



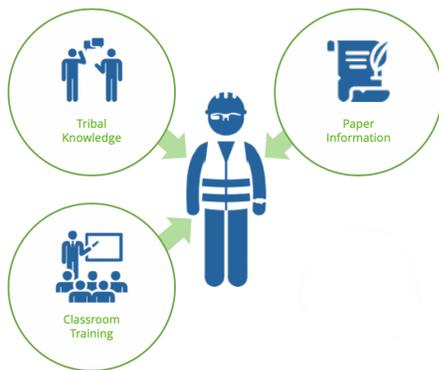
Rise of the Augmented Worker

How Enterprise Augmented Reality, Artificial Intelligence, and the Consumerization of Software will Revolutionize Manufacturing

Today's Frontline Workforce

With a global footprint of 350 million workers in manufacturing, today's frontline workforce is being asked to perform increasingly complex jobs using technology that has remained relatively unchanged for 20 years. Whether this was due to neglect, other priorities, or the misplaced belief that robots and automation would replace all of these jobs, these users and processes have been underserved.

Frontline Workers 20 Years Ago



The tools that have been used 20 years ago to help manufacturing workers be more productive include a mix of tribal knowledge, that's been shared informally with co-workers, and formal classroom training sessions with instructors. The problem with those is that the acquired knowledge typically fades within a short amount of time unless you're actively putting it to use right away. Finally, in the past, workers received their work instructions for a particular job in paper form which often became outdated and any data capture was done in an error-prone manual way.

Frontline Worker of Today



Today, unfortunately, that picture doesn't look all that different. Workers still rely heavily on knowledge passed down by their peers, as well as traditional classroom training. What has changed is that in some cases, companies have started to "digitize" their work instructions, and display some of the information previously provided on paper, now on a tablet, smartphone, laptop or other mobile device. Basically, we have taken the previous paper-based information and made a static electronic version of it possible to view on a device.

Digital Transformation and Challenges

More recently, there is an increased effort to improve productivity and quality through a “digital transformation” strategy. Organizations are beginning to adopt digital technologies to transform operational processes. Unfortunately, the frontline worker, the actual human, has typically been an afterthought in these strategies.

Underserved and ignored when it comes to improving their productivity and work operations, the frontline workforce is largely disconnected from the digital thread of the business.

It's not just the fact that these frontline workers are ignored. The manufacturing organizations that employ these frontline workers also face a variety of challenges:

Tribal Knowledge and the “Skills Gap”

Senior production workers and subject matter experts have accumulated vast amounts of tribal knowledge, which has been typically hard to capture and convert into an asset that is easily shared with and used by the rest of the organization. Related is the “aging workforce” problem and the younger workforce that is entering the manufacturing sector. These individuals do not have the knowledge that their senior peers have, yet are being tasked to perform the same jobs, at the same level of productivity and quality.

Lack of Guidance and accurate Information

Organizations are struggling with the quality of human-centric processes, as they often suffer from inaccurate, outdated paper-based work instructions. In many cases productivity is also an issue because workers are not equipped with the right tools or instrumented with the appropriate guidance that would help them perform their jobs at peak productivity.

Lack of Insight

Organizations also struggle with lack of insight into how workers are performing their jobs on a day-to-day basis. There is no fine-grained detail regarding worker activity – how are workers performing vs. benchmarks, are they having trouble on certain steps, what are they doing well, do they have feedback on operational procedures that could help the rest of the workforce? Improving the performance of these frontline workers has been difficult due to this lack of data and insight, and because of this, there is little or no basis for making decisions around improvement across the organization.

Workers are Disconnected

And lastly, frontline workers are not integrated with their work environment. The human-centric and job-specific workflows are not digitally integrated into the overall business environment and enterprise systems (ERP, CRM) that are critical to the business. The reality of today's frontline workforce in manufacturing is that workers are not connected to the digital fabric of the business.

Opportunity in Manufacturing

There are a number of new approaches and technologies that manufacturing organizations and people are looking at to solve these challenges.

Emergence of Enterprise Augmented Reality ... With Limited Adoption

Roughly 7-8 years ago, the acceptance of mobile devices and the subsequent introduction of wearable technology (specifically smart glasses) into the manufacturing setting, combined with the emergence of augmented reality (AR) technology, theoretically provided an opportunity for manufacturing organizations to begin to look at this as a way to help frontline workers to deliver more timely, accurate info so they could perform their job better, with higher quality.

The emergence of Enterprise AR, along with the adoption of mobile/wearable tech in the manufacturing sector, contributed to several offerings that attempted to change manufacturing:



Training: Instead of the classic classroom training, using Enterprise AR to guide technicians, providing a hands-on experience as they work through a procedure.



Remote Expert Support: On-demand remote assistance functionality allows your workers to quickly pull in a colleague when their expertise is required.



Complex Assembly: Using electronic work instructions and digital overlays to help guide workers through complex procedures – ensuring quality and standardization



Quality Assurance: Use digital overlays to verify technicians work and help determine pass/fail on manufactured parts



Safety: Providing not just safety training but guidance to newer workers as they are performing new tasks, operating new machines, etc.



Equipment Maintenance: Used to help streamline factory equipment maintenance, repair, and service

Limited Adoption & Pilot Purgatory

At first glance, Enterprise AR showed significant promise for manufacturing organizations. Early industry case studies highlighted successes and performance gains in assembly, inspection, and training. However, these early success stories masked the reality of Enterprise AR in the industrial sector - companies have been slow to adopt this technology and have had difficulty moving beyond the experimentation and pilot phase.

Why is this? When you look at the lack of widespread use of Enterprise AR, there are three primary reasons for limited adoption:

1. Existing Enterprise AR solutions are very expensive, technically complex, and not easy to implement
2. Existing solutions offered no continuous improvement beyond the initial gains
3. Most of the gains were directly attributable to the use of smart glasses which allowed workers to work "hands free".
Unfortunately, the cost, complexity and relative immaturity of this technology limited deployment to a small number of edge use cases

Existing Enterprise AR solutions are very expensive, technically complex, and not easy to implement, and offered no continuous improvement opportunities, resulting in many early adopters to struggle to justify cost or advance beyond pilot or evaluation stages.

Making Software Easy in Manufacturing

Historically, software in the manufacturing space has been expensive and cumbersome to implement, and largely limited to businesses that could afford it. Software technology was more geared towards business requirements rather than end-user adoption and experience.

Most of the existing software and technology vendors that are serving the Enterprise AR space today were formed 7 or more years ago at a time when, if you were going to build a software company focused on the enterprise market, you would model your go-to-market approach much the same way that a traditional enterprise software company did - both on how the software was built and how it was delivered to the market.

Up until now, this has been the case in the Enterprise AR space, and the result is software that has been increasingly difficult to adopt and implement, characterized by long sales cycles, expensive (and risky) proof of concept and pilot projects that are difficult to get approved, and long and resource intensive on-boarding and implementation processes.

For companies looking to adopt this new technology approach, it has resulted in:

- Pilot purgatory – adopting companies fail to justify cost and complexity and are never able to successfully emerge from a pilot or proof-of-concept initiative.
- Adoption is limited to only the largest manufacturing enterprises, those that have large innovation budgets, and significant resources.
- Solutions that are unpalatable for the small and mid-market manufacturing companies (SMBs)

However, a fundamental shift has occurred during the past few years, pioneered by enterprise companies such as Slack, Atlassian, Asana, and Trello. These companies have introduced a new approach to delivering software in the enterprise, an approach characterized by:

- Lower Cost
- Easy to try, buy, own
- Intuitive User Experiences

This “consumerization of software” has led to positive impacts for organizations that are using technology that adopts this approach, including improved business agility, user productivity, and user satisfaction.

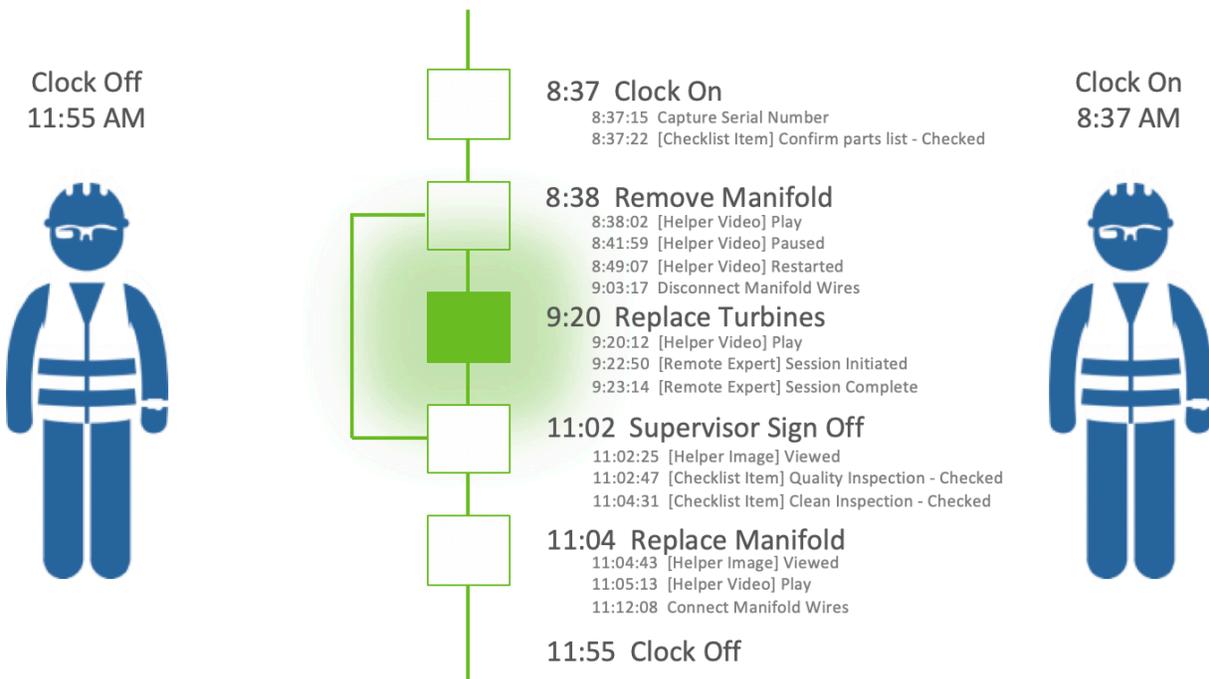
Our belief at Augmentir is that this consumerization of enterprise software creates a unique opportunity in the manufacturing sector, where now industrial companies from small, mid-sized, to large can take advantage of new technology and adopt approaches that will help them see the same gains in frontline worker productivity that large enterprises are experiencing.

AI as a Foundational Requirement

Beyond the consumerization of technology creating a widespread opportunity for adoption, one other important market force is contributing to solving the challenges of the frontline workforce and driving continuous improvement – Artificial Intelligence.

With the foundational elements of augmented, guided procedures and remote expert assistance in place, manufacturing companies can not only help guide their frontline workers with contextual

information, aiding them in performing their jobs at peak efficiency and solving problems faster, but this also allows organizations to capture valuable data not just on the work that is performed, but also on how those workers are performing their jobs along with what activities/interactions are contributing to the success or performance of certain jobs.

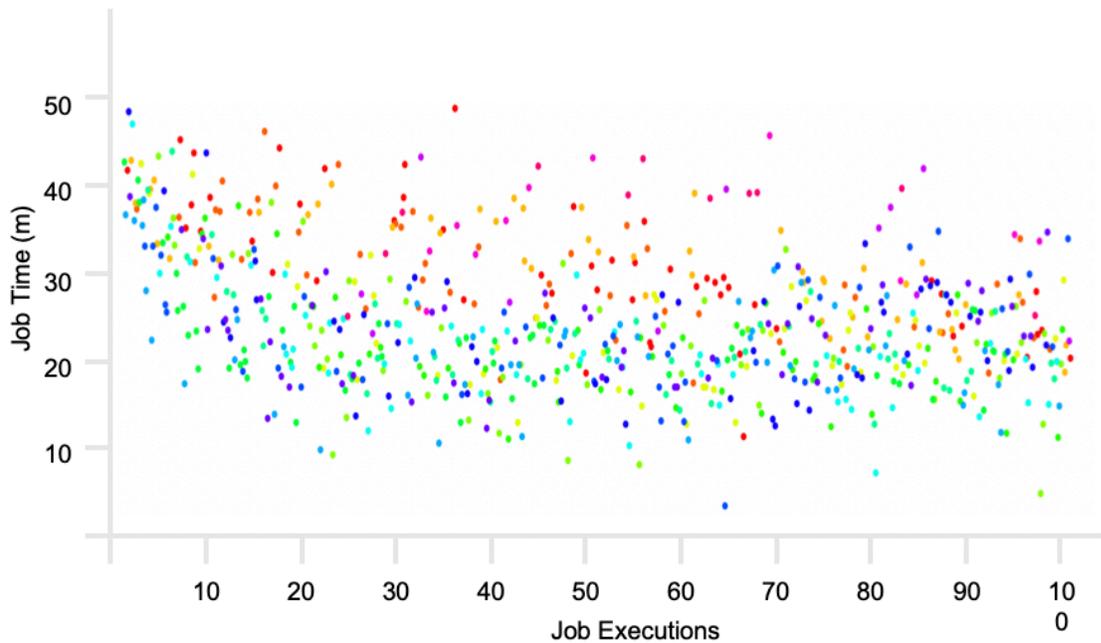


Capturing this fine-grained human activity data is beneficial, but it only solves part of the challenge of helping to improve the productivity and efficiency of the frontline worker and driving continuous improvement.

This is where Artificial Intelligence comes in.

The reason artificial intelligence and machine learning (AI/ML) is a necessary requirement is due to the nature of human activity data. When humans do things, they generate a relatively noisy set of data, and that is exactly what AI and Machine Learning is well-suited to handle.

The following is a real-world example from a manufacturing company. This graph represents a 15-person manufacturing workforce, running 100 instances of the same assembly job.



Each color represents a unique worker, and in fact, each data point contains a thousand additional data points on execution times, activities, tools/machines used, and job-level interactions. Utilizing an embedded AI/ML engine creates useful outcomes and eliminates the dependency on data scientists to make sense of the data.

What does AI see in this data?

At Augmentir, our AI engine and algorithms are able to identify patterns in the data and highlight areas that can then be used to improve overall worker performance, as well as act in real-time to provide personalized procedures based on the proficiency of each worker.

The AI engine is able to help continually deliver insights and recommendations based on that human worker data – these are insights that can be used to help drive continuous improvement across the entire organization – from operations to training to quality.



Some examples of this:

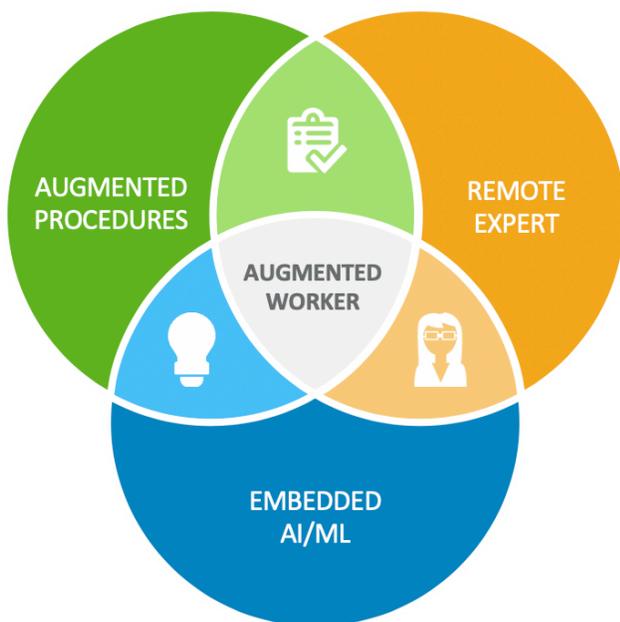
- Productivity
- Worker Skills
- Operations (backsliding, bottlenecks)
- Authoring
- Quality
- Training Effectiveness

The Augmented Worker, Powered by AI

Brining these essential components together, the combination of augmented, guided procedures and remote expert capabilities, supported by an AI/ML engine, helps to empower the Augmented Worker of today.

The combination of Augmented, Guided Procedures, Remote Assist, and Artificial Intelligence is not only essential to enabling the augmented worker but required for delivering the manufacturing workforce of the future. The value of combining these three core components is far greater than the value each component delivers individually.

Augmented procedures, remote expert, and AI/ML become force multipliers that enable manufacturing organizations to set the foundation for the augmented worker of the future.



Augmented Procedures

- Augmented, Guided Procedures help close the skills gap and reduce errors

Remote Expert

- Integrated Remote Expert assistance helps resolve issues faster by leveraging remote subject matter experts and using information from the guided procedure

Embedded AI

- Embedded AI dynamically optimizes procedures to minimize time at 100% quality
- Embedded AI uses granular data to identify the largest opportunities in the frontline workforce
- AI-bots deliver real-time decision support to workers

Summary

Despite some early momentum, Enterprise AR alone isn't enough to deliver sustainable value in manufacturing. Only when combined with easy-to-use software that is designed with the manufacturing worker in mind, and powered by Artificial Intelligence, can you get the customer scale to succeed and deliver year over year improvements that manufacturing companies require.

Enterprise AR

Delivers initial improvements in productivity and quality for the frontline workforce.

Consumerization of Software

Enables ease-of-use and ubiquity across the manufacturing landscape

Artificial Intelligence

Drives continuous improvement throughout the organization

Together, Enterprise Augmented Reality, Artificial Intelligence, and the Consumerization of Software will deliver transformational value in manufacturing.

About Augmentir

Augmentir is the first of the next generation of platforms that enable rapid and sustainable digital transformation for industrial companies. Augmentir's industry leading Augmented Operations™ platform combines Enterprise Augmented Reality with Artificial Intelligence and Machine Learning (AI/ML) to empower front-line workers in industrial settings to perform their jobs with higher quality and increased productivity while driving continuous improvement across the organization. The platform provides a unique approach to authoring and running augmented, step-by-step procedures that not only guide workers through their tasks more effectively but enables organizations to non-intrusively capture data on how tasks are being performed. Augmentir's embedded AI engine uses that data to develop unique insights that help organizations quickly identify where opportunities for improvement exist. Augmentir is being used to digitize and optimize human-centric work processes across a range of industrial companies in manufacturing, service, logistics, and energy.



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