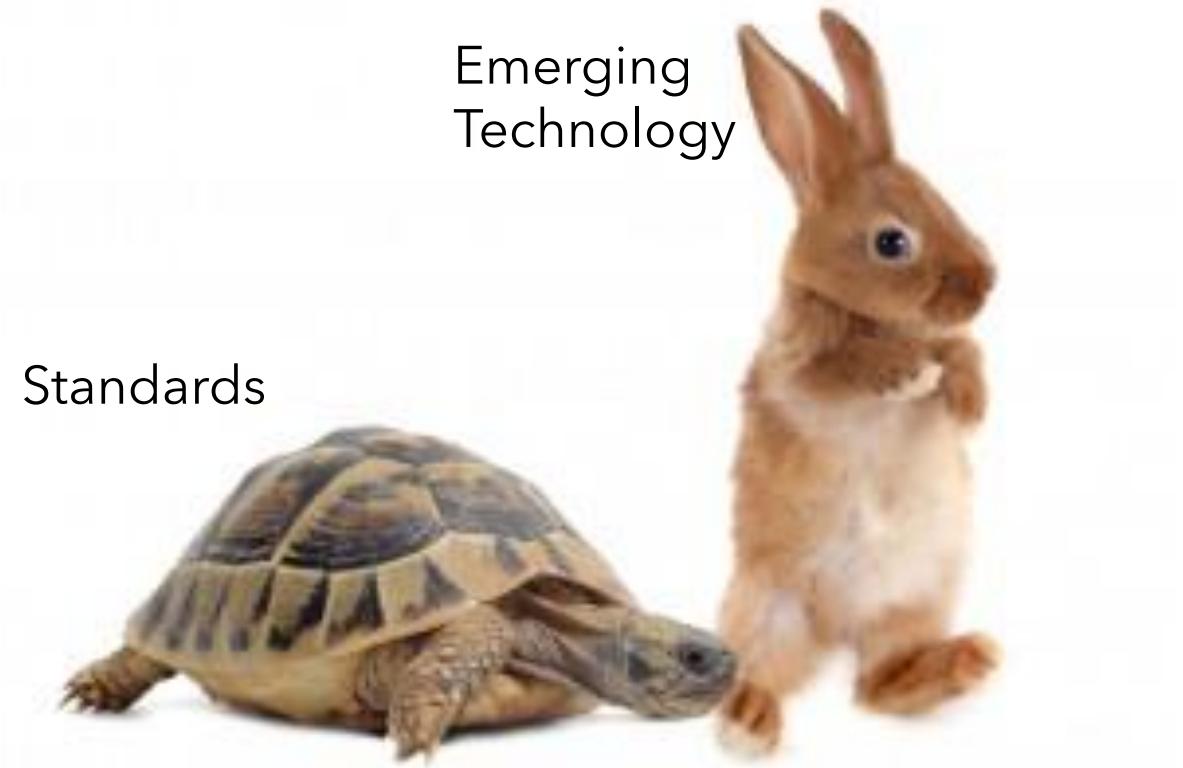
5 Things You Aren't Considering (But Should Be) For Your AMR Installation

1. Safety
2. Capacity
3. Security
4. Connectivity
5. Scalability

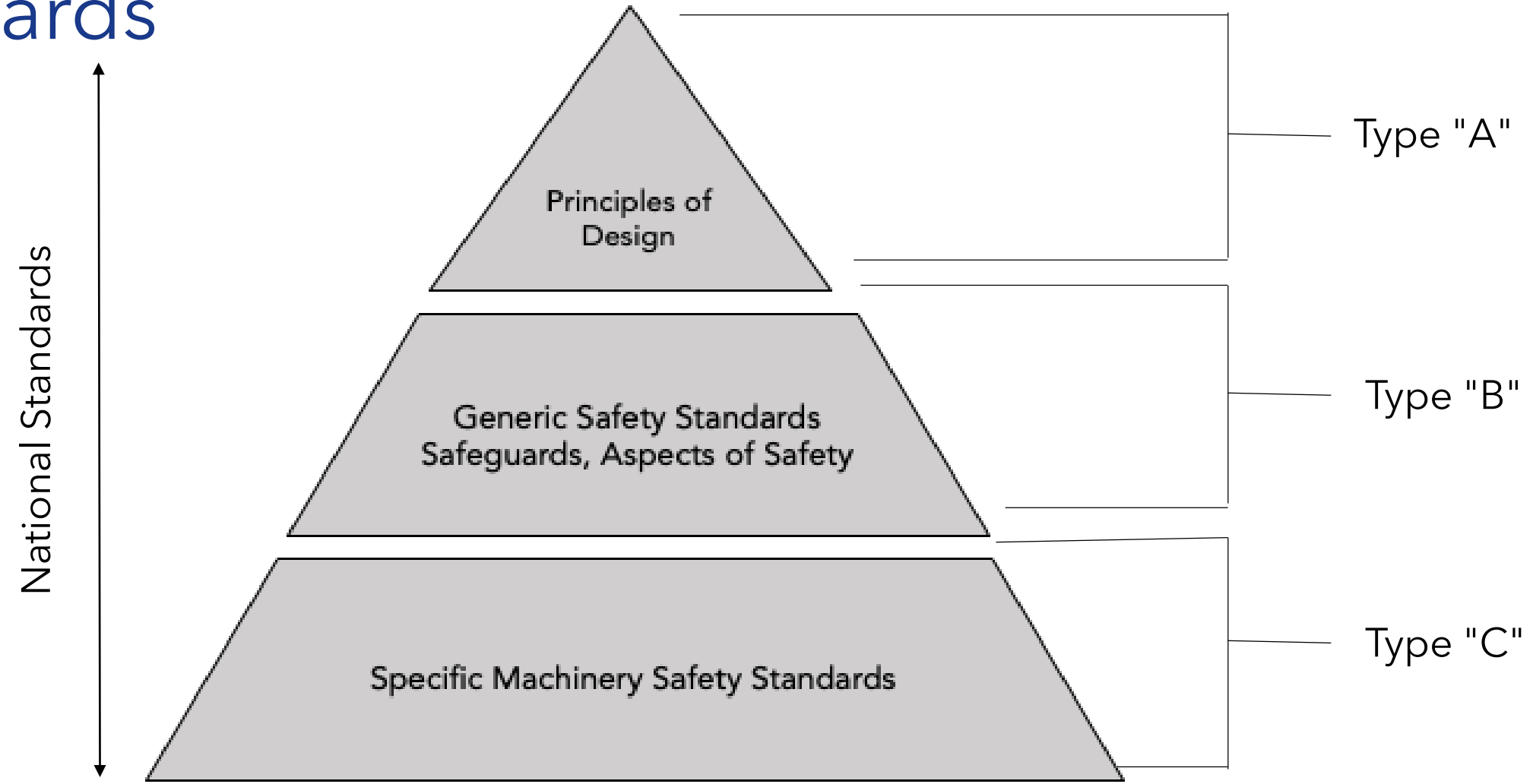
Many robots + Many sites
= New challenges:

1.Design for Safety

The Standard Fable



Standards



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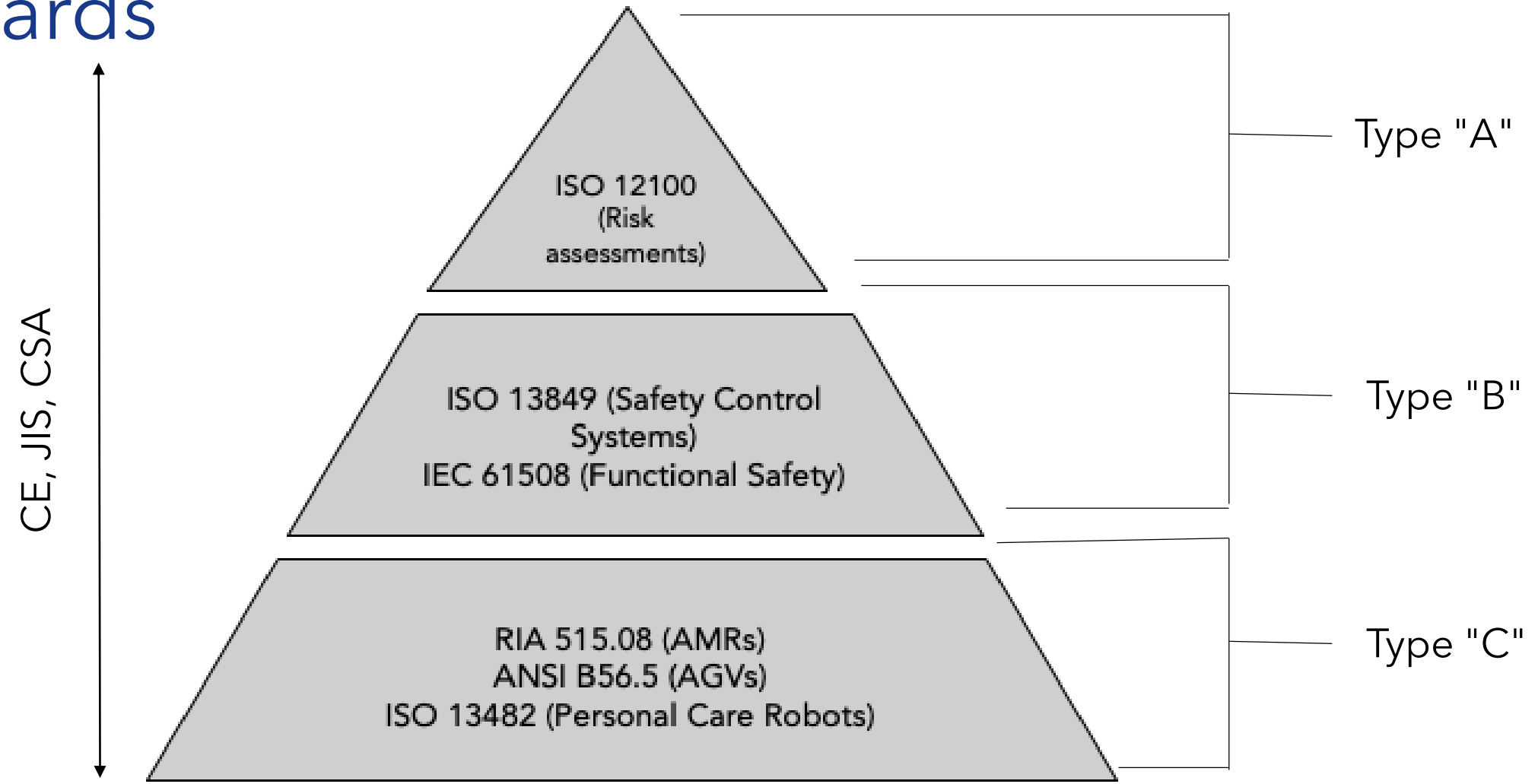
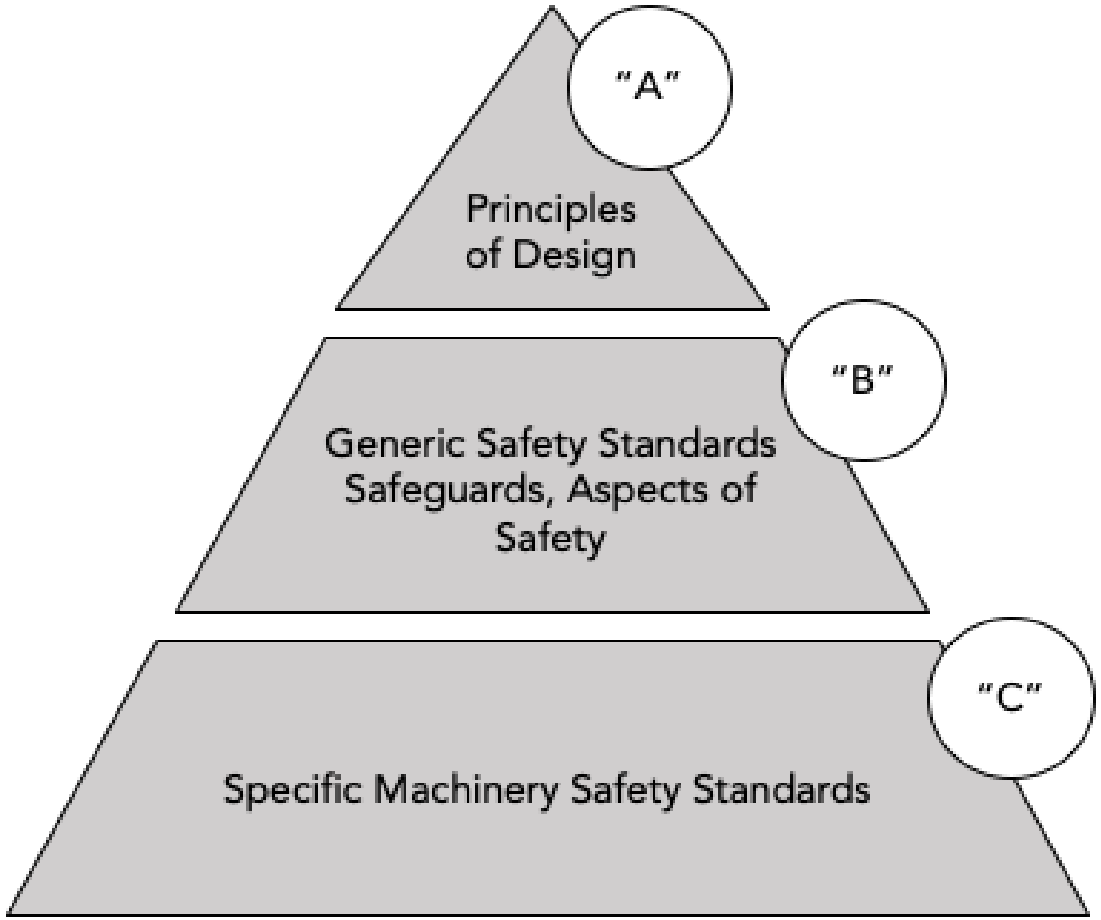


Design for Safety

Type C standards should have specific advice on:

- Moving object detection
- 3D object detection
- Vehicle dynamic testing and restrictions
- Proper use of machine learning

But they usually don't!



Recommendation

1. Ask your AMR provider for comprehensive safety review

2. Involve H&S early, test risk cases

3. 3D sensors: How are they used, how are they tested, what are their failure modes?

Many robots + Many sites
= New challenges:

1.Design for Capacity

The Nines

User: "I want 99% uptime"

Availability Level	Uptime	Downtime per Year	Downtime per Day
1 Nine	90%	36.5 days	2.4 hours
2 Nines	99%	3.65 days	14 minutes
3 Nines	99.9%	8.76 hours	86 seconds
4 Nines	99.99%	52.6 minutes	8.6 seconds
5 Nines	99.999%	5.25 minutes	0.86 seconds

Typical Situation

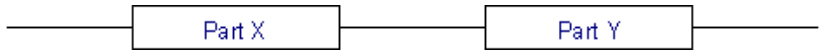
User: "I want 99% uptime"

10 robots x 16hrs/day = 160 robot hrs – target
1 robot down for 16 hrs = 144 robot hrs – actual

144 hr actual / 160 hr target = 90%

Availability vs Capacity

Availability in Series
Typical Process Automation Equipment

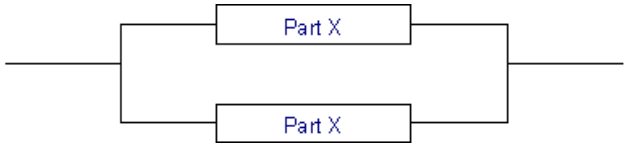


Failure of one part causes failure of system

$A = A_x A_y$

Component	Availability	Downtime
X	99% (2-nines)	3.65 days/year
Y	99.99% (4-nines)	52 minutes/year
X and Y Combined	**98.99%**	**3.69 days/year**

Availability in Series
Typical IT Server System



Failure of all parts causes failure of system

$A = 1-(1-A_x)^2$

Component	Availability	Downtime
One X component	99% (2-nines)	3.65 days/year
Two X components	99.99% (4-nines)	52 minutes/year
3 X components	**99.9999% (6-nines)**	**31 seconds/year!**

Availability vs Capacity

Partial Operational Availability
Typical AMR System

Hybrid System
A system with N components where the system is considered to be available when at least N-M components are available (i.e. no more than M components can fail). The availability of such a system is denoted by $A_{N,M}$

$$A_{N,M} = \sum_{i=0}^{M} \frac{N!}{i! \times (N-i)!} \times A^{(N-i)} \times (1-A)^{i}$$

Availability ≠ Capacity

Recommendation

1. Contract for Capacity where possible

2. Where not possible, spend time understanding the math

Many robots + Many sites
= New challenges:

1.Design for Security

Policy

Hackers eye the factory floor

Manufacturers are turning to internet-connected devices. That's bringing new risks

Network Topology

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Client Success

Technical Support

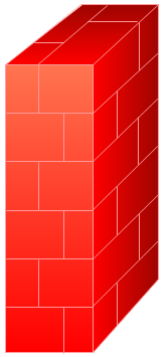
Systems Engineering

DB1

DB2

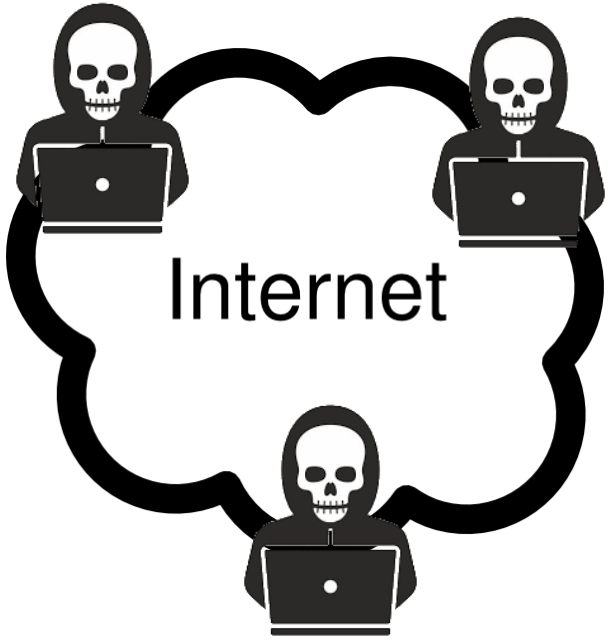
DB3

DB4



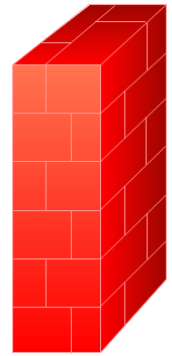
OTTO Firewall

The internet is a dangerous place!



Enterprise class security
cannot be achieved unilaterally

End User Site



End User Firewall

Fleet Manager

Robots

Network Topology

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All traffic and interactions across the internet in ALL systems protected by SSL.

End User Site

Client Success

Technical Support

Systems Engineering

DB1

DB2

DB3

DB4

OTTO Firewall

End User Firewall

Fleet Manager

Robots

Do NOT take shortcuts!
Cellular, Hotspots, Remote Desktop, etc....

Network Topology

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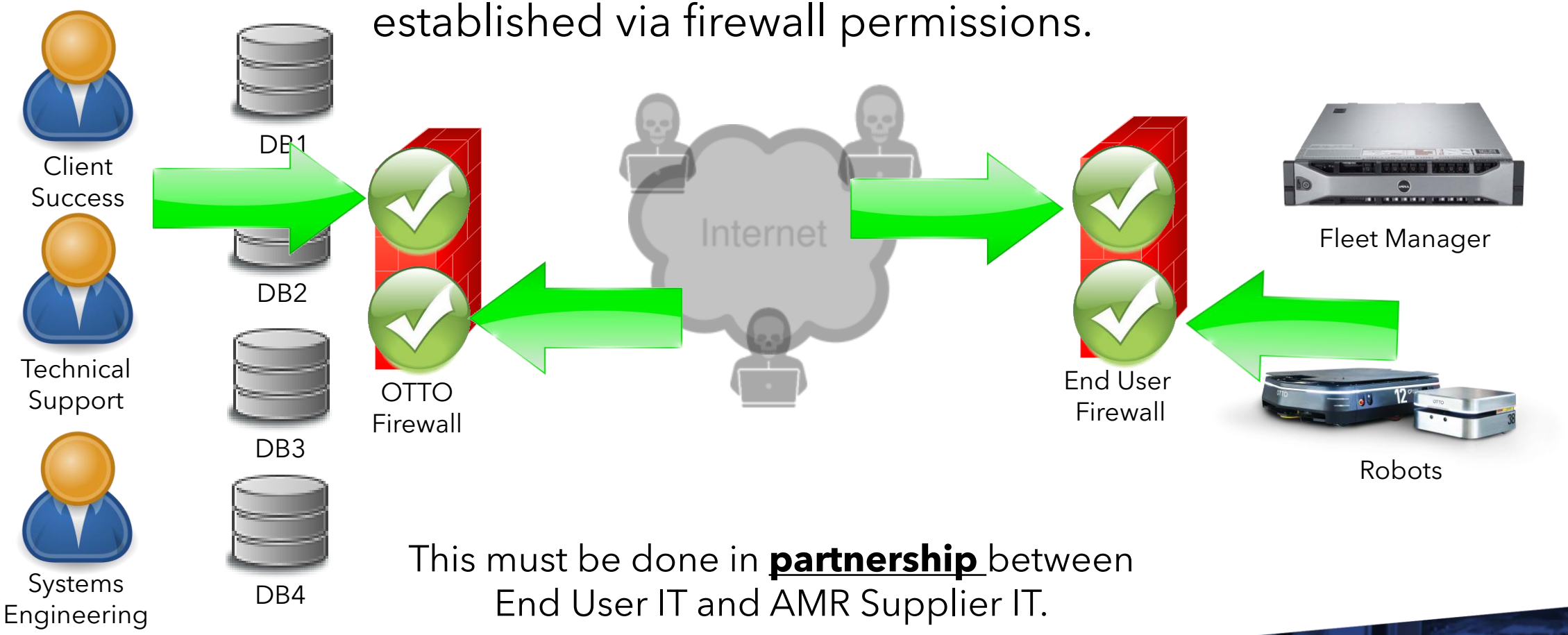
Secure communications must be established via firewall permissions.

End User Site



This must be done in **partnership** between End User IT and AMR Supplier IT.

Recommendations

1. Involve IT as early as possible, don't bypass

2. Ask your AMR provider for their InfoSec compliance policies

3. When in doubt get a 3rd party infosec audit or default to NIST frameworks/PCI DSS

Many robots + Many sites
= New challenges:

4. Design for Connectivity

The Smart Factory is Connected.
More and more machines are coming online.

AMR are Data Machines.
Wifi networks were not designed for AMRs.

More AMRs = More demand on your network.

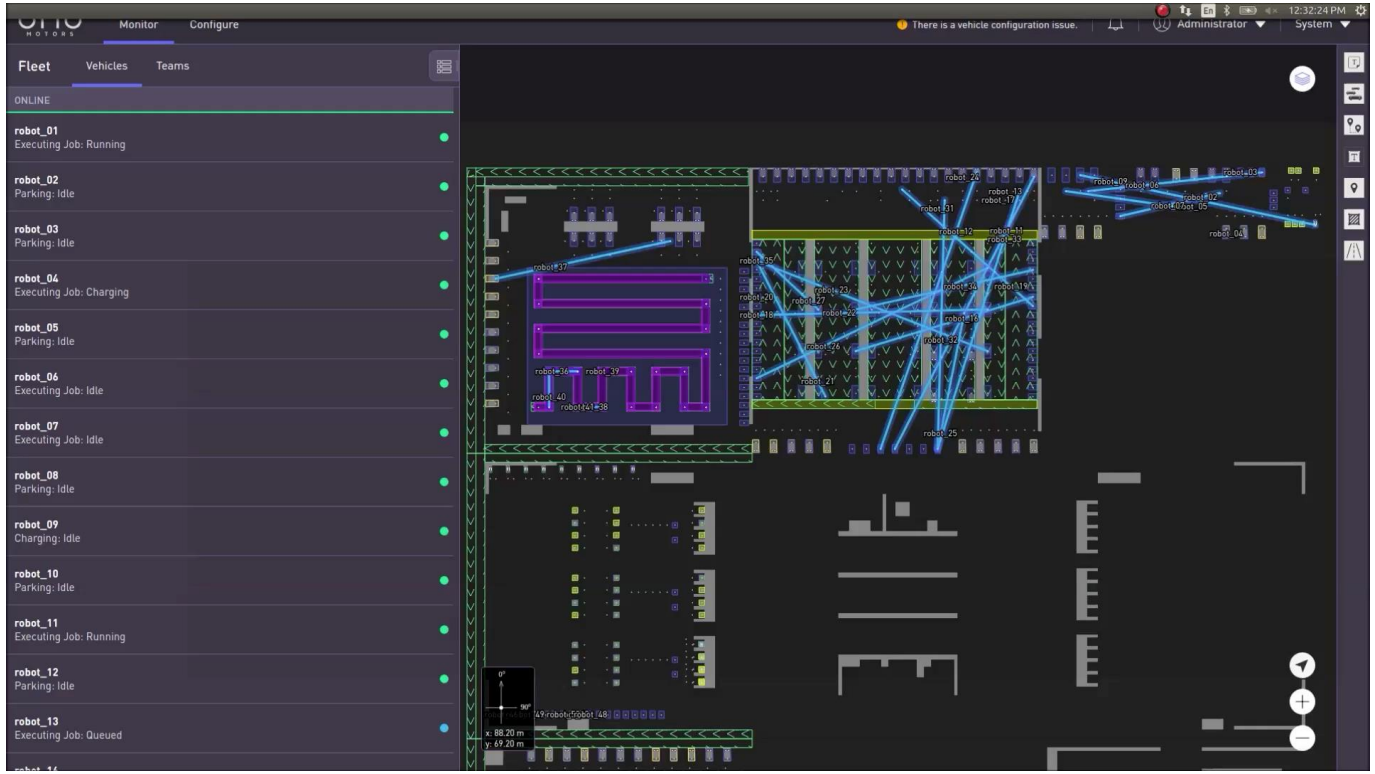
How many AMRs before your network breaks?
How many AMRs before their fleet manager breaks?

Virtual Test Pressure

10x+ more pressure on production software

Test pass criteria: 3000 missions per hour, 200,000 missions run in 72 hrs

Incorporation of user errors, network failures



Recommendation

1. Ask your AMR provider for detailed test reports.

2. Ask your AMR provider for information on their software QA/QC policies and strategies.

Many robots + Many sites
= New challenges:

5. Design for Scale

Full Facility Simulation

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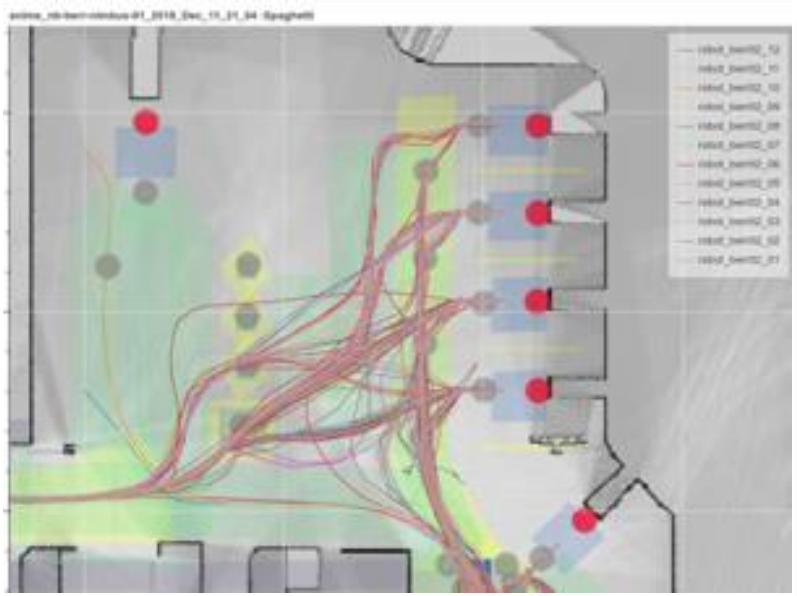
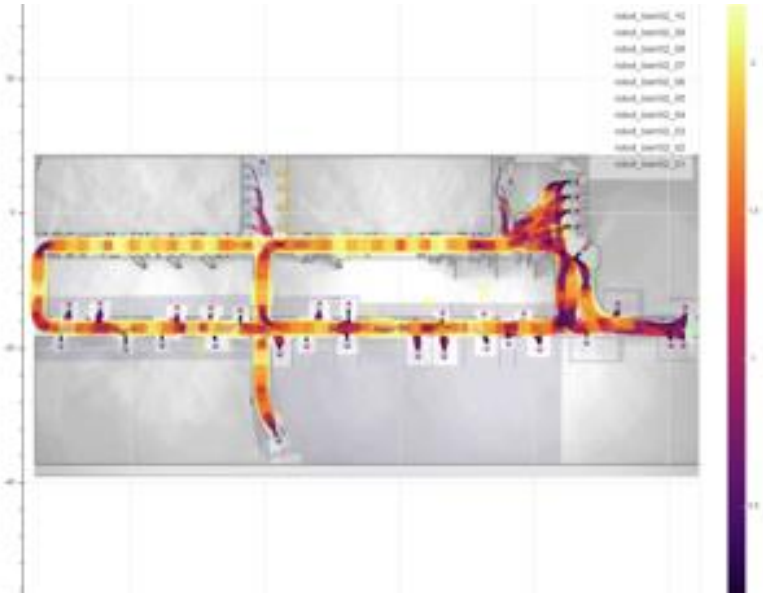
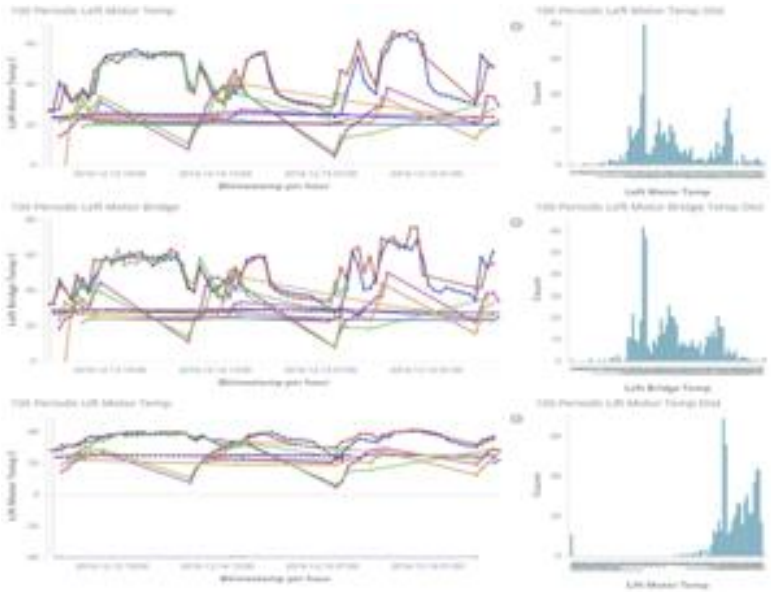
"What are the material flow patterns?"

"Where are the process bottlenecks?"

"What vehicles might need service?"







Spaghetti Maps

Speed Heatmaps

Vehicle Diagnostics

Questions for Scaling

1. Ask what services your AMR provider offers for design and simulation.

2. Ask what services your AMR provider offers for diagnostics, analysis and reporting.

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For more information:

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