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SKILLS CANADA ALIMENTAIRE CANADA

A Report on VIRTUAL & AUGMENTED REALITY

iFood360°

IN THE FOOD AND BEVERAGE PROCESSING SECTOR

August 2021

ABOUT US

Food Processing Skills Canada (FPSC) is the food and beverage manufacturing industry's workforce development organization. As a non-profit, located in Ottawa with representatives across Canada, we support food and beverage manufacturing businesses from coast to coast in developing skilled and professional employees and workplace environments.

Our work directly and positively impacts industry talent attraction, workforce retention and employment culture. We care about assisting the industry in finding, training and retaining the very best people for the job. Through our partnerships with industry, associations, educators and all levels of governments in Canada, FPSC has developed valuable resources for the sector including the **Food Skills Library™, Canadian Food Processors Institute™, FoodCert™** and Labour Market Information Reports.

TABLE OF CONTENTS

iFood360°

BACKGROUND

A GLOBAL LOOK AT XR TECHNOLOGIES IN FOOD AND BEVERAGE PROCESSING

This report was prepared by Food Processing Skills Canada as part of a larger project, **iFood360°**. This is an exciting and innovative new 2 year program that will deliver virtual reality learning experiences in industry specific skills, like food and worker safety, and social emotional skills, like adaptability, to people employed in the Canadian food and beverage processing industry. It will also assist jobseekers and students in exploring new career opportunities.

XR technologies can safely deliver enhanced training benefits for learners compared with more traditional experiential learning. Research has confirmed that XR training delivers a dramatic increase in learner confidence to perform trained tasks AND a significant reduction in on-the-job human errors. It also delivers risk-free training for potentially hazardous activities, and reduces workplace injuries.

Beginning in late 2021, we will be partnering with food and beverage manufacturers, educators and community employment organizations to deliver XR experiences to more than 600 participants across the country. If you, or your organization, are interested in partnering with us, visit **https://ifood360.ca**

This report, and iFood360°, are funded through the support of the Government of Canada's Future Skills Centre.

The technologies we collectively refer to as XR include: Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR).

XR Technologies

Virtual Reality (VR)

Augmented Reality (AR)

Mixed Reality (MR)

Executive Summary

This report will provide you with a snapshot of how Extended Reality (XR) technologies can be used within the food processing sector. This report draws on examples across myriad industries to develop an in-depth understanding of what each technology is and its potential applications in food processing. In demonstrating how XR technology options can be leveraged throughout a variety of industries it will be clear that the future of this virtual technology can benefit all companies or organizations regardless of size or niche.

As demonstrated by the wide range of use cases throughout this report, XR technology has already exploded in popularity amongst many mid to large sized companies across the globe. The need for additional training methods due to the distancing of the COVID-19 pandemic has only exacerbated the need for application of this technology. Due to the pandemic it's more important than ever for companies to consider digital assets to accompany their training, continuing education, troubleshooting and other support mechanisms.

Further, these case studies show that XR technology and its applications can help employees retain knowledge, reduce workplace injury/breakdowns, decrease the time spent fixing breakdowns, manage complex training or continuous learning, and even help salespersons make sales.

We break down the XR variations and make recommendations based on common business needs related to the food processing sector as well as a cost analysis. There are real world examples of how these technologies can (and have) worked in practice with visual samples from those examples such as KFC developing an escape room game to train its new cooks.

The practical application of XR technology has always been destined for a place in all kinds of industries, but the need to adapt to these technologies has only hastened because of the pandemic over the last year and a half. As more and more companies take advantage of these new opportunities for growth and efficiency the better the technology will be for future use.

The Future of Learning

XR technologies are fundamentally changing the way we learn by enabling anytime, anywhere education and redefining our definition of "classroom."

If you or your children grew up in the 90's, chances are you might remember a show called "The Magic School Bus." The series follows Ms. Frizzle and her class around as they set off on field trips. Magically transforming into a plane, submarine, spaceship or surfboard, the bus carries Ms. Frizzle and her students on super adventures as she teaches them about science.

In a similar way, we can achieve a "Magic School Bus" style of learning through the power of XR, where education and training curriculum is delivered in a fun, memorable and engaging way, regardless of the subject matter.

XR won't replace educators. Instead, it will serve as a tool to help them further enhance what they do best and better connect with the next generation of learners.

Virtual reality, the most widely adopted XR Technology, will allow educators to take learners on incredible and, often times, surreal educational endeavours. Augmented reality will help teachers and facilitators bring things into the classroom that could never be brought in before. Mixed reality will allow individuals to collaborate and learn from people on the other side of the world in a way that feels like they are standing in the room next to them. These types of technologies can, and will, change learning and are limited only by the imagination of those who are using it.

Hybrid learning, that encompasses both traditional teaching methods and XR technology, will be the way of the future. XR will be incredibly far reaching and alter the way education is delivered in institutions from high school and post secondary institutions to employment service providers and training associations. The shift towards a future filled with XR education can already be seen across the globe and right here in Canada. Many schools are already starting to implement XR into their curriculum, St. Lawrence College, Georgian College, Queens University and The Catholic District School Board of Eastern Ontario are just a just a few of the early adopters paving the way forward with XR.

Graylin, A. W. (2017, October). [VR Classroom deployed in a high school in the NingXia province of China].

Some high schools are already using the technology as a humane alternative for activities like frog dissection or using it to help students explore potential job opportunities. Colleges and universities are using it across a spectrum of programs with a heavy emphasis on trade training, vocational skills and medical careers. In some cases, institutions have already invested tens of thousands of dollars into immersive learning labs and re-purposing unused or underused spaces for XR classrooms. COVID-19 has helped speed up adoption with added pressure to come up with viable digital learning strategies. Some institutions are now looking to make XR devices a requirement as part of enrolment into specific courses. Mandating XR could help future-proof learning and enable rich interactive and engaging educational experiences from the comfort of one's home. One other major sign that XR is the future of learning is the fact that many institutions right here in Canada have already begun creating permanent, full-time positions for immersive technology leads, dedicated faculty members responsible for researching, supporting and implementing various XR learning solutions into the curriculum.

The technology could act as an equalizer for learning by giving anyone, anywhere, access to individualized education that would otherwise be impossible due to factors like distance, cost or time. The technology will make learning more accessible for marginalized and under-represented groups by allowing access to high-quality educational experiences that could be deployed in remote areas, multiple languages and at varying levels of difficulty. Imagine being able to virtually sit in on lectures with some of the top minds in the world simply by putting on a headset, or being able to access the newest and most expensive medical equipment to practice and train on.

Applications of XR will extend far beyond the classroom shaping the way employers train and on-board employees.

Like many other technologies that are now a part of our everyday lives, NASA and the military were some of the earliest pioneers of XR technology. Both organizations used it to train employees on incredibly specialized and expensive equipment. In the early days of XR, the technology could cost tens of millions of dollars, this made sense however for training on billion dollar equipment. Since then, the technology has become more accessible and affordable than it has ever been. Like all technologies, the cost will only continue to drop as adoption increases. An early indicator of how quickly the technology could impact small to mid-sized employers is by looking at what is already happening within larger companies. Of Forbes World's Most Valuable Brands, more than **75%** have already invested in some form of XR to improve the way they learn and work. XR is already being utilized for immersive training, inspection and quality assurance, as well as, design and assembly. XR is being used to view digital manuals, remotely access expert assistance, and even visualize special components that are behind physical barriers.
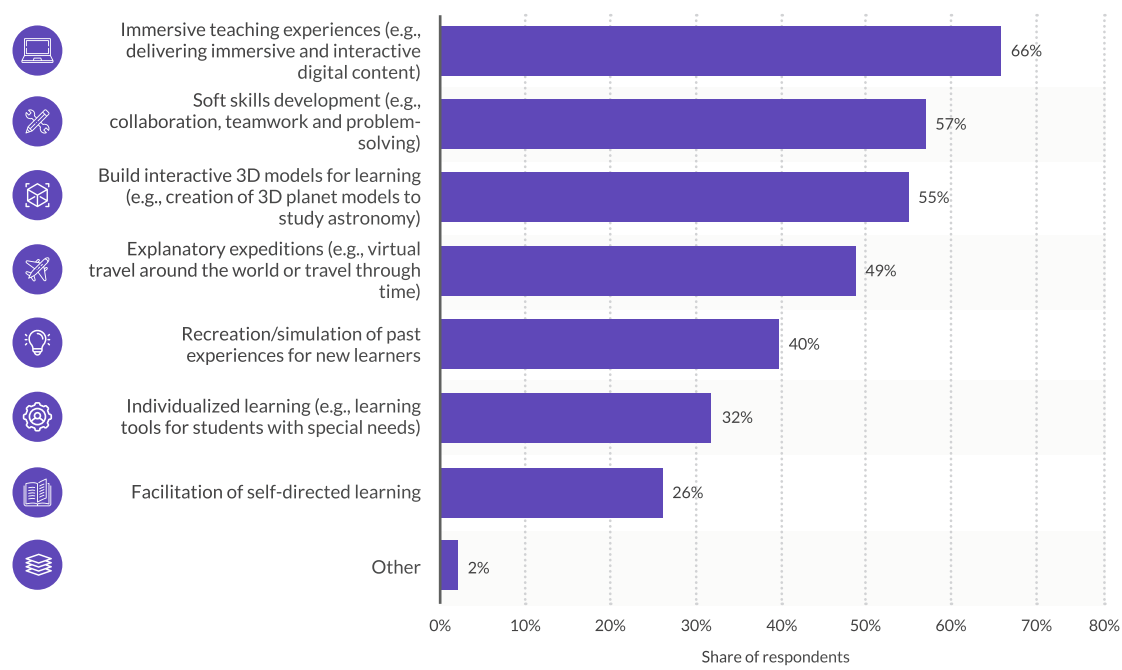

The photo above shows a NASA employee in the early 90's using a VR headset for simulation based training.
NASA Ames Research. (1990). Virtual Reality + 3D Internet [Photograph].

Regardless of the size of your organization, XR could play a critical role in the future of workforce education. As more employees are plagued with labour shortages and high turnover rates, XR could be the solution. During on-boarding processes, XR could provide a way to streamline and standardize training delivery. Imagine being able to assess a candidate's knowledge and skill level by simply handing them a headset for a virtual assessment. When new employees are hired, XR could help ensure everyone has the same baseline knowledge by individualizing the speed of training, giving those who need extra time the ability to take it without using up valuable production resources. Similarly, when it comes to re-skilling or upskilling employees, XR provides the option to do so quickly and efficiently outside of production hours.

The future of learning with XR, as well as its potential impacts across education and training, can already be seen today. COVID-19 has only accelerated adoption and shed light on critical flaws in our current digital and remote learning abilities. XR, if properly implemented, could help close the skills gap, reduce on-boarding/training time and help employees develop/retain technical skills in addition to soft skills. Finally, XR could help foster relations between industry and academia by developing innovative, intersectional XR based learning solutions.

Over the next two years, experts across North America see XR being utilized for multiple applications. The graph below highlights the most popular predicted use cases for the technology.

Application	Share of respondents
Immersive teaching experiences (e.g., delivering immersive and interactive digital content)	66%
Soft skills development (e.g., collaboration, teamwork and problem-solving)	57%
Build interactive 3D models for learning (e.g., creation of 3D planet models to study astronomy)	55%
Explanatory expeditions (e.g., virtual travel around the world or travel through time)	49%
Recreation/simulation of past experiences for new learners	40%
Individualized learning (e.g., learning tools for students with special needs)	32%
Facilitation of self-directed learning	26%
Other	2%

Share of respondents

How could XR impact the food and beverage workforce?

The impact XR could have on the food and beverage workforces are incredibly vast. This technology could help employers with labour shortages by allowing them to attract and retain employees within vulnerable and marginalized populations such as youth, people with disabilities and newcomers to Canada. By nature the technology is incredibly engaging for young people, the hands-on capabilities of the technology could help those with developmental disabilities better comprehend and retain information, plus the ability to quickly convert materials into multiple languages makes it a great tool to train Canadian newcomers.

The effects of XR could be seen long before an employee is ever hired. It could be used to recruit new employees by empowering them to virtually visit facilities in order to try out a job before even applying. This would enable job seekers to consider roles they might not have considered before or even reduce turnover by weeding out candidates who might not be as interested in a role.

Before a hiring decision is made, companies could use XR to conduct pre-employment assessments to truly understand an individual's competencies with minimal risk. For example, by putting a potential employee through a virtual forklift simulator, you could ensure they actually know how to safely operate one.

Once an employee is officially hired, a large portion of on-boarding and training processes could be done from the comfort of the employee's home. This type of on-boarding ensures that no time, or product, is wasted by training them in a live production setting. XR could be used to show them around the workplace, teach them technical, as well as safety, skills and even help them build their emotional intelligence by allowing them to simulate real life work scenarios. This training could ensure every employee starts work with the same baseline knowledge before they step into the workplace. Assessments built directly into training experiences can personalize that training to meet a user's unique learning needs, allowing those that need extra practice the time to take it while simultaneously allowing those with more experience the ability to get through training quicker.

This adaptive, at pace, learning will ultimately lead to more confident and productive employees in addition to less injuries and mistakes on the job.

During the first few weeks of employment, XR could also be used to help employees think through more complex processes by using augmented or mixed reality guides to navigate real world tasks. Things like paper manuals and inspection check-lists could be a thing of the past as XR optimizes a significant number of workplace processes.

XR could also be used for continuing education for employees without hindering production or using in-person training days that can be incredibly costly and disruptive to the workplace. With a VR headset, training content could be provided directly to employees at a time and place that is most convenient for both the worker and employer. Through scenario based training technical skills, safety skills, and soft skills can be continuously improved.

With the significant impact COVID-19 has had on the workplace, XR can also be used as a more engaging way to participate in remote collaboration and design. Whether employers are using it to simply host a virtual team meeting or work with engineering and design teams. XR's unique 3D nature could simplify rapid prototyping and/or product visualization.

Finally, XR could be used to empower front-line workers with the knowledge and expertise of more experienced employees. For example, in more urgent situations like specialized machinery break downs, mixed reality glasses could be used to quickly get the in-person support needed to troubleshoot without actually bringing the expert(s) on-site.

What are the benefits of XR?

Given the efficacy of XR technologies in training, there is a mass movement towards on-boarding them. The International Data Corporation (IDC, 2020) is the premier global provider of advisory services, market intelligence, as well as events for the telecommunications, information technology, and consumer technology markets. According to the IDC, enterprises are moving to XR with **$31.2 (USD) Billion** spent by 2023.

The most notable benefits of the technology include:

- *Reduced time/cost to train employees*
- *More focus/emotional connection to content during training*
- *Increased knowledge retention in short and long term*
- *Reduced workplace injury*
- *Increased efficiency in the workplace*
- *Improved productivity/performance*

E-learn
45 minutes

Time to complete training

Classroom
2 hours

VR
29 minutes

Source: PwC VR Soft Skills Training Efficacy Study, 2020

Regardless of the specific benefits of XR, all of the above examples lead to cost savings for companies that invest in the technology. These savings are found directly through reduced downtime and increased productivity, as well as, indirectly through things like reduced workplace injury and more confident employees. Throughout the report we dive deeper into the benefits of XR and provide real world examples of how the technology is already benefiting the companies that are using it.

Given the efficacy of XR in training, there is a mass movement towards onboarding VR technologies. The International Data Corporation (IDC, 2020) is the premier global provider of advisory services, market intelligence, and events for the telecommunications, information technology, and consumer technology markets. They say enterprises are moving to XR with $31.2 (USD) Billion spent by 2023.

Understanding the potential downsides of XR

Like all technology, XR also has potential drawbacks. XR experiences may lack flexibility, particularly for off-the-shelf VR training modules with company-specific or site-specific training programs which are costly to develop. Poorly developed experiences can also cause motion sickness (a.k.a cyber-sickness), vertigo, ataxia, disorientation, headaches, eye-strain, and nausea. Those who are unaccustomed to computerized learning systems may struggle with XR training, resulting in poor training outcomes. Moreover, a learning curve exists for understanding the software and developing the skills to use it for training purposes in addition to addressing any technical issues including hardware and software functionalities which may require troubleshooting.

Lastly, XR will never be able to perfectly replicate the real thing, especially when it comes to more tactile tasks that require incredible eye-hand coordination. Because of this, we encourage companies to blend the technology with their existing training practices thereby offering a hybrid type of learning using both traditional methods and XR technologies combined. As the hardware and software capabilities increase and the devices come down in cost, companies will be able to integrate the technology further.

SECTION 2: Understanding XR Technologies

Virtual Reality

Virtual Reality (VR) is a technology used to fully immerse an individual into computer generated worlds or experiences. Imagine you could simply close your eyes and step into the world of your favourite movie or video game, with VR you can do exactly that. The real world around you temporarily ceases to exist while you look around, move around and often times even interact with the digital reality that VR enables.

Although there are many different forms of VR, each requires two main components. The Head Mounted Display (HMD) and a computer generated experience. These experiences can be fully animated with 3D objects and worlds created from scratch or they can be created by stitching together real world photos and videos captured with a specialized camera.

VR headsets can range in both cost as well as immersion. The higher end equipment, though more expensive, can enable significantly more immersive, as well as, realistic experiences. All VR can be broken into two classifications **Three Degrees of Freedom (3DOF)** and **Six Degrees of Freedom (6DOF.)** 3DOF VR allows users to look up, down and side to side, but doesn't allow any forward or backwards movement. These experiences are typically the end result of content captured with a specialized 360 degree VR camera. 3DOF VR is more of a window into the virtual world as users can look around with very limited interactions. 6DOF VR is where the magic starts to happen! Users can move freely around the virtual world almost as naturally as they do in the real world. Most types of 6DOF VR also include a set of controllers that enables lifelike interactions with digital objects. With a high quality headset and a well designed 6DOF VR experience, a user will almost immediately feel as if they stepped through a portal into a completely new world.

Although there are many individual brands of VR hardware, there are three main types you can choose from.

PC BASED VR
Powerful but costly

Cost: $2500-7500 ★★★
These systems are more expensive since they need a gaming PC or laptop to process the graphics. That extra power leads to incredibly realistic and complex simulations that you can't get anywhere else.
Example: HTC Vive Pro + PC

STAND ALONE VR
Portable, limited power

Cost: $500-2500 ☆★★
These headsets are incredibly portable, but can be limited as they use a built-in graphics processing card to run experiences. These cards are similar to what you see in high-end smart phones.
Example: Oculus Quest, Vive Focus 3

3DOF VR
Low cost low immersion

Cost: $15-500 ☆☆★
These headsets are portable but are extremely limited as they often times run off a user's mobile phone and they are unable to run 6DOF, but are great for showcasing VR videos and photos.
Example: Google Cardboard, Gear VR

High-end PC based devices are currently the most popular among consumers. As the technology improves, stand alone headsets are set to become as widely adopted as PC based VR. 3DOF devices like Google Cardboard and Samsung Gear VR have already started to get phased out and will most likely continue to decline in popularity as they provide significantly lesser quality experiences when compared to their counterparts.

Augmented Reality

Augmented Reality (AR) is a technology used to show what computer generated objects or animations look like in the real world. The technology works by utilizing the camera and display on a smart phone or tablet. The camera captures a real-time recording of the world behind it, while the tablet display superimposes a digital object on top. Traditional AR experiences require some type of physical marker (like the blue pad in the image below) for the digital object to stick to. As the user moves the tablet around, the object stays fixed to the tracker creating the sense that object is really there.
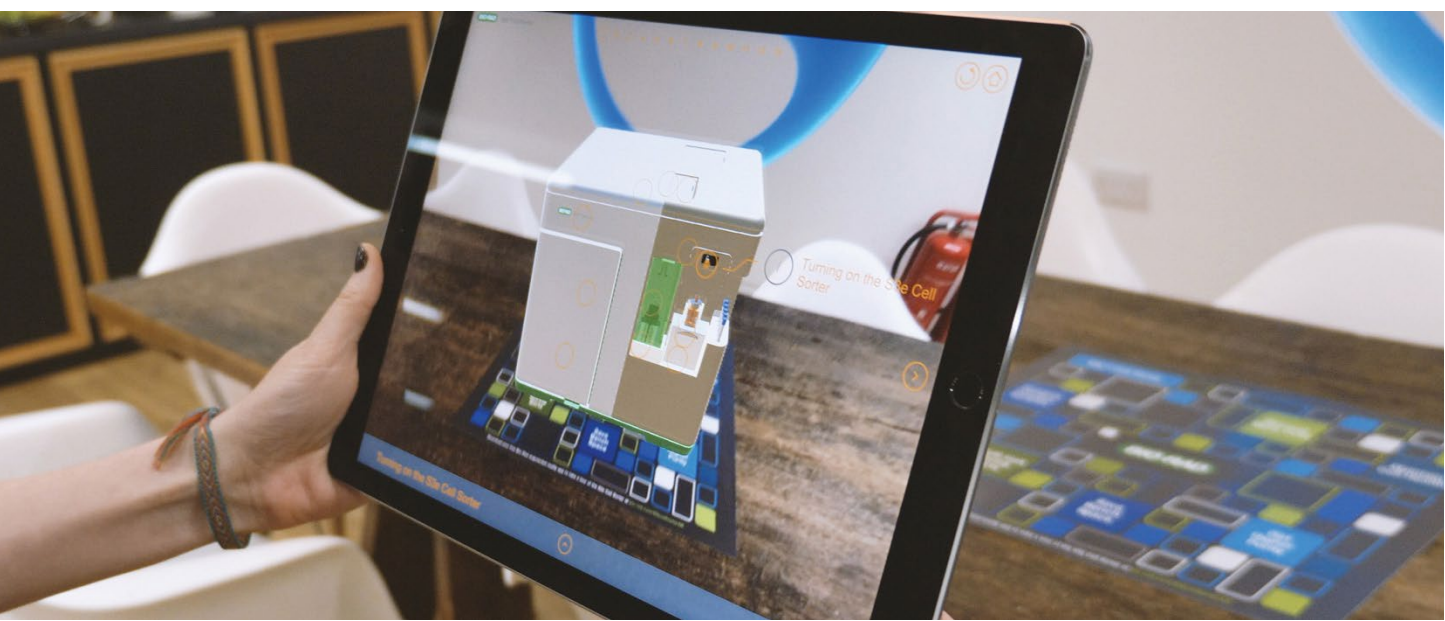
Newer smart phones and tablets no longer need trigger images for AR to work. They leverage multiple on board sensors and scanners to help the device understand the world around it.

More modern AR experiences can now incorporate things like physics, audio and other forms of haptics to make the experience incredibly realistic. Imagine, through the screen of your phone, a digital door appears directly in front of you. You tap on the door with your finger and all of a sudden out comes an animated character who starts walking freely around your world. With today's high end smart phones, these types of experiences are entirely possible.

It's important to note that, unlike Virtual Reality which is designed to immerse you into completely new worlds, Augmented Reality is designed to change the real world around you. The biggest limitation of AR is the need to hold a device in your hand and look through a screen to see the experience.

Mixed Reality

Mixed Reality (MR) is the newest and most unique technology in the XR family. It can be thought of as a hybrid between VR and AR, although some people prefer to call it another form of AR. Like VR, MR requires the user to wear a specialized set of goggles and, like AR, MR glasses still allow the user to see the world around them. With Mixed Reality, the real and digital worlds blend seamlessly together as interfaces are projected through the glasses. Since the device is worn on the user's head, one can simply use hand gestures to interact with the content and navigate digital screens. MR is often referred to as hands-free computing since the device is more powerful then the average laptop which allows a user to perform almost any task a computer could.

THE HOLOLENS 2
THE BEST MIXED REALITY DEVICE
AVAILABLE ON THE MARKET

The HoloLens 2, created by Microsoft, is the best in its class when it comes to commercially viable MR devices. Although they are relatively new, Microsoft already signed a **$22 billion** contract with the US Military to supply more then 120,000 devices over the next five years. Don't worry, you can still get one, but the device costs close to **$5000 CAD**.

Although there are many devices on the market advertising themselves as mixed reality headsets, there are only a few that come close to offering true mixed reality experiences.

For the purpose of this report, anytime we refer to mixed reality devices we can assume they offer a true mixed reality experience. These devices must have the ability to understand the environment around them and project realistic digital and iterative objects into the space around you. Devices like the Google Glass only offer a basic heads up display projecting text in the user's field of view. Although these other devices have some applications within industry, we don't consider them immersive and therefore excluded them from our definition of XR Technologies.

How is VR being used today?

In this next section, we explore the variety of ways companies around the globe are leveraging XR technologies within their organizations.

Technical Training

Training Heavy-Duty Crane Operators

Using virtual reality, a traditional 30-day activity-based training that required a 120 page manual was distilled into a 30-minute VR based activity.

Traditional training of heavy construction operators (e.g. heavy-duty cranes) is a long, drawn-out process. Typically, it starts with exposure of trainees to basic principles and design/configuration details of the equipment using manuals and drawings, which is then followed by demonstrations by experienced personnel. This process is required before trainees are involved in the operation of machines.

Both the American Fuel & Petrochemical Manufacturers in Houston, Texas, and Exxon Mobil in Baytown, Texas turned to VR as a solution. The objective of VR based training of heavy-duty crane operators was to provide a comprehensive understanding of the design/configuration as well as the control and safety aspects of the machines and to impart operations training. This immersive experience facilitates trainees to develop necessary proficiency in operation without supervision, so that the trainee can start performing independently within a short period of time.

As a result, the traditional 30-day activity-based training that required a 120 page manual was distilled into a 30-minute VR based activity. The immersive nature of VR based training of machine operators has proven to be effective. Trainees acquired real-life experience and a high level of knowledge retention. This method is also cost effective as it does not require expensive physical assets and can be repeated a number of times without major additional costs. The integration of purposeful mistakes by trainees provided rare experiences and impresses upon them the implications of these mistakes. Moreover, there was a significant rise in trainees' comprehension of crane operations and enhanced awareness of consequences and the means to avoid/mitigate those situations.

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EQUIPMENT TRAINING IN FOOD PROCESSING

Although you might not have a need for crane operator training, there are many off-the-shelf simulators for more standardized equipment like forklifts or elevated platforms. Some of these simulators can virtually replicate facilities so employees can practice in the same environment they will be working in. If you have more complex, and potentially proprietary equipment, there are many VR firms that can work with you to create a virtual duplicate thereby reducing downtime and risks associated with training employees on the real thing.

Bhagwat, P.S., Moreno, D., Davis, W., Moshasha, S., Deatherage, R., Neeter, E., McKee, N., & Allen, T. (2021). VR/AR in the energy sector [White paper]. VR/AR Association.

Training Nuclear Facilities Operators

The VR solution was found to improve the capabilities of participants through intensive VR training and contributed to the reduction of cost and risk.

Due to strong regulatory controls, nuclear training is provided by a limited number of suppliers offering traditional training. Under traditional procedures, training requires complex mock-ups which are expensive to maintain. Physical mock-ups limit the scope of training and training needs vary based on the specific site conditions. For example, General Electric Hitachi Nuclear Energy sought to address the cost of fuel movement (FM) operations. This is a complex and highly skilled activity requiring high level expertise and training, as well as exceptional coordination between the different parties involved in the fuel movement process. VR training was identified as an opportunity for training in the most efficient and cost effective manner.

An FM VR simulator aims to improve capabilities through intensive training while reducing cost and risk. It replicates the complex process thereby permitting multi-user collaboration in a VR nuclear environment by replicating the process with tactile and haptic feedback. A physical replica of the refuelling mast is connected to the virtual environment, enabling the user to carry out virtual fuel movement operations as if they were doing so in reality. The experience also introduces unplanned failures to challenge the trainee and to improve their capabilities.

The VR solution was found to improve the skill sets of participants through intensive VR training and contribute to the cost/risk reduction. Moreover, these VR systems allow for just-in-time, customized training solutions on-site that contribute to training and quality cost reduction. Given recent travel restrictions and social distancing requirements due to the pandemic, this VR solution allows remote interconnectedness even on an international level.

THIS PROJECT LEVERAGED HAPTIC FEEDBACK HARDWARE

In the above photo, there is a small black sensor connected to the front of the user's VR headset. This sensor allows them to see and use their own hands in the virtual environment rather than paddle style controllers. The experience also leverages a physical control panel that replicates one used in a nuclear plant. This configuration allows the user to receive lifelike feedback from the physical control panel helping them memorize exactly how the process feels and not just the required step-by-step process.

Haptic hardware can be custom built for unique applications or even off-the-shelf haptic gloves, like the photo on the left, that can be leveraged to further enhance physical haptics in a virtual experience.

Bhagwat, P.S., Moreno, D., Davis, W., Moshasha, S., Deatherage, R., Neeter, E., McKee, N., & Allen, T. (2021). VR/AR in the energy sector [White paper]. VR/AR Association.

VR for Manufacturing Training

Users who undergo training through VR are more efficient, correct errors more quickly, and have a higher feelings of confidence compared to users who underwent traditional training.

Governor Kay Ivey's 2018 goal for the Alabama workforce was to add 500,000 highly skilled employees by 2025. To address this goal, AIDT (Alabama's State Workforce Development Agency) expanded its partnership with Hyundai Power Transformers to provide access to VR manufacturing training to unemployed workers and those who aspire to join the manufacturing industry.

The TRANSFR VR program provided access to VR simulations of Hyundai Power Transformers' seven-story manufacturing facility. Within the VR simulation, Oculus Quest headsets allowed workers to gain first-hand experience with the safety protocols needed to operate heavy machinery and equipment of up to 400 tons and the experience of lifting 800 ton power transformers.
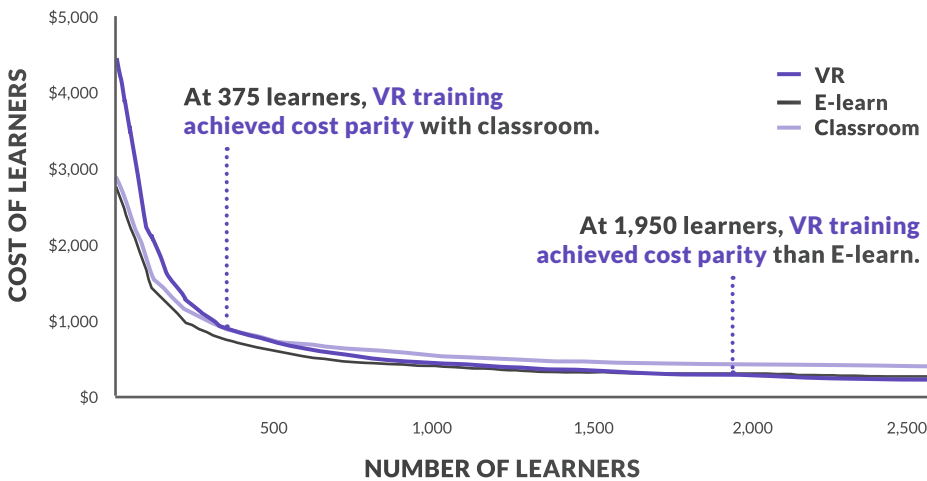

The TRANSFR training initiative facilitates employees' learning how to operate and service cranes in accordance with increased compliance for OSHA industry standards (Business Wire, 2021.) Moreover, the application of VR is making job training in Alabama one of the fastest-growing industries accessible to thousands of unemployed workers aspiring to be manufacturing professionals across the state (Business Wire, 2021.)

TRANSFR has found that users who undergo training through VR are more efficient, correct errors more quickly, and have a higher feeling of confidence compared to users who underwent traditional training (Selko, 2021.) Moreover, nearly half of the trainees scored at or above **90%** on the real-world transfer test with no prior coaching or hands-on experience with the tools (Selko, 2021.)

VR training allowed for the implementation of highly consistent, repeatable training and is being increasingly utilized in industries that require either heavy-duty safety training or customer interfaces including warehousing, law enforcement and food services. VR training is especially useful for employers that need to train large groups for repetitive tasks or who need to train for facilities or equipment that are difficult to access (Moody, 2021).

Training modality cost per learner

At 375 learners, VR training achieved cost parity with classroom.

At 1,950 learners, VR training achieved cost parity than E-learn.

Source: PwC VR Soft Skills Training Efficacy Study, 2020

Moody, K. (2021). Alabama partners with Hyundai for VR manufacturing training. Healthcare Dive.

Safety Training

General Safety & Hazard Awareness Training

With VR, Tyson Foods was able to reduce workplace injuries by more than 17% after implementing the technology.

Tyson Foods investigated a variety of technologies for awareness and training which resulted in the identification of VR technology as the solution for training staff to use equipment and handle foods in a safe manner. Tyson's innovation team called in STRIVR to identify the biggest gaps in Tyson's training and to identify a specific training program to figure out how best to enhance the current training using the platform.

The goal was to reduce injuries by **15%** over the 2017 fiscal year and, with VR technology, a **17%** reduction was actualized. VR was able to transcend language and cultural barriers allowing Tyson to leverage the tool across employee populations. For managers, VR is providing better training for their own work as the data can now be collected on how team members respond to certain processes which allows managers to adjust their approaches. As the trainer is better able to understand the task at hand through VR training, the employee is simultaneously learning new skills and better work quality. Initial survey results from Tyson's pilot program reported that **89%** of learners said they felt more prepared after VR training.

THIS PROJECT LEVERAGED 360 DEGREE VR VIDEO

A specialized 360 Degree Camera, like the one on the left, was used to create the safety training experiences for Tyson foods. The biggest benefit of this technology is that it is incredibly cost effective when compared to computer generated VR. The reason for this is no developer or 3D artist's time is required to create the scenes. Instead, scenes are staged in the real world with actors and props and recorded with the camera. The panoramic images are very similar to what you might see when looking at Google street view except, when you wear a VR headset, you feel fully immersed in the scene.

GET INSPIRED
HEALTH AND SAFETY TRAINING IN FOOD PROCESSING

This example is much easier to comprehend as it's already based in the food processing sector. It's also one of the more cost effective experiences as the material can be created internally with a 360 Degree or 180 Degree VR camera (basic editing skills.) The easiest approach would be to work with your current training team to capture videos of health and safety techniques being demonstrated. Once the videos are captured, they could be uploaded in to a VR video library and viewed by employees with VR headsets. After viewing the videos, post assessments could help measure retention. More complex iterations of this can include questions and basic virtual activities in between scenes to test an employee's knowledge throughout the process of watching the content, this approach would require some additional programming.

O'Donnell, R. (2018, September 18). Tyson Foods reduces worker injuries, illnesses with VR safety training. HR Dive.

Replicating Real-Life, High-Risk Scenarios With VR in Aviation

Training using VR provided a faster route to competency development of trainees. Crews of trainees experienced a greater breadth of scenarios resulting in better trained people at a reduced cost.

The International Air Transport Association (IATA) faced a challenge of how to train employees effectively if they are unable to learn on-site by experiencing work in real life situations. IATA needed to establish a training program that would provide trainees with extensive classroom-based learning, mixed with shadowing experienced staff. While this gave trainees a thorough theoretical grounding, it did not give them a real sense of the space they would be working in, including the impacts of adrenaline, fear, and a sense of things "going wrong" or their reactions and decision-making skills. Dimitrios Sansos, Senior Product Manager of Airport, Fuel & Ground Operations Training and Publications expressed his concerns and identified VR as a solution:

"The most effective way to learn is through experience. In live operations it's very difficult to show people what can go wrong and how you can mitigate. Everything is smooth when operations are running in a very safe way. You don't have the chance to show them what can go wrong...In the virtual environment, you can replicate error issues that we know exist in the industry and you can do it several times without affecting any real operations or any real equipment."
(Duhon & Trevino, 2020)

IATA developed RAMPVR, a VR technology to replicate real-life, high-risk scenarios in which people can learn safely. Participants were placed in a variety of scenarios to address operational issues such as foreign object debris and marshalling aircraft. In the marshalling module, trainees used VR controllers to perform the correct hand signals used on the tarmac. Using a neural network trained to understand these gestures, participants could signal to aircraft in VR and the aircraft would react as it would at the airport, enabling a new level of immersion in the training scenario.

Being fully compatible with IATA standards, this VR training was integrated into IATA's training program to compliment classroom-based learning. It has built-in metrics to track and monitor each participant's performance which is fed in to their overall training record. Training using VR provided a faster route to competency development of trainees. Crews of trainees experienced a greater breadth of scenarios resulting in better trained people at a reduced cost. Training without risk of damage and the opportunity to practice multiple times without tying up expensive equipment were additional outcomes.

In the photo above you can see an example of training for ground maintenance engineers within aviation practicing in a high risk environment like an active runway where mistakes could lead to death.

Duhon, A., & Trevino, S. (2020). Virtual reality (VR) and augmented reality (AR) best practices for the aerospace industry [White paper]. VR/AR Association.

Soft Skills Training

Leadership Training with VR

Companies like T-Mobile, Google, Johnson & Johnson, Blue Cross Blue Shield, and Genentech that used VR witnessed their employees becoming better communicators.

Coca-Cola sought a way to scale its global leadership training for 1,300 managers. This new program was aimed at high-performing employees who previously reported dissatisfaction with traditional peer-to-peer role-play in the company's training programs.

Mursion curates immersive VR training for emotional intelligence in the workplace to help employees and managers practice diffusing, de-escalating, and redirecting office conflicts. Coca-Cola turned to Mursion's customized VR simulations which allowed the leadership program cohort the opportunity to have authentic, high-stake conversation practice. The platform establishes consistency and scalability for managers across all geographic regions of the company and provided skills measurement as well as needs identification for individuals and the organization as a whole.

The result was that engagement of participants **tripled** in the span of nine months. The effects of the program have been long-lasting, and the self-paced immersive training is now available to all participants in the entirety of the company's regional workshops.

Mursion works with many Fortune 1000 companies including T-Mobile, Google, Johnson & Johnson, Blue Cross Blue Shield, and Genentech. These companies witnessed their employees becoming better communicators. The applicability spans from leadership development, customer service, performance reviews, diversity and inclusion training, and settling office conflicts. The software was originally developed at the University of Central Florida to help teachers in The School of Education practice working with children with disabilities prior to the in-person experience.

Improvement in confidence acting on issues of diversity and inclusion after the training:

Classroom	198%
E-learn	203%
VR	275%
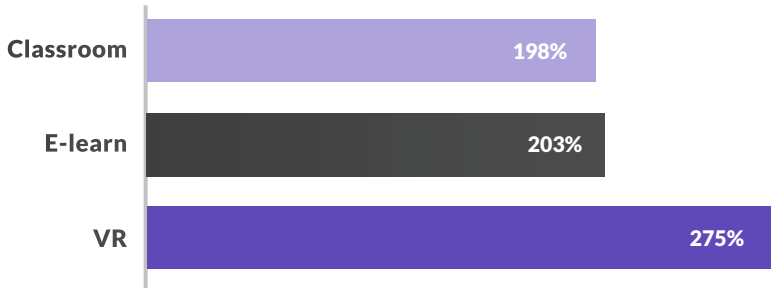
Improvement in confidence discussing issues of diversity and inclusion after the training:

Classroom	166%
E-learn	179%
VR	245%
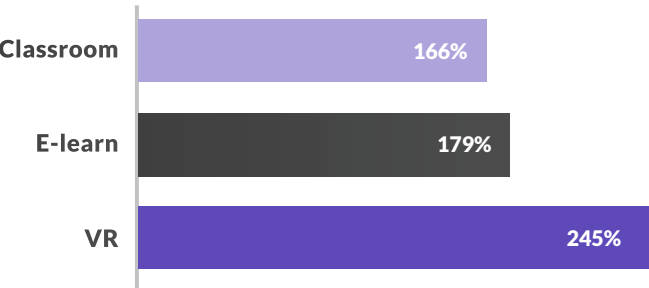
Source: PwC VR Soft Skills Training Efficacy Study, 2020

THIS PROJECT LEVERAGED LIVE MOTION CAPTURE

Motion capture technology uses the movements and facial expressions of actors to power the computer generated avatars in a simulation. Mursion takes advantage of this technology to enable more natural, free flowing conversations during training exercises. A single actor can jump between avatars playing multiple roles in a single training session.

This can be beneficial as traditional experiences use a more scripted approach where trainees have to select from a list of pre-programmed responses if they want to interact with avatars.

Clifford, L. (2020, December 2). This new VR simulator helps you prepare for the most awkward office encounters. Fortune.

Empathy & Customer Service Training with VR

Walmart uses VR with over one million employees, immersing them in real-life social situations designed to build emotional intelligence.

Since 2017, Walmart has used VR for employee training and development through integration of the technology at Walmart Academies nationwide. Walmart uses VR to train associates in three main areas: new technology, soft skills like empathy and customer service, and compliance. This has been extremely successful, and the company now provides Oculus VR headsets to all stores in the U.S. to bring the same level of training to more than one million employees. Andy Trainor, Walmart's senior director of Walmart U.S. Academy elaborates:

> **"The great thing about VR is its ability to make learning experiential. When you watch a module through the headset, your brain feels like you actually experienced a situation. We've also seen that VR training boosts confidence and retention while improving test scores 10 to 15 percent – even those associates who simply watched others experiencing the training saw the same retention boosts." (Andy Trainor, 2018)**

Walmart's senior director of digital operations worked with Trainor to on-board VR for employee training encompassing more than 45 activity-based modules using industry-leading software provided by STRIVR. STRIVR's platform delivers realistic, repeatable and scalable training content, which helps employees learn and retain information more quickly.

Average emotional connection felt to learning content

Category	Value
Classroom	4.29
E-learn	5.29
VR	20.43
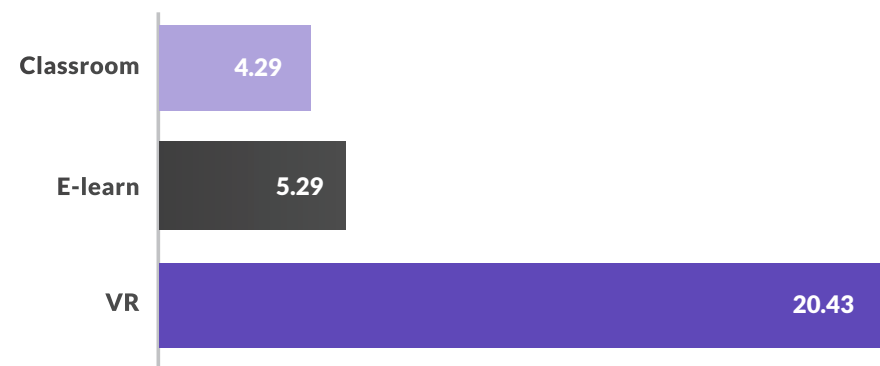
Source: PwC VR Soft Skills Training Efficacy Study, 2020

One of the reasons VR is so effective for helping individuals build empathy and emotional intelligence is its ability to immerse us in scenarios from multiple perspectives and connect with the content on an emotional level. From the point of view of employees, customers or supervisors, these role reversals help develop a better understanding of what it's like to walk in someone else's shoes.

Incao, J. (2019, September 23). How VR is Transforming the Way We Train Associates. Walmart.

Productivity & Performance

Personalized on the Job Training with Mixed Reality

Through gamifying, personalizing, and shortening the training process, Mixed Reality made the on-boarding of new employees to workspaces easier and more pleasant. Employee satisfaction and service quality increased, as well as profitability of the business associated with quickly adapting new employees.

The frequently high number of mistakes and slow nature of junior food service employees has a negative result on sales and customer satisfaction. Considering the elevated turnover rates and poor training processes in the fast-food sector, MR technology is having a vital impact on employee training. In this study, mixed reality glasses were used to train fast-food kitchen employees to increase speed, efficiency, service quality, and lower labour costs.

New employees were given a set of Mixed Reality glasses to wear while they prepared food. The employer programmed each step of burger preparation into the software, considering the trainee's hands would be occupied while preparing the burger. Three alternative triggers to move to the next part of the process: talk-to-text, head gestures, and marker-based object detection.

Although no photo examples of the tool previously mentioned were publicly available, we can imagine it looked and functioned similarly to the image above. Through the MR glasses, an employee could navigate a list of tasks like making a dish. Once they selected a task through hand gestures or voice command, the experience would walk them through each step allowing them to see their progress as they got closer to completion. Additional visual indicators could also be used to help identify ingredients or tools and pre-recorded videos could also be embedded into view to help them further understand and practice more detailed techniques such as cutting.

GET INSPIRED
MIXED REALITY STANDARD OPERATING PROCEDURES

With a device like the Microsoft HoloLens 2, organizations with an off-the-shelf application like Dynamics 365 Guides you can quickly and easily create Mixed Reality SOPS for everything from the steps needed to properly create a product to the steps needed to inspect and perform preventative machine maintenance. Think about procedures within your workplace that often times are done incorrectly or can only be done by employees with extensive knowledge and start there. Create guides that can be utilized during the procedure with callouts and/or photo or video references embedded directly into them. These guides can also be set up to automatically generate reports to give you an immediate snapshot of what was done and the time required.

Mixed Reality for Remote Support & Inspection

Technicians at Siemens completed maintenance tasks much faster and more accurately, minimized human error, and immediately recorded service reports in the field using MR glasses.

For more than 170 years, innovation and creativity have been at the heart of Siemens' company culture. Using the Microsoft HoloLens, technicians working on Siemens' fleet of electric freight trucks are able to view all the relevant information needed to prepare the vehicle for operation at any location. The service employee has full access to all necessary documents and information through the mixed reality interface. The interface guides technicians through service reports and prompts them on all necessary measurements needed for report implementation. Technicians use audio commentary to document and record results making them immediately available to all other departments.

If technicians run into issues while completing a report, Mixed Reality makes remote collaboration with experts anywhere in the world a breeze. The photo to the right displays what a remote collaboration session with MR looks like. The technician wearing the headset can see the person they are calling in an interface that can hover directly above the work surface. The person on the other end can see exactly what the technician is seeing through the cameras on the front of the headset. During a call, the spacial annotations can be drawn in by the person on the other line further helping the technician to quickly navigate the intricacies of the machinery being worked on.

LEVERAGING DATA TO TRACK PERFORMANCE

XR experiences can also help employers better understand how employees are preforming by tracking time to completion and time in between tasks as users go through digital manuals and inspections in real time. Once employees have baselines for how long tasks should take, performance expectations can also be embedded into the experience letting users know how much time they have left to complete a particular task.

GET INSPIRED
REMOTE SUPPORT IN FOOD PROCESSING

If you have any incredibly specialized equipment in your facility, that only a few people are capable of fixing when problems arise, the HoloLens with the off-the-shelf Remote Assist application could be an huge time and money saver. Consider costs you might have incurred from flying in specialized repair people or downtime due to equipment failure and assess if something like a MR headset could have streamlined the process.

Duhon, A., & Trevino, S. (2020). Virtual reality (VR) and augmented reality (AR) best practices for the aerospace industry [White paper]. VR/AR Association.

XR for Remote Collaboration & Design

As the fight against COVID-19 continues, technology makes it possible for us to work, learn, and interact with one another while remaining physically distant. XR is driving a new generation of collaborative tools for business and education.

XR has another unique use case that helped boost productivity as well as allow for collaboration despite geographical or physical restrictions. There are many examples of how XR is being used for collaboration which are listed below. The most popular collaboration platforms allow users to connect with the XR device of their choice.

ARCHITECTURE, ENGINEERING & PRODUCT DESIGN

The 3D nature of XR allows designers and engineers to work together like never before. Allowing them to view buildings, products and complex mechanical systems together in a 3D space. There are several great XR collaboration platforms that make it easy for users to place AutoCAD models directly into XR making it easy to visualize and make design changes on the fly.

REMOTE WORK AND MEETINGS

Many companies are turning to XR to combat Zoom fatigue caused by the realities of the current pandemic. Users can join virtual meeting rooms using any XR device and those who don't have XR can join through desktop or smart phone. The virtual rooms allow people to gather in a group meeting space where employees can share files, use virtual whiteboards, screen share and pull in resources from the web.

LIVE TRADE SHOWS AND CONFERENCES

With the cancellation of most major in-person events in the past year, XR has empowered vendors to carry on virtually with trade shows and conferences. Vendors can create and/or customize virtual booths showcasing their products while users explore freely, join keynotes and interact with other participants. Similar to remote work, those without VR headsets can still join with desktop or mobile phone.

GET INSPIRED
### XR COLLABORATION IN FOOD PROCESSING

Using XR to collaborate with your front-line workers might not be feasible as they are assembling product, but working with your business and operations teams across multiple sites and locations could dramatically improve the way your employees work together particularly with the level of Zoom fatigue brought on by COVID-19. Depending on the collaboration platform you choose, employees could use an XR device or just join with a cellphone or desktop if they aren't yet comfortable with the technology.

Reducing Equipment Downtime with Mixed Reality

Using Mixed Reality, Ganong Bros. Limited are able to bring technicians from all over the world into their facility virtually.

Located in St. Stephen, New Brunswick, Ganong Bros. Limited is a manufacturer of confectionary and chocolate items that occasionally faces critical downtime events due to equipment failure. Since their equipment comes from all over the globe, they traditionally rely on the original equipment manufacturers to come on-site to troubleshoot.

COVID-19 made their traditional approach nearly impossible due to travel restrictions. In order to solve this issue, they turned to the Microsoft HoloLens and a remote support application called Cognitive Spark. Rather than rely on sending cellphone videos, emails and voice calls back and forth to equipment manufacturers, the HoloLense allows Ganong Bros. employees to put on the device and remotely call technicians. Technicians can see exactly what the person wearing the headsets sees and they can quickly direct employees around the equipment, allowing them to drop multiple forms of media into the employee's view to help them troubleshoot issues.
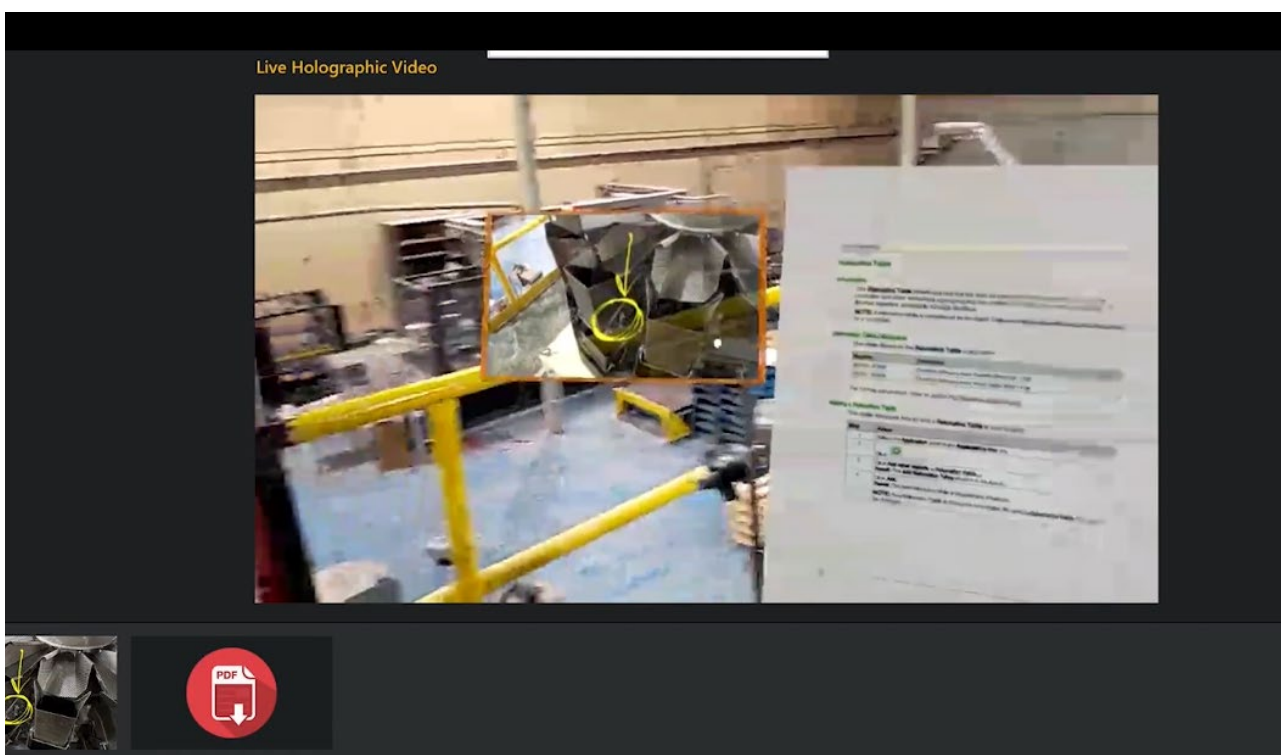
The photo above shows a first person view of what a technician would see from their computer screen while a Ganong Bros. employee wears a mixed reality headset. You can see a photo and PDF has been virtually dropped into the employee's field of view.

When their starch conditioning machine broke down, they where able to have an OEM in Colorado virtually on-site within two hours. The OEM was able to quickly walk them through various tests and identify what needed to be done to get things operational. Without the HoloLens and Mixed Reality, they would have had to halt operations for much longer.

In another instance, the company planned to purchase a high speed bagging machine. The original plan was for the team at Ganong Bros. to travel to Atlanta to visit the original equipment manufacturer, then travel to Germany for factory approval testing before the machine was shipped to them in New Brunswick. Once the equipment was received they had also planned to have manufacturers come on-site to complete installation and provide training. However, due to COVID-19, no travel could take place and the equipment showed up on their doorstep like an Amazon package. Using Mixed Reality, they were able to complete installation and training without in-person support and avoid months of potential delay.

Design Optimization of the Production Process

Ford Motor Company uses Virtual Reality to help engineers optimise production process by understanding how workers move within it.

At the virtual manufacturing lab, Ford's team uses VR in combination with 3D printing to create virtual workstations that will eventually be replicated on physical production lines around the world. With the use of sensors strapped to an employee, full-body motion capture provides data on how a future production line worker would have to move in order to assemble subsystems for a new vehicle.

A key point of using VR to plan production line workstations is that, if something is easy to build, it both enhances quality and reduces the risk for worker injury.

Since implementing this virtual manufacturing programming the automaker has:
- **Reduced employee injury by 70% using the latest ergonomic research**
- **Reduced over-extended movements, difficult hand-clearance and hard-to-install parts on new vehicles by 90%**
- **Reduced employee days away from work due to injury by 75%**

In the photo to the left, you can see someone wearing a VR headset next to a white 3D printed object, which is a dimensionally-accurate transmission. He has been asked to line up the transmission (which you can see) with the engine (which only he can see) in his VR headset.

This was an actual test used to make sure workers would have a good sight-line to the bolt holes needed to attach the engine to the transmission. Based on the VR results, information went back to engineering team, requiring the length of the bolts to be changed in order to allow for easier, less strenuous assembly.

GET INSPIRED
DESIGNING NEW PRODUCTION FACILITIES IN VR

As a food manufacturer, the production process is critical to your business. If you are planning on expanding your production facilities, consider using VR as a way to virtually map out what the physical production and assembly lines could look like. Even without the same complex motion capture technology Ford had, simply having employees walk around the virtual space could help you gain incredible insight into how your employees move and allow you to try rapidly try multiple layouts to catch potential problems before they arise.

Other Applications of XR

Marketing & Advertising

XR can help consumers visualize products or help brands engage with consumers in a meaningful way.

Toyota and its agency 360i collaborated with their industry partner to create a VR consumer experience that would curb distracted driving among teens. The object was to deliver a VR experience that provided a realistic simulation of distracted driving while providing educational insights for the user. Toyota desired the VR experience to garner attention at American auto shows and national events in the USA, including the South by Southwest (SXSW) Conference & Festivals that converge interactive, film, and music industries.

The VR distracted driving experience was designed using an Oculus Rift headset and 3D sound by VisiSonics. Over nine major markets, **20,000** participants experienced the distracted driving simulation. Participants were situated in an actual Toyota vehicle using both the steering wheel and pedals which were integrated into the experience. Participants were required to drive in the 3D environment while managing audio and visual distractions (e.g. passengers, incoming text messages, and external hazards). The simulation often ended in an accident.

Participants were surveyed to identify what they learned and how the experience may impact their driving behaviour. It was revealed that **94%** participants planned to reduce future distractions following the experience. The VR experience generated over **277MM** media impressions and received over **37** original stories from outlets such as USA Today, NBC and Fast Company.

Coca-Cola Hellenic is one of the largest bottlers for the Coca-Cola Company, operating in 28 countries. To sell new coolers and equipment at the point of sale, their field reps used to rely on standard PowerPoint presentations with 2D images of the proposed materials. This process created uncertainties as the buyer had trouble figuring out where the point of sale materials would best fit.

Augmented Reality completely revolutionized the sales process by allowing reps to create real size simulations of the ideal POS placement to share with their client. Sales reps can now close deals more efficiently while also securing the best placement for their equipment and their buyers can make more informed decisions. AR helped Hellenic increase sales on cooler items, shorten the overall time for customer approval and reduce returns.

> *GET INSPIRED*
> *SELLING WITH AUGMENTED REALITY*
>
> ───────────────────
>
> Your product doesn't need to just have custom display cases in order to leverage AR. You can help consumers visualize your products by creating models of various food and beverage items and allowing customers to engage with them via social media platforms like Facebook or Snapchat or even host digital assets on your company website.

Worrell, D., & Moshasha, S. (2018). Virtual and augmented reality best practices for advertising + marketing [White paper]. VR/AR Association.

Gamified Training & Experiential Marketing

Since 2017, KFC has been training employees and inspiring the next generation of cooks with a VR game called **"The Hard Way – a KFC Virtual Training Escape Room."**

In a 25-minute process, employees need to virtually prepare fried chicken to "escape" and win. The VR simulation gamifies the Colonel's proprietary, once-patented, process for pressure-frying chicken using his recipe of 11 herbs and spices. The game is intended to supplement KFC's current multi-step employee training program with the overall goal of boosting food quality.

The immersive VR experience was designed and built by Wieden and Kennedy. After completing the five steps to making KFC chicken, (inspecting, rinsing, breading, racking and pressure frying) employees exit the training kitchen with a high-level glimpse of what goes into cooking Original Recipe chicken. This training tool was also released to the general public as a way to educate people on the process of how KFC prepares their chicken while also leaving them with a positive and long lasting impression of the brand.

The photo above you can see a screen shot of the KFC game. Unlike traditional approaches to training in VR, this experience took on very different look and feel. The focus was on the story and the experience first which is the best way to apply gamification learning.

Taylor, K. (2017, August 24). KFC has a terrifying new game to train employees. Business Insider.

Getting Started with XR?

As a company in the food processing sector, there are many ways you can get started with XR technologies regardless of the size of your organization. In this next section, we look at the specific ways you can get started with the technology and what you can expect in terms of cost.

Getting Started With VR

With the incredible range of ways VR can be used, it's important to truly understand your organization's pain points before going out and buying your first VR headset. Once you understand the problems you are trying to solve, you can begin to explore potential off-the-shelf solutions that could solve them or avenues to create custom content yourself.

Choosing Your Headset

We highly recommend for your first VR headset that you invest in a system that allows both 3DOF and 6DOF VR. The Oculus Quest 2 and the Vive Focus 3 are great starter headsets as they are standalone devices that can be tethered to a PC should you choose to explore the high end experience that PC VR has to offer down the road. We also recommend starting slow with one or two headsets. Once you are comfortable with the technology and the solutions you want to implement, you can look at expanding your fleet of headsets. Both headsets cost around $2000 CAD for the enterprise edition. Be sure to buy a case for the headset and some hygiene accessories like disposable face covers and wipes as well.

Off-the-shelf content

There are several great, pre-built experiences that you can invest in the day you get your headset. For team collaboration, EngageVR or Spatial are great beginner experiences. When researching pre-built content be sure to check headset compatability.

360 Degree Video

If you can't find the right off-the-shelf content, consider investing in a VR camera. Mid-range cameras can cost around $2500. Editing VR photo and video is as easy as editing 2D video. This could be a quick way to create virtual tours of your workplace for on-boarding and orientation.

Custom Built Content

Computer generated VR experiences developed from scratch can be cost prohibitive for small companies. Training simulations typically start at around $50,000 and get more expensive the more complex they get. However, if you're a larger company, the ROI is much easier to identify. There are also several grants available to companies investing in innovative training solutions that can offset the cost of custom development.

Getting Started With AR

Getting started with Augmented Reality can be much easier as most smart-phones and tablets already support the technology. There are only two routes to consider when getting started with AR. First is to consider what off-the-shelf experiences are available and second is exploring custom AR development. Since custom development can be as costly as VR development, we will focus on a few great off-the-shelf apps that can get you started for under $100 and a few hours of your time.
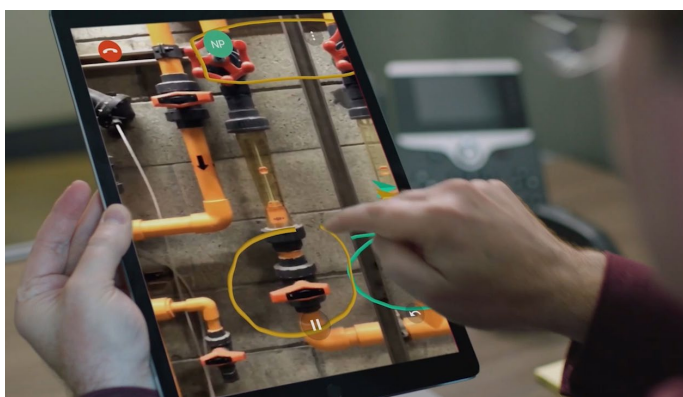
VUFORIA CHALK:
REMOTE AR COLLABORATION

Vuforia Chalk turns your smart phone into a powerful, visual tech support tool. Once the app connects you and a co-worker on a video call, you use your phone's rear camera as a viewfinder to show exactly what you need help with. Both parties can then draw on the screen with AR chalk that works like visual annotations, letting you find the right buttons, dials, and controls without the confusion caused by solely verbal descriptions.

AUGMENTECTURE:
AR VIEWING OF AUTOCAD FILES

AUGmentecture is a service to view complex 3D models on a mobile device in an AR format. With the help of the AUGmentecture plug-in, you can seamlessly and securely upload 3D models and floor plans directly from Autodesk® Revit® to your AUG account to view them later with your mobile device. AUGmentecture's goal is to make AR a day to day design communication and collaboration tool for architects, designers, and artists.

PLACENOTES:
CREATING AR GUIDES

Placenotes makes it simple to build practical AR experiences that can make the lives of on-site workers easier in the construction, maintenance, manufacturing and inspection industries. The app allows users to create and share AR guides to help a new employee get around or even help someone remember all the key items they need to inspect.

Getting Started With MR

Since Mixed Reality is still so new compared to the other technologies, the only headset we recommend is the Microsoft HoloLens 2. It's an incredibly robust piece of hardware that is ready to be implemented into almost any workplace. The device costs around $5000 CAN and most apps cost around $100 a month per user. The two most notable MR apps available on the HoloLens 2 are noted below.

DYNAMICS 365 REMOTE ASSIST

Microsoft's Remote Assist allows you to share your real-time view with experts remotely to get the help you need while staying hands-free. This app also enables experts to make spacial annotations similar to Vuforia Chalk mentioned previously under AR apps.
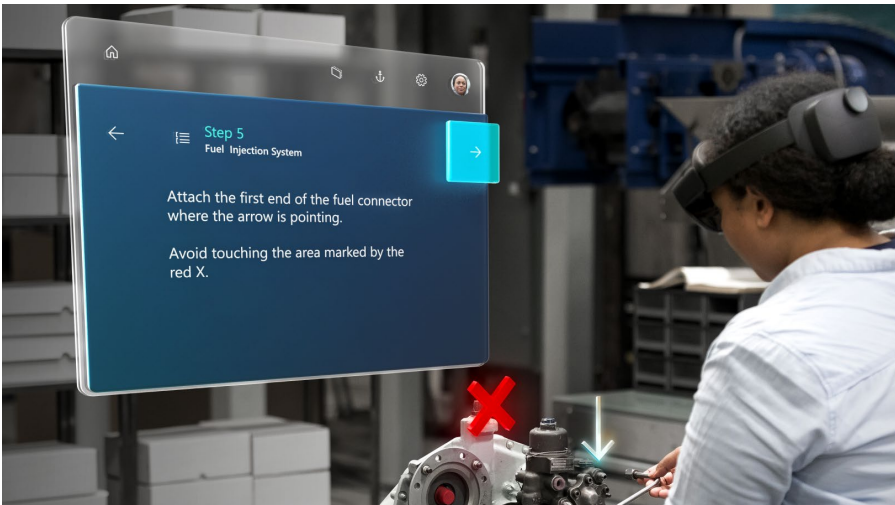
DYNAMICS 365 GUIDES

Microsoft Dynamics' 365 Guides is a Mixed-Reality application for the Microsoft HoloLens 2 that helps operators learn during the flow of work by providing holographic instructions when and where they're needed. These instruction cards are visually tethered to the place where the work is to be done and can include images, videos, and 3D holographic models. Operators see exactly what needs to be done, and where, so they can get the job done faster, with fewer errors and greater skill retention.

Summary & Recommendations

As demonstrated by the wide range of use cases throughout this report, XR technology has already exploded in popularity amongst many mid to large sized companies across the globe for things like education and training to productivity and performance. Although the technology is relatively new to the food and beverage sector with only a few known brands leveraging it today, XR has the potential to play a critical role in supporting companies of all sizes within the industry. In order to minimize risk and maximize the potential benefit for companies in the sector we recommend the following:

GET TO KNOW YOUR END USER AND THE PROBLEMS YOU ARE TRYING TO SOLVE

Before you dive into the deep end, it's critical you understand who your audience is and the problems you're trying to solve. There is a wide range of XR technologies and applications available for businesses to utilize. It's important to understand that some populations will be much more receptive to using new technologies than others. XR can be incredibly beneficial for youth, people with disabilities or those who struggle to absorb knowledge through traditional teaching methods such as sitting in a classroom or reading training manuals. Understanding who the end user will be and including them in the conversation early on will help to identify considerations during the planning process.

It's also important to clearly understand the problems you are trying to solve. Like all tools in a tool belt, XR can be incredibly beneficial in some areas and not in others. For example, XR is a game changer for things like safety training or remote support, whereas teaching someone how to use basic hand tools or perform tasks that require fine motor skills would not be as beneficial due to cost or lack of tactile feedback in XR.

In the early days of XR, some companies fell into the trap of using the technology because it was new and exciting, capitalizing on the novelty of it. Leveraging XR just for the sake of it might create short term benefit but could impair the potential long-term success and implementation as novelty quickly wears off. Applying it seriously to real, specific problems will help prove out the return on investment over the long term.

WORK WITH XR EXPERTS TO HELP YOU NAVIGATE THE TECHNOLOGY

At the rapid evolution rate of technology, there will probably be a dozen new applications and XR devices on the market by the time you read this. Regardless of how tech savvy you and your team might be, consider working with XR companies and industry experts to help quickly navigate the landscape and focus on the most impactful areas. Many companies will offer free consultation that could also help you quickly understand if XR is a viable solution. The last thing you want is to purchase new XR hardware or buy applications that end up sitting in a closet due to unexpected hurdles.

START SLOW AND SMALL; EXPLORING OFF-THE-SHELF EXPERIENCES AND HARDWARE

Regardless of whether you want to develop something custom or use something off-the-shelf, starting slow is critical to the success of any strategy. Purchasing off-the-shelf applications and playing around with the technology can help you develop an in-depth understanding of it to spark new and creative ideas around leveraging it.

When it comes to selecting the physical hardware, it can get overwhelming as there are hundreds of manufacturers of devices on the market, yet only a few are widely adopted. Many Mixed Reality devices, for example, make big claims about how great their technology is. However, the Microsoft HoloLens 2 is the only device with a proven track record in this field. Reputable brands might be more expensive than the alternatives, but at the end of the day, they are the most user friendly and stable device in the market. It's not uncommon that cheaper devices from lesser-known companies have software that is riddled with bugs leading to frustrated users and devices that end up collecting dust.

GOVERNMENT, INDUSTRY AND ACADEMIA SHOULD EXPLORE MORE COLLABORATIONS

It's no surprise that developing high end XR experiences can be costly and, therefore, a luxury. Only larger companies have been able to afford it. To have widespread impact with XR in the food and beverage industry, a collaborative approach will need to be taken. Government, industry, and academia will need to work together to identify critical problems faced by the industry, such as widespread labour shortages or specific skill gaps. Once these problems are identified, a consortium of partners can work together to build custom tools to be implemented by companies of all sizes. Take something like food safety for example, a fundamental program that hundreds of thousands of employees need to take prior to working in food and beverage. Although the upfront costs of developing a program like this might be high, the vast number of participants that would benefit from a virtual reality food safety course quickly outweighs the upfront cost. A single employer wouldn't be able to justify developing this alone but working together to share costs could make XR accessible to even the smallest of companies and create widespread benefit throughout the industry.

Conclusion

As demonstrated by the wide range of use cases throughout this report, XR technology has already exploded in popularity amongst many mid to large sized companies across the globe. The need for additional training methods due to the distancing of the COVID-19 pandemic has exacerbated the need for application of this technology. Due to the pandemic it's more important than ever for companies to consider digital assets to accompany their training, continuing education, troubleshooting and other support mechanisms.

Given the variety of XR technology applications through Virtual, Augmented and Mixed Reality there are options for companies of all sizes to take advantage of these virtual opportunities. Although the ROI is easier to justify with larger corporations, there are myriad options for organizations of any size.

Case studies have shown increased employee retention, decreased turnover issues, more positive training experiences, improved general safety, reduced breakdown times and greater overall employee confidence through the use of XR technologies in the workplace. It is clear that, regardless of industry, these mechanisms are important for the future of work as well as the future of workplaces. Even as organizations begin to return to in-person life, the flexibility of being able to do numerous aspects of work from wherever one is will likely remain in every industry. Early estimates predict at least **25%** of Americans will remain working remotely for the future (CNBC) and up to **40%** of Canadian jobs can be done remotely even long after offices reopen permanently (Statista.)

This move to supporting remote work is good news for businesses wanting to invest in XR technology because, according to Forbes the cost savings is huge for both employer and employee:

> **"Extrapolate that to a full year and every remote worker is reducing company costs by $22,000. Employees will save additional money, too. A recent FlexJobs survey shows the average remote worker saves $4,000 per year by not spending money on gas, coffee, lunches and more clothes for their wardrobe."**
> **(DeVerter, Dec 2, 2020)**

As applications, products and technological capabilities of XR continue to increase, it is becoming more accessible for industries of all sizes, needs and niches. Now with the cost savings associated with remote/virtual work and training options it is optimal for organizations to consider the possibilities.

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This project was funded by the National Plan for Science, Technology, and Innovation (MAARIFAH), King Abdulaziz City for Science and Technology, Saudi Arabia.

The authors declared no conflicts of interest with respect to the research, authorship, and/or publication of this article. The authors received financial support for the research, authorship, and/or publication of this article from the National Plan for Science, Technology, and Innovation (MAARIFAH), King Abdulaziz City for Science and Technology, Saudi Arabia.

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This VRARA report was sponsored by Oberon Technologies, a leading provider of interactive training solutions, leveraging virtual reality technologies coupled with state-of-the-art information delivery.

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The Aerospace Committee serves the XR Association and its community by promoting the application of XR technology as a solution to long-standing problems in aerospace. In addition to curating industry case studies, the committee shares best practices and information on XR related applications in the industry. Moreover, the committee shapes and recommends best practices to scale XR applications. The case studies identify challenges faced, the impact of adopting XR solutions, and recommended best practices for the industry.

This VRARA report was sponsored by Scope AR, the pioneer of enterprise-class augmented reality solutions, delivering the industry's only cross-platform AR tools for empowering frontline workers. The company revolutionized the way enterprises work and collaborate by facilitating complex remote tasks, employee training, product and equipment assembly, maintenance and repair, field and customer support, and more. https://www.scopear.com/about-scope-ar/

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Foundry 45 uses leading-edge technologies to create better process training outcomes for enterprise clients. They are a team of technologists, strategists, engineers, creatives, computer programmers, and project managers. They create powerful, immersive VR experiences with new, interactive content to help organizations break the monotony of their current business training routines while providing safer, engaging, and more efficient employee training solutions.

Acknowledgements