



ARTILLERY INTELLIGENCE BRIEFING INDUSTRIAL AR: BENEFITS AND BARRIERS



AUGUST 2019



Table of Contents

EXECUTIVE SUMMARY	3
KEY TAKEAWAYS	4
INTRODUCTION: VISUALIZING ROI	5
PART I: BENEFITS	7
INDUSTRIAL AR FLAVORS	7
INDUSTRIAL AR BENEFITS	8 م
MACRO-BENEFITS	
DRILLING DOWN: INSTITUTIONAL KNOWLEDGE	
By the Numbers	
	12
	12
	13
INDUSTRIAL ENTERPRISE PERSONAS	14
THINK LIKE A MARKETER	
PRODUCT	
RIGHT TOOL FOR THE JOB	
TARGET THE RIGHT MARKETS	
SOLVE REAL PROBLEMS	
	۱۵ ۱۵
GRASS ROOTS	19 19
IT: THE GATEKEEPERS	
DEVICE CONTINUUM	20
PART III: CASE STUDIES	21
ATHEER	
Re'FLEKT	
SCOPE AR	
KEY TAKEAWAYS (REDUX)	29
ABOUT ARTILLERY INTELLIGENCE	30
METHODOLOGY	
DISCLOSURE AND ETHICS POLICY	32
CONTACT	32
REFERENCES	



Executive Summary

One of augmented reality's (AR) proposed beneficiaries is the enterprise. That can take many forms including data visualization in corporate settings, or software to create customer-facing AR experiences for brands. Impact will also occur through AR visualization in industrial settings.

The latter includes things like assembly and maintenance in manufacturing facilities. The idea is that AR's line-of-sight visualization can guide front-line workers. Compared to the "mental mapping" they otherwise do with 2D instructions, line-of-sight support makes them more productive.

This plays out in a few ways including speed, effectiveness, error reduction and safety. These micro efficiencies can add up to worthwhile bottom-line impact in large-scale operations. Macro benefits meanwhile include lower strain and turnover, leading to higher morale and institutional knowledge.

These benefits were examined in ARtillery Intelligence's February 2018 report, *Enterprise XR: Impacting the Bottom Line*.ⁱ But since that analysis, we've tracked several growing challenges to AR's viability and implementation in industrial operations. The picture may not be as rosy as we all thought.

For example, though all of the advantages outlined above are valid, it's challenging to get to the point of realizing them. Practical and logistical barriers stand in the way such as organizational inertia, politics, change management and fear of new technology among key stakeholders.

The biggest symptom of these stumbling blocks is the dreaded "pilot purgatory." As its name suggests, and as you may have heard in AR industry narratives, this is when AR is adopted at the pilot stage, but never progresses to full deployment. It's the biggest pain point in industrial AR today.

In a recent analysis with Re'Flekt,ⁱⁱ ARtillery Intelligence identified the sources and solution areas for these challenges: the "Three P's." Comprising *People*, *Product* & *Process*, they're the top areas where effective AR implementation strategies should focus in order to avoid pilot purgatory.

For *product*, it's all about addressing real operational pain points, uncovered through ground-level research. For *people*, it's about customizing AR's ROI story to individuals at all levels of the organization. For *process*, it's about multi-disciplinary prototyping rather than top-down innovation.

We'll go deeper on all of these in the coming pages, including demonstrable case studies. We'll examine industrial AR's benefits and barriers. This entails everything from product planning to internal communications refinement. The name of the game is to set up industrial AR to succeed.





Key Takeaways

AR's benefits are being demonstrated throughout enterprises, especially industrial enterprises.

- AR line-of-sight visualization breeds operational efficiency in areas like assembly and maintenance.
- Primary formats are remote AR assistance and automated pre-authored sequences.
- Recorded AR sessions are evolving to better capture and distribute institutional knowledge.

Advantages and ROI gains result from micro and macro factors.

- Micro-benefits include unit economics in production output (e.g., speed, accuracy and safety).
- Example: tasks can be completed up to 99% faster (examples cited throughout this report).
- Macro-benefits include profitability gains, job strain reduction and institutional knowledge retention.
- Example: Less strain delays retirement, while recorded sequences distribute knowledge optimally.

But it's not all good news: several organizational hurdles stand in the way of the above benefits.

- e "Pilot purgatory" has emerged as industrial AR's biggest pain point, diminishing real deployment.
- ➡ Failure to reach deployment squanders opportunity and investment in AR implementation.
- Causes are mostly organizational and cultural, such as natural resistance to change.

→ Pitfalls originate within three main areas we've identified as the "3Ps": people, product & process.

- These are where enterprise AR stumbling blocks happen and where solutions should focus.
- Pilot purgatory's tactical avoidance maps to these areas, each of which are detailed in this report.

With *people*, industrial AR's value proposition should be customized to individual stakeholders

- Organizations are made up of people, who adopt products and processes based on selfish needs.
- R's benefits to front-line workers shouldn't be communicated based on things like unit-economics.
- Marketing best practices should be used to target messaging internally, using consistent language.
- ➡ Tactics such as "objection handling" should be customized and standardized for AR stakeholders.

With product, the principles of product/market fit should be followed... just like consumer products.

- e Features should address real pain points such as reducing friction or worker strain.
- AR adaptiveness across verticals varies and maps to specific factors (e.g. spending power).
- B UX is critical in terms of pinpointing the right balance of features, functionality, and complexity.
- Example: Industrial front-line workers require simple and singular-purpose interfaces.

Example: For *process*, AR product planning, deployment and communications require tactical precision.

- Product design is often top-down but should be bottom-up, including department-level input.
- Front-line worker input breeds comfort and ownership in the technology, and better product fit.
- A common mistake is to sidestep the IT department until late in the process. Involve them early.
- Successful AR deployments hinge more on *marketing* and *communications* than technology.

The importance of following all these tactics is to set AR investments up to succeed.

- AR investments can be protected rather than lost, if deployed with the 3Ps in mind.
- The points of failure are often within enterprises themselves (as opposed to AR vendors/providers).
- e AR success therefore results from tactical execution at those common failure points.



Introduction: Visualizing ROI

In February 2018, we wrote a report that was part of the monthly flow of ARtillery Intelligence briefings. Entitled *Enterprise AR: Impacting the Bottom Line*, it defined how AR is being deployed in industrial enterprises like Coca Cola; and the operational efficiencies they accomplish.

Part of that report was also to examine some of the biggest challenges these companies face in implementing AR, including cultural and budgetary factors. We now revisit this analysis with 18 months of market analysis to draw upon. Many things have changed and some remain the same.

The high-level assessment is that all of industrial AR's theoretical benefits still apply, and many are being demonstrated through real deployment (explored in this report). But some of the challenges we identified are even more pronounced today, while new organizational challenges loom.

The biggest phenomenon that's accelerated over the past 18 months is "pilot purgatory." As its name suggests, and as you may have heard in AR industry narratives, this is when AR is adopted at the pilot stage, but never progresses to full deployment. It's the biggest pain point in industrial AR today.



Source: Microsoft



As such, we've devoted much of this report to the dynamics of pilot purgatory. What causes it? And more importantly, how can industrial enterprises avoid it? We've identified three areas where both causes and solutions lie. Known as the "Three P's," they include *people*, *product* and *process*.

For *people*, it's about customizing AR's ROI story to individuals at all levels of the organization. For *product*, it's all about addressing real operational pain points, uncovered through ground-level research. For *process*, it's about multi-disciplinary prototyping rather than top-down innovation.

But the most important of the three is likely *people* (the reason it comes first). Because organizations are comprised of people, the points of adoption (and resistance) lie with people. And it's with people that AR's value proposition should be customized and optimized for maximum results.

"Because organizations are people, new technology shouldn't be sold as solving business problems but people problems," said Wolfgang Stletzle, CEO of Re'Flekt. By working with Re'Flekt on a recent project, ARtillery Intelligence has uncovered new insights, which are reflected in this report.

We'll dive into these dynamics along with the other two P's. How do they present challenges, and what are tactics to overcome them? We'll focus mostly on AR's role in industrial settings. This is where its benefits are most pronounced... and where its challenges are most evident.



Source: Lenovo



Part I: Benefits

Since our last report on enterprise AR, many of the benefits we examined (e.g. operational efficiencies) have been validated through real industrial deployments, as explored in case studies later in this report. Adoption challenges (e.g. organizational inertia) have likewise been validated.

But before diving into deeper strategic analysis of all these moving parts, let's level set on some of the fundamentals of AR in industrial settings. What are the formats being deployed today? What are the benefits they're demonstrating? And what's the projected market size for industrial AR?

Industrial AR Flavors

Industrial AR takes several forms. The holy grail – and eventually prevalent format – is headworn AR, where visualization software is installed on AR glasses such as Microsoft's HoloLens. Nearer term deployments also include smartphone or tablet-based AR, for reasons examined later in this report.

Beyond AR's vessels, there are also varied functions. For example remote assistance (a.k.a. "see what I see") lets subject matter experts remotely view (via camera) and guide front line workers. The latter can occur through voice instructions and/or spatially-accurate line-of-site annotations.



Source: Microsoft



Conversely, pre-authored AR involves programmed animation sequences that overlay machine parts with line-of-sight instructions for maintenance or assembly. These sequences are usually activated through user inputs and visual markers – the latter also helps to spatially anchor the animations.

Lastly, somewhere in between these two methods is the growing practice of recording AR sessions. This helps to capture best practices, train new users or inform future scenarios. It can also help retain institutional knowledge at a time when job turnover is high and baby boomers retire at a rapid pace.

Industrial AR Benefits

Advantages for these and other AR formats are varied, meaning broad applicability to functions such as maintenance and assembly. Advantages map to micro-benefits such as unit economics of production; as well as macro-benefits, such as organizational evolution. Here are a few examples.



Time to Task Completion: Line-of-sight overlays can speed up productivity up to 90 percent by replacing the process of "mental mapping" (cognitive translation of 2D instructions to 3D space).

Machine Uptime: When machines break, vendors fly experts to a job site. That creates machine downtime which has a large opportunity cost. Remote assistance eliminates the need for travel.

Error Reduction: Just as line-of-site AR instructions speed up productivity, they can lessen costly mistakes. By reducing human error from mental mapping, AR can have real bottom-line impact.

Macro-Benefits

Morale: AR's liberation from mental mapping can reduce strain, which leads to more comfortable work. Reducing errors can also improve workplace safety, performance and self-esteem.

Longevity: The most experienced workers often do the most strenuous work (think: field maintenance). Remote assistance positions them as remote experts, thus increasing their longevity.

Institutional Knowledge: By increasing longevity, organizations collectively retain knowledge. Recorded AR sessions can meanwhile capture that knowledge to train new workers.



Drilling Down: Institutional Knowledge

To go a bit deeper on just one of the above benefits as a representative example, how can AR help companies boost and retain institutional knowledge? It can accomplish this on a few levels including delaying retirement for valued experts, as well as knowledge transfer to more novice workers.

As mentioned above, the timing for this is ripe as macro factors create greater levels of turnover and institutional knowledge loss than ever before. Combine these factors and you get a growing challenge to retain knowledge or transfer it to younger workers who cycle in. It becomes an expensive problem.

"Joe, who's worked here for 40-some years is going to retire and he's going to take that forty-some years of domain expertise out the door with him," said PTC's Jim Heppelmann at the AWE show. "We're going to hire somebody new to do what Joe did, but it'll take them years to be as good."

AR can combat this challenge in a few ways. First, it can turn seasoned employees into remote AR experts that guide novice field workers as mentioned above. Compared to their previous field work, a cushier job can delay their retirement. And it accelerates knowledge transfer to all those novice folks.



Source: Microsoft



"They leave the workforce but they've literally got 35 years of knowledge," said Scope AR CEO Scott Montgomerie at AWE. "We can move them into a cushy call center position where they can advise younger workers that are more willing to go crawl around on their hands and knees."

Meanwhile, as introduced above, recorded sessions can aid this process of institutional knowledge transfer. By strapping an AR headset to top-performing workers (or doing so during the above remote-assist sessions), sequences can be recorded to capture and reinforce best practices.

"While we're working together between front-line technicians and people with decades of knowledge, we're doing a knowledge transfer and we can record that," said Montgomerie at the same AWE show. "So now we can reuse that for training purposes or for continuous process improvements."

AR also enables microlearning. The idea is that instead of the traditional method of educating someone for months or years on a given topic or skill (most of which they won't use), deliver the right knowledge at the exact moment they need it. It's a more efficient form of learning.

"One of the things that's happening with AR is that we can rethink the training model from 'inadvance' and 'just-in-case' to 'in-the-moment' and 'just-in-time,' said Heppelmann.

By the Numbers

What's the revenue opportunity to provide the above AR tools? ARtillery Intelligence's latest AR industry revenue forecast projects industrial AR revenues to reach \$3.7 billion by 2023. That includes revenue from AR hardware (smart glasses) and software to accomplish the functions outlined above.

Revenue is led today by AR software for mobile devices, as it involves trusted hardware and smaller investment levels. That's followed by AR glasses, which represent enterprise AR's hardware base. Glasses-based software will pull ahead in outer-year spending, as it builds on that installed base.

As for vertical segmentation, the largest source of spending is government and military. That's mostly due to the U.S. Army's \$480 million contract with Microsoft to buy and deploy 100,000 HoloLens units over the next five years. This amount is amortized over the full contract period in our market sizing.

Other highly adoptive industrial verticals include oil, gas & utilities, automotive and aviation & aerospace. These verticals have a unique mix of criteria that increase AR adaptiveness, which we'll expand later in this report when examining the importance of lining up AR's product/market fit.

Meanwhile, another key distinction in these figures is the degree to which they've been dialed back from previous ARtillery Intelligence projections (and other firms' projections). This is due to the market's slower than expected adoption and several other demand signals we track.

Just like enterprise smartphone adoption over the past decade, AR adoption will build up to a tipping point which is followed by accelerated adoption. We're confident that tipping point will come. But it will be later than previously estimated due to the adoption inertia that's become evident in today's market.



Enterprise AR Revenue



Enterprise AR Hardware

2019 Enterprise AR Hardware Spend, by Vertical

U.S. \$Millions

ARtillery

Government/Millitary spending includes Microsoft's \$480 million contract to supply up to 100,000 Hololens 2 units to the U.S. Army over the next five years. This spending total is amortized over the full contract period.



- Retail & Commerce
- Real Estate
- Education
- Finance
- Other Corporate/Commercial
- Healthcare
- Other Industrial
- Telecom
- Transportation
- ■AEC
- Aviation & Aerospace
- Automotive
- Oil, Gas & Utilities
- Government/Military

© ARtillery Intelligence, 2019



Part II: Barriers

Industrial AR is experiencing a slow climb, as characterized in the above figures. This mostly results from slower than expected adoption which in turn results from organizational inertia. Though industrial AR's ROI story is clear, prevailing organizational resistance can often overcome it.

"When you have a new technology, the antibodies come out to stop it," said former Lockheed Martin CIO David Smith at an ARiA event. "That's true for your body... except when it's not a disease but something that takes similar resources: a baby. So the trick is to explain it's not cancer, it's a baby."

Adoption challenges are multi-dimensional but share this common trait of organizational resistance. That can happen on a system-wide basis or through inter-departmental friction as C-level change agents champion AR while ground-level stakeholders (or sometimes the IT department) resist.



Source: Microsoft



The Three P's

This all leads to industrial AR's biggest stumbling block: "pilot purgatory." As its name suggests, this is when AR is adopted at the pilot stage, but never progresses to full deployment. It happens when AR fails to gain traction due to suboptimal planning, communication and implementation.

Fortunately, these challenges can be studied in a structured way as they map to three key organizational areas. These are what ARtillery Intelligence has started to call the Three P's: *People Products* and *Processes*. They're both the root of AR's problems and the source of its solutions.

Let's examine them one by one, including the challenges they raise and ways to overcome them.

People

When devising ways to get past organizational hurdles, it's important to customize value propositions to specific needs. And with that thinking, it's important to remember that organizations are made up of people. Their technology adoption likewise happens through people -- albeit several people.



Source: Upskill



"Because organizations are people, new technology shouldn't be sold as solving business problems but people problems," said Re'Flekt CEO Wolfgang Stelzle. "The often-ignored reality is that people within organizations adopt technologies that benefit them individually, rather than the company."

For example, metrics about AR's operational efficiencies are not only misaligned with front-line worker's goals but can be counterproductive. If a new tool can to do a job 2x faster, does that mean a worker has a 50 percent chance of keeping his or her job? This is the message they can infer.

The takeaway is that messaging should be addressed to individuals in order to boost AR adoption. But before diving into those messaging strategies, who are the organizational personas that AR often touches? Identifying them and their AR adaptiveness is the first step. Let's take a look at a few.



Executives and Business Leaders

AR Adoptiveness: High

Business leaders always look for operational efficiencies and bottom-line impact so AR's ROI metrics naturally resonate.

Innovation Managers

AR Adoptiveness: High

Stakeholders within enterprise innovation hubs are tasked with bringing in new technology to improve operations, so AR likewise resonates with them.

Business Unit Managers

AR Adoptiveness: Neutral

Business unit managers oversee front-line workers. They are open to AR if it improves their departmental productivity and output.

IT Department

AR Adoptiveness: Low

IT professionals are risk-averse, as their job mandates. They don't want to be responsible for data breaches and aren't motivated to bring in new technology.

Front-Line Workers

AR Adoptiveness: Lou

Front-line workers are AR's end-users and biggest resistors, stemming from fear of technology, job security and other factors explored further below.





Source: Re'flekt, ARtillery Intelligence

Think Like a Marketer

With the above personas in mind, targeted communication and education are key factors in enterprise AR success. And that communication is more about marketing than technology. Communication and education to proposed AR end-users should therefore follow the best-practices of marketing.

"Act like a marketer," said Atheer's Amar Dhaliwal at AWE Europe. "Porsche brands everything as 'Tech Live Look.' So everything they do, every press release, every analysts briefing, they talk about the program. Internally, the posters and packaging... when glasses go out... everything is branded."

To illustrate this principle further, earlier we examined the benefits AR can bring organizations in the form of reducing the loss of institutional knowledge. This resonates with executives, but the benefit can be flipped or spun in a different way to underscore its impact on front-line workers personally.

For example, in physically draining fields like energy and construction, the most experienced workers often do the hardest jobs, such as climbing poles and fixing turbines. The viability of that work decreases with age, but AR creates comfort and flexibility by empowering them as remote experts.

Like in marketing, companies should standardize such messaging. Taking lessons from other areas of marketing and sales, the practice of "objection handling" can help win over workers. This practice, along with demonstrative examples, are provided in the Re'Flekt case study later in this report.



Product

Beyond the people that represent barriers to AR success, there's also the product itself. Its success hinges on a few main factors that should be considered when in development and strategic planning. They include product/market fit as well as a deliberate and targeted user experience.

Right Tool For the Job

Enterprise technology adoption is a microcosm of open market dynamics. So just as "product/market fit" is a key success factor in consumer technology products, it can make or break successful enterprise deployments. And the name of the game is deploying AR where it can have real impact.

This thinking is grounded in the fact that AR is not a "silver bullet" and it excels in some areas more than others. For example, AR's visualization advantages can be most effective in jobs that require guidance for complex and non-repetitive tasks such as large-equipment maintenance.

Conversely, it's less effective in jobs that involve repetitive simple task such as assembly line work. With this type of work, front-line workers are already well-equipped by "muscle memory." Therefore AR products deployed in these settings will fail to add any value or gain traction.



Source: Clayco



"You don't want to use AR to help somebody change the oil in your car," said Atheer's Amer Diawali at AWE. "You train somebody to change the oil, because that is a task that they're going to be doing repeatedly. "They should be able to do it without having to read any instructions."

Target the Right Markets

Beyond targeting the right job functions for AR, it's likewise important to target the right companies and industry verticals. ARtillery Intelligence's recent AR revenue forecastⁱⁱⁱ mapped industry-specific AR adaptiveness based on factors such as spending power and product fit (see slide below).

By targeting markets that score high on these criteria, adoption likelihood is greater. For example, education has a high product fit but low spending power. Medicine has high product fit but low regulatory autonomy. Military has high spending power, regulatory freedom and product fit.

AR Adoption Factors, by Vertical Government/Military Education Automotive Oil, Gas & **Healthcare** Utilities <u>leed/Urgency/Fit</u> **Aviation &** AEC Aerospace **Retail &** Commerce **Transportation** Finance Telecom **Real Estate** Spending Power and Regulatory Freedom -ARtillery © ARtillery Intelligence, 2019

Solve Real Problems

If we look at the most successful tech products in consumer markets over the past decade, they often take a basic human need or utility and remove friction. This is the case with tools such as Uber (easier transportation), Twitter (easier communications) and Slack (easier workplace collaboration).



Translated to enterprise AR, the most success will result from reducing workplace friction. Therefore, product design should focus on directly addressing real operational pain points, rather than being a "solution in search of a problem." That can include things like reducing strain or improving safety.

For example, one of AR's biggest benefits is to reduce the "cognitive load" of mentally translating 2D instructions into 3D space. Not only can AR reduce errors in such scenarios (company benefits) but it can reduce strain and make work more comfortable (employee benefits), as explored earlier.

UX is Key

There are often sliding scales of simplicity versus complexity in user interfaces for any product. Not customizing the right "sweet spot" for the application and its intended users will cause any enterprise AR product to fail. For example, industrial front-line workers often have a need for simplicity.

"Industrial workers -- the people who are the principle users of AR -- have very low tolerance for complexity." said Dhaliwal at AWE Europe. "Complexity is your enemy when rolling out to the industrial worker. That's a fact and it's important in terms of how we design solutions as an industry."

Speaking of simplicity, successful AR deployments can happen in stages. And given front-line workers' tech fears or lack of comfort, slow acclimation can be more prudent. This lesson can apply to the user interface or, more broadly speaking, the type of AR that is chosen and deployed.

For example, among the AR formats outlined earlier, "remote assistance" is less tech-involved because it still incorporates a live human guide. This can sometimes acclimate front-line workers before graduating to more technology-centric forms of AR such as pre-authored instructions.



Source: PTC



Process

Flowing directly from product success factors are procedural ones. Like the previous section we'll highlight the biggest factors that can impact AR adoption. They include the process of product planning & prototyping, as well as the timing and level of involvement of the IT department.

Grass Roots

In order to achieve the above "product/market fit," true department-level pain points must be understood. That doesn't happen when AR champions or solutions developers within an organization fail to get the direct input and perspectives of front-line workers and business unit managers.

Innovation and product planning instead often happen in a top-down manner from innovation leaders that work with AR vendors. But without the direct involvement of departmental entities, they're "flying blind," in their quest to solve real problems. The result is a mismatch in product fit.

Conversely, bottom-up product planning breeds success by involving front-line workers. That not only pinpoints the right product features that will solve real operational issues, but it gives front-line workers a sense of ownership and investment in the technology. This can vastly boost their interest.

"They've cooked their cake, now they can enjoy it too," said Re'Flekt CEO Wolfgang Stelzle in a recent report that ARtillery Intelligence co-wrote with Re'Flekt based on industrial AR research.^{iv}



Source: Microsoft



IT: The Gatekeepers

Many AR champions within organizations make the mistake of sidestepping IT involvement. They figure that it's more prudent to first prove the technology's value, then worry about IT. But IT managers are influential gatekeepers and will often resist technology if they are brought in too late.

Involving IT sooner conversely makes them less likely to be surprised or offended by late-stage awareness. Sooner involvement also breeds greater understanding and appreciation for the technology, thus inclination to support it. They are an inevitable force so should be lobbied early.

Device Continuum

Another tactic to lessen resistance is to start with proven hardware when possible. If the use case aligns, consider deploying AR through smartphones and tablets before headsets. There can be less resistance from risk-averse IT and comfort-driven workers when trusted hardware is the vessel.

And to reiterate a related point made earlier, simpler integrations can exist at different points of the AR software spectrum. Remote assistance involves less automation and data transfer which can alleviate data security concerns from IT, as well as technology fears from front-line workers.



Source: Microsoft



Part III: Case studies

To illustrate the principles examined so far in this report, a few companies are exemplars in applying tactics that help counteract pilot purgatory. Though this list is not complete, it is a representative sample of best practices taken from direct conversations as well as recent conference presentations.

Atheer

Early stages of enterprise AR have given us many glowing case studies from pilot projects. But the dreaded "pilot purgatory" often stalls deployment and makes enterprise AR adoption relatively rare – a key theme of this report. It also makes real deployments valuable in their scarcity and learnings.

We've examined these from Scope AR and Re'Flekt (both below). Joining the list is Atheer's work with Porsche to drive 40 percent faster maintenance using AR. This says a lot according to Atheer's Amar Dhaliwal at AWE, given that Porsche was already operating at an elite level.

"These are some of the most trained, certified and competent auto technicians in the world," he said. "It can take ten years to actually become a gold-certified technician. Yet when Porsche rolled out AR, it was able to achieve a 40 percent reduction in service resolution time."

In fairness, this isn't a new figure. In fact, **Dhaliwal** is first to admit that Porsche has already publicized the 40 percent stat, and for good reason. It's a subtle message that they're investing in AR so that customers are in good hands. This makes AR part operational and part marketing.

PORSCHE CARS NORTH AMERICA

- Porsche North America's challenge – an increasingly complex range of products
- Saw AR as a possible solution to reduce service resolution time and support costs
- Achieved a 40% reduction in service resolution time
- Now rolling out to all 189 dealerships in North America







"When somebody's going into a Porsche dealership they probably came from a Mercedes dealership and going to BMW next," he said. "Porsche wants to be able to tell customers 'Not only are you buying the best technology, but we'll look after you once we've sold you the technology."

This message makes sense because Porsche's point of deployment for AR is at the dealer level. It's the dealer-centered technicians that are using AR to fix cars that Porsche owners bring in locally. So AR's presence and value can be that much more apparent to the end customer.

As for how it achieved that 40 percent, the first step is planning and needs-assessment. AR is only successful when applied in the right places. As explored elsewhere in this report, it's not a silver bullet: It can only be successful when used to solve specific problems in specific job roles.

Here, one important distinction according to Dhaliwal is training versus guidance. AR doesn't really do much for jobs that require training (repetitive, simple tasks). But it can have lots of impact in jobs that need guidance (complex, non-repetitive tasks). Pinpointing this should be step one.

"We'll start by saying 'what is it that you're trying to do?" he said. "If they're trying to do something that sounds better for training, we'll say 'we're not the right partner for you, because deploying this technology to solve this problem will not have the ROI that you're looking for'."

The next step is to win over end-users, such as technicians — a lesson we've heard over and over. And the name of the game is simplicity. For example, when possible, start with simpler forms of AR such as remote assistance, before graduating to things like pre-authored sequences.



Source: AWE



"Industrial workers, the people who are the principle users of AR, have very low tolerance for complexity." said Dhaliwal. "Complexity is your enemy when rolling out to the industrial worker. That's a fact and I think it's important in terms of how we design solutions as an industry."

And the simplicity angle works on many levels. Atheer also owes its success with Porsche to simplifying the business model. In its case, it faced an additional challenge of working with individual dealers, so it created an end-to-end offer where it handles all of the logistics.

"All the glasses come into our office," said Dhaliwal. "We pre-install the software, set up the users, put in all of the manuals and guidance. We package them up with Porsche's branding and send them out to the dealers, because Porsche is saying 'that's not what we're experts in'."

Several of these tactics make enterprise AR success factors extend well beyond the technology itself. It's about speaking the language, knowing the vertical you're selling into and PR. That brings us back to the first point: AR can boost, and be boosted by, fundamentals in marketing.

"Act like a marketer," advises Dhaliwal. "Porsche brands everything as 'Tech Live Look.' So everything they do, every press release, every analysts briefing, they talk about the program. Internally, the posters and packaging... when glasses go out... everything is branded."

The good news is that there's clear momentum in year-over-year demand. And enterprise use cases are naturally segmenting into categories like maintenance and training, around which Atheer is organizing its services and marketing. This makes things more digestible for enterprises.

"There's been a huge difference and a huge move just in the last year in terms of the type of conversations that we're having with enterprises," said Dhaliwal. "We see a set of use cases [such as] maintenance and repair operations... training and certification [and] warehousing and logistics."



Source: Atheer



Re'Flekt

Earlier we mentioned that communicating AR's benefits internally to stakeholders should execute marketing & sales best practices. One such practice is "objection handling." A recent analysis by AR software leader Re'Flekt and ARitllery Intelligence^v further examined these tactics.

You may be familiar with this sales practice, as it involves standardized and pre-designed "counterarguments" to a list of common objections to a new product or idea. It's particularly fitting to facilitating AR adoption within organizations because there are lots of objections among certain stakeholders.

The list below further illustrates an objection-handling exercise. For maximum impact, we'll focus on the two main stakeholders outlined above that have the greatest AR resistance: IT and front-line workers. These are the types of objections they have and their pre-devised rebuttals.

Why is this "cheat sheet" important? It's all about standardizing language. Like in marketing and sales, messaging is most effective when established, internalized and used consistently for maximum impact. Anyone trying to implement AR in industrial organizations should engage in this practice.



Source: Re'Flekt



Objection Handling Cheat Sheet: The IT Department

Objection: We have software platforms across departments. System integration will be difficult. **Response**: AR integrates into legacy systems. It's AR vendors' job to handle that for you.

Objection: Content portability will be problematic. **Response**: You already have 3D data files. AR systems are built to import standard file formats.

Objection: These devices have cameras, which is a security risk **Response**: You already have smartphones and tablets deployed. AR follows the same protocols.

Objection: We have unique security needs. **Response**: AR providers work closely with you to customize security for you.

Objection: This will make my job harder? What is the benefit for me? **Response**: AR is the future of industrial work. You can be linked to its success, not its prevention.

Objection Handling Cheat Sheet: Front-line workers

Objection: This is a departure from the job that I'm already skilled at. How does it benefit me? **Response**: On-the-job training, valuable skills, preparation for the industrial work of the future.

Objection: I don't see the advantage of AR compared to my traditional manual. **Response**: AR guidance is less strenuous and draining than "mental mapping" 2d instructions.

Objection: If AR is so efficient and productive, does that put my job (or co-workers' jobs) in danger? **Response**: AR means better job security, given capabilities for the next era of industrial work.

Objection: I'm going to retire soon anyway. What's the point of learning new tools? **Response**: With AR, we can empower you as a remote subject matter expert (greater job comfort).

Objection: These devices have cameras and sensors, and I don't want to be tracked **Response**: AR doesn't track productivity on an individual basis... only on a system-wide basis.



Scope AR

Industrial AR software provider Scope AR has been mentioned and quoted a few times throughout this report. The company has been an exemplar in pulling together ROI proof points, including increased output, better accuracy in diagnosing problems, and reducing time for task completion.

For example, Scope AR's Work Link software for pre-authored AR instructions reduced Lockheed Martin's "orient & decide" portion of satellite assembly by 99 percent. This type of work is where AR shines, as it reduces the cognitive load that's inherent in translating 2D manuals to 3D space.

"To put into common terms, think about IKEA furniture," said Scope AR CEO Scott Montgomerie at AWE Europe. "You have to look at those paper instructions, read weird diagrams, and do mental mapping. Multiply the complexity of that by a thousand and that's the challenge we're facing."

Beyond pre-authored AR instructions, remote AR assistance (a.k.a "see what I see") is proving valuable. Fast-food equipment supplier Prince Castle used Scope AR's Remote AR to fix on-site equipment. It achieved a 100 percent first time diagnosis rate and a 50 percent labor cost reduction.

"There's about thirty things that can go wrong with these pieces of equipment," said Montgomerie. "Figuring out which one of those things have gone wrong is really the key, and just with a phone call, their diagnosis rate was terrible — about 90 percent failure in first-time diagnosis."

As examined earlier, AR can also have macro-effects in an organization, such as reducing impact from subject-matter experts retiring. Shifting them from field work to remote AR assistance can delay retirement. It can also optimize diminishing volumes of experts through telepresence.



Source: Scope AR



"In the next five years, they're going to lose 330 years' worth of experience just by having baby boomers retiring," said Montgomerie. "These guys have spent 35 years learning exactly how to maintain, fix and operate equipment, and that knowledge is literally walking out the door."

Unilever realized this advantage, as well as the unit economics of lessened downtime. Using Remote AR, it was able to reduce downtime by 50 percent for an ROI of 1,717 percent. The benefit is having things fixed faster when you don't have to wait for a human to travel to the site.

But again, ROI proof points only get you so far. It's also about setting the technology up to succeed by appealing to stakeholders throughout an organization — business leaders, IT departments. and employees, says Montgomerie. And that's more about marketing than technology.

Business leaders are the easy part and are usually sold on AR's performance gains and ROI proposition. Then comes IT, whose job is to be risk-averse. Montgomerie's advice: Get them involved as soon as possible. That may seem counterintuitive, but it pays dividends downstream.

"I think it's a common mistake — one we've certainly made — to do an end run around IT," said Montgomerie. "It's easy to say 'yeah, let's prove the value first and then we'll worry about IT when we get to scale. IT will [block] you at that point, so you need to get them in the conversation early."

He also recommends deploying AR through smartphones and tablets when possible. The IT and data security pushback is lower with mobile devices, given their tenure and trustworthiness in the enterprise. Headsets like the HoloLens conversely haven't gained that level of trust from IT yet.



Source: AWE



As for employees, it's likewise hard to win them over as examined earlier. But successful deployment requires their buy in. Resistance includes fear of new technology and job security. Montgomerie recommends educating them on how it benefits them, and enlist change-management pros.

"We're talking about some pretty impressive ROI numbers here," he said. "If I'm a worker I'm thinking, 'oh well, the company can still do exactly the same on their bottom line with 50 percent of the workforce... does that mean I have a one in two chance of keeping my job next year'."

In a broader sense, Montgomerie recommends deploying AR where it works best. It doesn't work in rote and automated functions, where employees are already fine-tuned. It shines in low-volume, high complexity situations (like space shuttles), or high volume, small improvement scenarios.

Put another way, don't be a hammer searching for nails. Act in a needs-driven way to deploy AR in targeted and optimized ways. Scope AR took this path with aerospace, engineering and heavy equipment, but Montgomerie believes there are many other verticals primed for AR.

"I think there's an impression out there that AR is great for everything. I can tell you it's not," he said. "We've chosen key industries to go after... there are other industries where this is a greenfield things like medical, construction, and logistics. There are some great use cases there."



Source: Scope AR



Key Takeaways (Redux)

AR's benefits are being demonstrated throughout enterprises, especially industrial enterprises.

- AR line-of-sight visualization breeds operational efficiency in areas like assembly and maintenance.
- e Primary formats are remote AR assistance and automated pre-authored sequences.
- Recorded AR sessions are evolving to better capture and distribute institutional knowledge.

e Advantages and ROI gains result from micro and macro factors.

- Micro-benefits include unit economics in production output (e.g., speed, accuracy and safety).
- Example: tasks can be completed up to 99% faster (examples cited throughout this report).
- Macro-benefits include profitability gains, job strain reduction and institutional knowledge retention.
- Example: Less strain delays retirement, while recorded sequences distribute knowledge optimally.

But it's not all good news: several organizational hurdles stand in the way of the above benefits.

- e "Pilot purgatory" has emerged as industrial AR's biggest pain point, diminishing real deployment.
- Search and the search deployment squanders opportunity and investment in AR implementation.
- Causes are mostly organizational and cultural, such as natural resistance to change.
- Bitfalls originate within three main areas we've identified as the "3Ps": people, product & process.
 - These are where enterprise AR stumbling blocks happen and where solutions should focus.
 - Pilot purgatory's tactical avoidance maps to these areas, each of which are detailed in this report.

With people, industrial AR's value proposition should be customized to individual stakeholders

- Organizations are made up of people, who adopt products and processes based on selfish needs.
- R's benefits to front-line workers shouldn't be communicated based on things like unit-economics.
- Marketing best practices should be used to target messaging internally, using consistent language.
- Tactics such as "objection handling" should be customized and standardized for AR stakeholders.

With product, the principles of product/market fit should be followed... just like consumer products.

- e Features should address real pain points such as reducing friction or worker strain.
- AR adaptiveness across verticals varies and maps to specific factors (e.g. spending power).
- B UX is critical in terms of pinpointing the right balance of features, functionality, and complexity.
- Example: Industrial front-line workers require simple and singular-purpose interfaces.

E For *process*, AR product planning, deployment and communications require tactical precision.

- Product design is often top-down but should be bottom-up, including department-level input.
- Front-line worker input breeds comfort and ownership in the technology, and better product fit.
- A common mistake is to sidestep the IT department until late in the process. Involve them early.
- Successful AR deployments hinge more on *marketing* and *communications* than technology.

The importance of following all these tactics is to set AR investments up to succeed.

- AR investments can be protected rather than lost, if deployed with the 3Ps in mind.
- The points of failure are often within enterprises themselves (as opposed to AR vendors/providers).
- e AR success therefore results from tactical execution at those common failure points.



About ARtillery Intelligence



ARtillery Intelligence chronicles the evolution of spatial computing. Through writings and multimedia, it provides deep and analytical views into the industry's biggest players, opportunities and strategies.

Run by analysts and former journalists, coverage is grounded in a disciplined and journalistic approach. It also maintains a business angle: Though there are lots of fun and games in spatial computing such as AR & VR, cultural, technological and financial implications are the primary focus.

Products include the *AR Insider* publication and the *ARtillery PRO* research subscription, which together engender a circular flow of knowledge. Research includes monthly narrative reports, market-sizing forecasts consumer survey data and multi-media, all housed in a robust intelligence vault.

Learn more here.





About Intelligence Briefings

ARtillery Intelligence Briefings are monthly installments of VR/AR data and analysis. They synthesize original and third-party data to reveal opportunities and dynamics of VR and AR sectors. In addition to data, a layer of insights is applied to translate market events and raw figures into prescriptive advice.

More information, past reports and editorial calendar can be seen here.

About the Author

Mike Boland was one of Silicon Valley's first tech reporters of the Internet age, as a staff reporter for *Forbes* (print) starting in 2000. He has been an industry analyst covering mobile and social media since 2005, and is now Chief Analyst of *ARtillery Intelligence* and Editor-in-Chief of *AR Insider*.

Mike is a frequent speaker at industry conferences such as AWE, VRLA and LeadsCon. He has authored more than 120 reports and market-sizing forecasts on the tech & media landscape. He contributes regularly to news sources such as *TechCrunch*, *Business Insider* and the *Huffington Post*.

A trusted source for tech journalists, his comments have appeared in A-list publications, including *The New Yorker*, *The Wall Street Journal* and *The New York Times*.

Further background, history and credentials can be read here.





Methodology

This report highlights *ARtillery Intelligence* viewpoints, gathered from its daily in-depth coverage of spatial computing. To support narratives, data are cited throughout the report. These include *ARtillery Intelligence* original data, as well as that of third parties. Data sources are attributed in each case.

For market sizing and forecasting, *ARtillery Intelligence* follows disciplined best practices, developed and reinforced through its principles' 15 years in tech-sector research and intelligence. This includes the past 3 years covering AR & VR exclusively, as seen in research reports and daily reporting.

Furthermore, devising these figures involves the "bottom-up" market-sizing methodology, which involves granular revenue dynamics such as unit penetration, pricing and growth patterns. More on ARtillery Intelligence market-sizing research and methodologies can be read **here**.

Disclosure and Ethics Policy

ARtillery Intelligence has no financial stake in the companies mentioned in this report, nor was it commissioned to produce it. With respect to market sizing, *ARtillery Intelligence* remains independent of players and practitioners in the sectors it covers, thus mitigating bias in industry revenue calculations and projections.

ARtillery Intelligence's disclosure and ethics policy can be seen in full here.

Contact

Questions and requests for deeper analysis can be submitted here.





References

ⁱ Enterprise XR, Impacting the Bottom Line

ⁱⁱ Enterprise AR, Breaking Free of Pilot Purgatory

iii Global AR Revenue Forecast 2018-2023

^{iv} Enterprise AR, Breaking Free of Pilot Purgatory

^v Enterprise AR, Breaking Free of Pilot Purgatory