

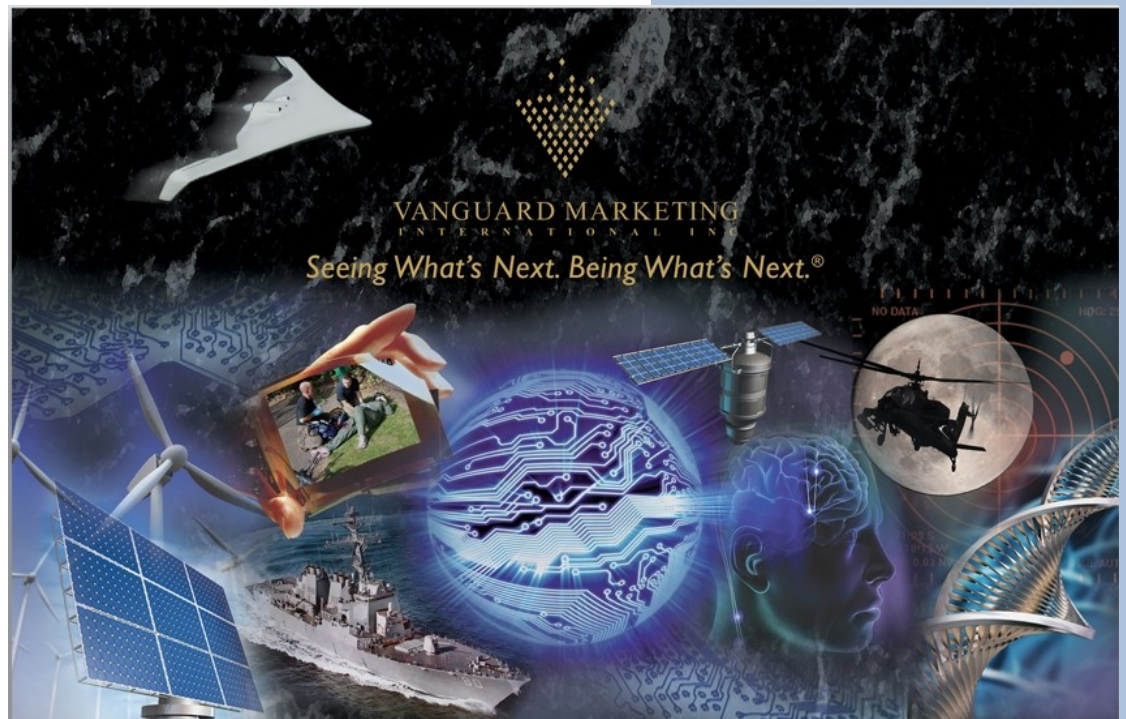


Key Findings

Automated Business Operations

Workforce Augmentation

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Top Trends in Workforce Augmentation

About the Research

Over the last couple of months, our team researched and interviewed subject matter experts in fields that provide innovative solutions for today's industrial business operations. These thought leaders volunteered to join VMI's "Topical Community" and provided us with cross industry-level insights and perspectives. We thank them for their contributions to the body of knowledge and to this key findings briefing.

Introduction

Siemens has been working for the past 25 years to slowly whittle out human involvement in manufacturing plants. Today, they have practically achieved it. At the Amberg facility¹, Siemens has only 1150 employees which leave the operations roughly around 75% automated. The human involvement is limited to observation and very minor input.

Mercedes² debuted the FT (Future Truck) 2025 showing a possibility where long haul trucking is driverless. This level of automation combined with automated warehousing would make an end-to-end operation of autonomous robotics achievable thereby practically eliminating human involvement. This robotic autonomy allows for reutilization of human resources to more managerial, decision making and innovative roles, thus allowing for more menial labor to be completed by these autonomous, robotic systems.

Today's operating margins have become increasingly small for enterprises, requiring innovative methods to reduce costs while competing at the forefront of their industries. This need for a lean operating environment has given way to revolutionizing traditional operational practices by providing businesses with the savings and advantages that will deliver a new paradigm in workforce automation. For Siemens and Mercedes, and their respective operations, these practices are driving solutions that increase visibility while automating tasks as standard procedures. From our research, chosen for their robust capabilities in broad application and opportunities, we have determined the following key trends as those that will most shape the future of our workforce.



Micro-Electro-Mechanical Systems (MEMS) chips and solutions showcased at last year's Consumer Electronics Show included leading edge motion sensing capabilities...

- *MEMS and sensor fusion will play a critical role in enabling a more intelligent and intuitive Internet of Things (IoT) Solutions and Services—ones that will revolutionize the consumer and industrial space forever.*
- *Small, low power integrated nine-axis motion tracking: location, altitude, velocity, temperature, illumination, motion (pitch, yaw & roll), power, humidity, blood sugar, air quality, soil moisture...*

Key Trends

1. Internet of Things (IoT): Personal Sensors (AKA Worker as a Sensor)

Manufacturing and Maintenance Services enterprises need more visibility into their operations and to capture some of that data requires insight into what is occurring at the field engineer/worker level. Embedded-sensing "MEMS" technologies within consumer products has advanced quickly, dropped in price and now provides enormous opportunities to track and monitor human biometrics, locations, environmental conditions and so forth. Personal sensors have experienced its most recent developments in smart watches used for every day fitness and sleep tracking, creating a growing industrial case for expansion. One organization, Human Condition Institute, has seen the potential for such an industrial application and is in the process of designing sensors to monitor workers' overall conditions, especially those in high stress jobs via Smart Hard Hats and Smart Vests³.

The development of these two products has come from statistical evidence regarding the dangerous nature of construction. With over 400 deaths⁴ occurring annually in the U.S. from OSHA's "Fatal Four", which comprises of falls, struck by object, electrocutions, and caught-in/between, worker condition monitoring has the ability to prevent many of those deaths. With a Smart Vest, encased with MEMS devices that can monitor both the environment as well as the vitals of workers, a company may be made aware of adverse conditions occurring before they have a detrimental effect.

Another less overt use of the IoT is to facilitate robotic and human interaction. Safety is a huge concern when it comes to human-robot collaboration and standards such as ISO 10218:2011⁵ have been established to help guide this area. One way to help is in situational awareness, applying sensors to human counterparts, so robotic agents are aware at all times of potential dangers which may occur around their human partner.

Currently, there is a gap in the data regarding workers in their environment. With real-time, worker-sensor data filling the gap, industries will have a more complete baseline of understanding of activity, surroundings and performance to improve safety and efficiencies.

2. Augmented Reality (AR)

Processes in manufacturing and maintenance services are becoming increasingly complex as technology advances and the skill level required of the worker, becomes too costly to employ. Providing expert knowledge, and the ability to reacquaint, rehearse and/or validate the activity at the point of occurrence via AR, can help bridge the skill gap, by augmenting an enterprise's existing labor force capabilities. Recent applications



of this technology with the use of AR Glasses have been seen in EasyJet's⁶ MRO functions for their fleet.

EasyJet has been documenting the inefficiency of their operations where time-critical maintenance has lagged and thereby impacted their competitive stance. In the past, to perform diagnostics, EasyJet repair engineers servicing or repairing equipment onboard the aircraft emailed photos of the parts in question then followed up with calls to remote experts in hopes of better trouble shooting the problems. Now, while using the Epson Moverio AR Glasses, remote experts immediately "See What They See", and are able to dialog-through the troubleshooting process in realtime. EasyJet aims to provide their in-line engineers with all the advice needed to maintain the craft that an expert engineer would, if physically present.

Augmented reality is just beginning its foray into the industrial setting and several new applications are being released. Many smaller company entrants are developing software apps for AR platforms along with larger established software developers such as SAP⁷, who has created a suite for AR devices paving the way for smooth integration into current enterprise software suites.

AR is an evolving arena that may be outpacing some of the capabilities of the wearable offerings. There remain three key barriers before a widespread adoption can occur: security, feasibility of the wearable, and an image recognition operations obstacle.

- Security depends upon the enterprises own policies. For example, some manufacturers will not allow cameras into areas of their facilities making AR impossible. Despite the fact that many AR software do not require internet connectivity to operate, enterprises are still concerned about possible proprietary data leaks.

- Along with the security concerns, wearable hardware is still in its first generation and is working steadfastly to overcome shortcomings: battery life and distortion which can cause dizziness. Google Glass, as an example can only run 15-20 minutes under full AR operation and users often experience dizziness while wearing them. However, the latest Epson Moverio BT-200 Glasses can operate for several hours, lessens the eye strain on the user and provides real time measurement capability. Until widespread standardization and deployment of AR glasses, the best AR hardware solution may be to just use tablets.

- Image recognition is a sought after capability for remote operations, but it is difficult to implement as the software needs ideal conditions and positioning to recognize and analyze the environment. If lighting is suboptimal, the camera will be unable to capture the full image, leaving "noise" that the AR software is unable to interpret.





Until these three barriers are fully addressed augmented reality will remain in the early adopter phase for commercial and industrial operations. For now the AR applications we see are basic and more consumer marketing oriented, such as the 4D 2013 Lego Catalog⁸ which DAQRI developed. The LEGO Connect app was designed for consumer Smartphones and/or tablets to interact with traditional paper catalog. While the software and platform are simplistic in implementation, it does provide a new way for an enterprise to interact with its customer base, earning customer loyalty.

3. Robotics to Augment the Workplace

In today's industrial environments, there are tasks that can greatly benefit with the use of robotics. Two specific operational areas are highlighted here: 1) Robotic automation which couples additive manufacturing *within* the repair process and 2) Flexible/agile insertion of automation to fill repetitive activities due to resource gaps. With a workforce where skill gaps exist due to aging legacy systems, robotics fill a natural gap in business operations.

Robotic-additive manufacturing (3D printing)

Automated applications of 3D printing are expanding in commercial aerospace, driving more opportunities for workforce automation. With deployment in Lufthansa's⁹ operations and a growing role in Pratt & Whitney's, additive manufacturing is on its way to becoming an industry standard. In Lufthansa's case, robotic-additive manufacturing is being used to directly repair damaged wing-surfaces, which eliminates several human logistical and supply chain steps. The process is all robotic except for the placement of the robot onto the surface of the damaged site and the final installation of the repair. The Lufthansa robot "Composite Adaptable Inspection and Repair" (CAIRE) works on carbon-fiber reinforced polymer (CFRP) structures of the plane by being positioned via suction cups onto damaged areas. The most notable areas that this robot will be able to repair are the wings and the fuselage, which before CAIRE would require extensive human diagnostics and repair. This repair cuts down on required labor and allows for on-site, automated repair to occur, thus greatly reducing the amount of time the craft is out of service.

Flexible Agile Robotics

Lufthansa's robot is highly specialized to the task, but autonomous maintenance leader Battelle¹⁰ has developed an Advanced Maintenance Robot system which is unique for its separation of the software component from the robotic. It allows for companies to tailor



robotic tasking to their operational needs, utilizing a company's current robotics in the facility and reprogramming them for new or more efficient tasking. To more quickly respond to shortcomings in labor availability and/or as the demographics shift in the labor force, Volkswagen envisions robotics retasking fulfilling these gaps.

While guided maintenance can help to bridge gaps in workforce requirements, not every job task will remain as a human task. This gives way to partially automated factory settings where engineers can apply their knowledge and expertise to the next round of innovation, with increasing autonomous applications in other settings. Human safety will need to be addressed to make sure the flow between machine and worker is seamless. At this time there are more programmatic capabilities being designed, such as guided pathway and increased sensing abilities, but concerns still remain that the human-robotic interaction issues are still not optimally addressed.

4. Recommendation Engine; Big Data and Machine Learning

New, complex operations are occurring every day, but the existing workforce and operational processes often lag in their ability to adapt quickly and to respond effectively. This has made way for a new evolution in computing which is most commonly known as Artificial Intelligence (AI). In its new form, AI is arising out of the convergence of Big Data and deep, machine learning technologies. In this area, innovation has the potential to allow technology to catch up to, and perhaps in time, surpass human capabilities to “recommend” efficiencies not previously seen. The most notable of artificial intelligence products are IBM's Watson and IPsoft's Amelia.

IBM Watson

Prior to the implementation of Watson, it took 72 hours¹¹ for an authorization to occur for healthcare workers to approve a treatment method. For situations where time is critical in patient care, this delay is detrimental. Present day operations guided by Watson allows for these responses to happen in seconds. In a day where lean operations are the norm, time delays are a cost that no company wants, nor can survive. Using systems that run Big Data analytics over enterprises data gives the speed and ability to make decisions faster and proceed to next steps more efficiently.

Watson, created by IBM, has been implemented in healthcare, retail, law enforcement, financial operations and is continually being integrated into more industrial settings. This drive for further innovation is being helped by the \$100 million developer fund set aside by IBM. Recently on November 12, 2014, IBM stated that Watson will now be utilized in DNA analysis with Pathway Genomics¹². This partnership will allow for a more capable and intelligent deep dive into the medical history of the patient. The power of data ana-



lytics will allow for these patients to receive a customized experience that a doctor may never be able to give them.

IPsoft's Amelia

A second large machine learning system was released this past year after more than a decade of silent development. In September, Amelia¹³ made her debut. IPsoft's version of machine learning was modeled to follow the path of human learning and ultimately to create a level of artificial intelligence that would be indistinguishable from a human counterpart in certain tasks. Today there are trial runs of Amelia operating help desks, procurement processing, financial trading operations support, and providing advice to field engineers. She is also being placed into current robotic solutions as a way for autonomous robotic operations to occur. For an industrial solution, Amelia is being integrated into Rethink Robotics' Baxter. This pairing of Amelia and Baxter may help move the human and robotic collaboration further along with the help of Amelia's natural language processing capabilities.

Conclusions

Each of these trends, IoT Personal Sensors, AR, Workplace Robotics, and Recommendation Engines, has provided methods and tools for human optimization, with efforts progressing to eliminate the need for intensive human labor.

All of these workforce augmentation examples still have a human element to them. This will remain the case until automated business operations standards solidify and acceptance of full robotic autonomy occurs, ***leaving human workers for supervising and engineering new innovations... the ultimate value of workforce automation.***

Again, we would like to thank our thought leaders (VMI's Topical Community), without whom this paper would not be possible. Their insights continue to deliver great value to our research and allow us to provide you with a cross industry perspective.

While this briefing has covered top findings, if you are interested in gaining further insights, we would be happy to arrange a teleconference to discuss them in further detail. Please give us a call at 480-488-5707.

The VMI Team



About VMI

Founded in 1992, in Phoenix, Arizona, Vanguard Marketing International's longstanding mission is, "to be widely recognized for clear cutting edge thinking and delivery of actionable results that make a difference for our clients." VMI's methodologies and expertise gives us the ability to analyze markets and design processes that produce disruptive, innovative, low-risk strategies and action plans. VMI works on an ongoing basis with many of its clients to ensure that they address changing market needs, capitalize on important industry trends, and maintain brands, which clearly differentiate their company and innovations throughout the investment community and prospective markets.

As a follow-up, the reader is encouraged to review Vanguard Marketing's website and published white papers on selected topics related to VMI's core competencies at:

<http://www.e-vmi.com/html/papers.html>

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For more information or to contribute to this or other white papers
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