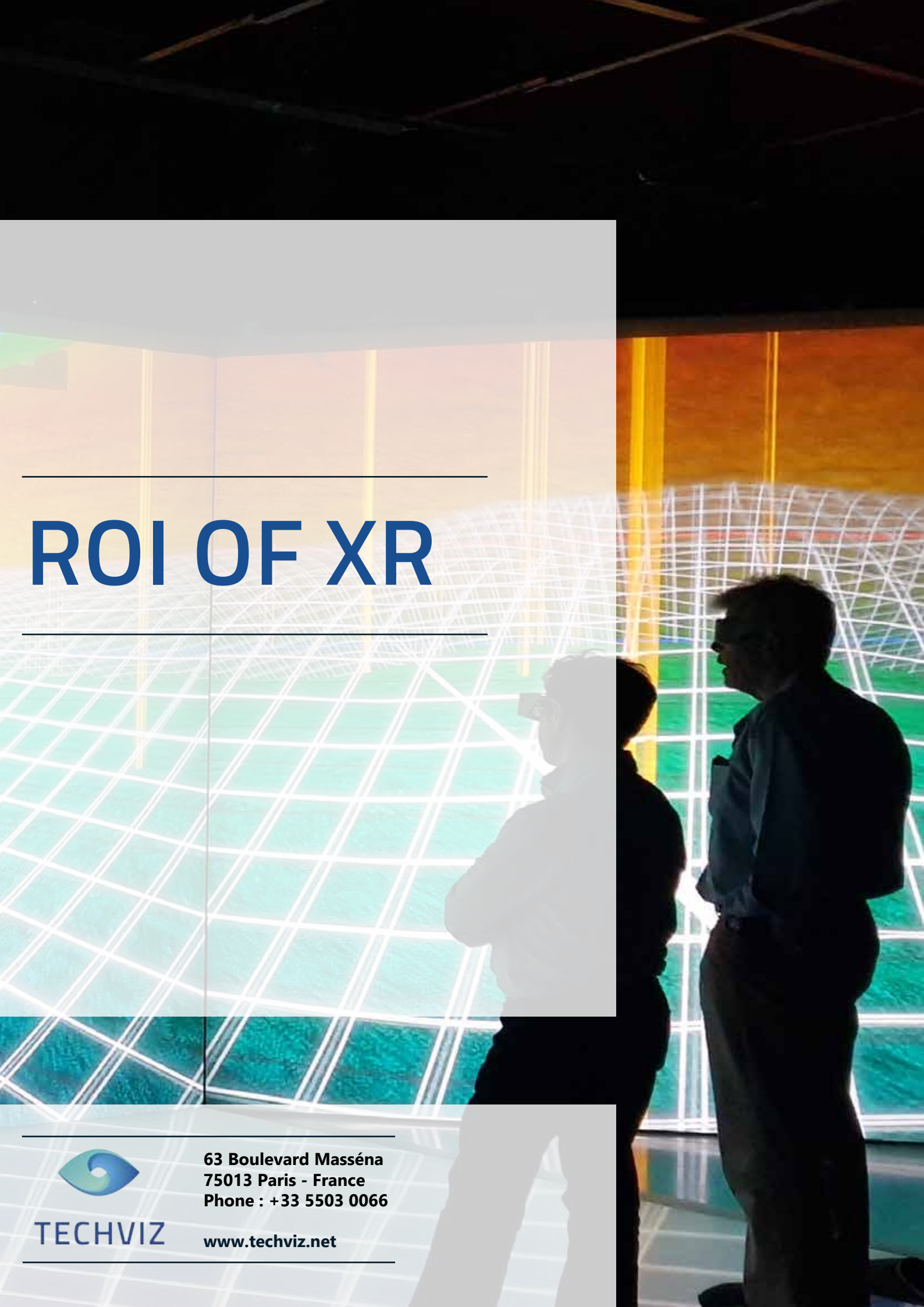
ROI OF XR



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2020 propelled us in the "future of work". A lot of things changed in the way we work. There is no need to commute to the office every day. There is no need to work from the office: a laptop and a good WIFI are enough for a lot of people. Projects have changed too. They are growing more and more challenging, and businesses must adapt if they don't want to be left behind:

Increased complexity
Industrial projects are often divided between different teams, or even different contractors. Companies must collaborate remotely and integrate outsourced parts.

Reduced budgets
Even before COVID-19 had begun to spread, it proved difficult to fund engineering projects. In OECD countries, R&D spending a flat ? 2,3% of GDP.

Faster time-to-market
With less time and resources, industries must compete in a fast-moving "winner takes it all economy". Time-to-market becomes a key performance indicator for stakeholders.

To find a solution to these challenges, many companies have invested in XR technologies in the past few years. The possibility to overlay CAD models and 3D simulations on a real-like environment, while working from home or from different working sites was one of their main focuses.

Neither AR (augmented reality), VR (virtual reality) or MR (Mixed Reality) are new technologies. However, hardware and software evolve every day, adapting to the needs of professional use. Improved connectivity with 5G/6G is opening a new range of business cases. Investing in XR has become very profitable for companies in a wide range of sectors: AEC, manufacturing, automotive, shipbuilding, education, healthcare…

According to a recent study from Forrester, Mixed Reality (MR) brought in a 3-year ROI of 177% for decision-makers.

Today, XR is a crucial investment to make your company thrive. Companies that already deployed immersive technologies have found themselves ahead of their market. More and more decision-makers are now relying on XR technologies out of necessity. So, there's no time to lose.

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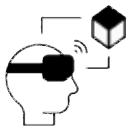
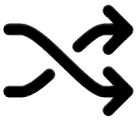
WHAT IS XR?

Extended Reality (XR) refers to the combination of all immersive technologies, that merges real and virtual worlds and human-machine interactions. Generated by computer technology and wearables, there are currently three types of extended reality in the market. Each are defined by the level of interaction between the virtual and real environments:



Virtual Reality (VR)
The users are immersed in a computer-generated world where they can interact with virtual objects in real time

Augmented Reality (AR)
Virtual objects are displayed in the real world to enhance reality with images or data and assist workers in their daily work



Mixed Reality (MR)
It mixes the real and virtual worlds in an environment where real and digital objects can co-exist and interact in real-time

XR is a catchall term: all devices with AR, VR or MR tech are considered "XR devices". Depending on your use case, extended reality can rely on various equipment. For professional use, you can choose between:

- **A tethered headset (or HMD):** a screen in the headset isolates the user from the real world. Workers can use it to collaborate remotely in the same virtual environment.
- **A PowerWall:** a projector or a LED wall shows two sets of slightly different images to create a 3D effect only visible with special glasses
- **An immersive room (or CAVE):** two walls (or more) display two sets of slightly different images to create a 3D effect. The more screens, the more immersive the system is.

What hardware do I need for professional XR?

For most of the professional use of XR, you will need a PC or a Mac that is ready for XR. Please note that depending on the XR hardware you choose, there might be some changes to consider:

- Graphic card: NVIDIA GTX 1060 / AMD Radeon RX 480 or greater
- CPU: Intel i5-4590 / AMD FX 8350 equivalent or greater
- Memory: 8GB RAM or greater
- Video Output: Compatible HDMI 1.3 video output / DisplayPort 1.2
- USB Ports: from 1 to 4 USB 3.0 port
- OS: Windows 10

For more information on the subject, consider using SteamVR performance test tool. It measures your system's rendering power and determines whether your system can run VR content at 90fps, and whether VR content can tune the visual fidelity up to the recommended level.

Why an XR software is required for engineering?

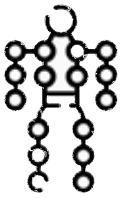
XR is created from a combination of hardware and software. The XR software acts like a driver to directly capture a 3D model loaded in your application, and display it in AR, VR or MR. It manages the input and output of data, analyses your moves in the real world and generates the proper feedback. When you physically interact with the virtual objects, the XR software promptly adapts the simulation to give the impression of real-time interaction with your 3D model at 1:1 scale.

The software can provide you with many additional features thought for engineers, such as :

Digital mock-up

Video recording

Automated reporting



Tracking
(body, finger, eye…
depending on your devices)

Virtual assembly

Multi-system collaboration

IS XR MADE FOR YOUR BUSINESS?

To determine if you should invest in an XR system for your company, you must first determine which current challenges and opportunities you have. Here are the most common challenges decision-makers faced that made them consider using XR:

The cost of physical prototyping is too high. There are too many iterations during the design process because the product is either too complex (ex: an airplane) or too big (ex: an architectural maquette), requires bespoke adaptations (common in shipbuilding industry) or is currently done without prototype.

The design phase is growing increasingly complex as they must flawlessly integrate mechanics, electrics, electronics, and software (ex: in a car, brakes and sensors must work together). You can no longer conceive the project component by component: you must include the input from many suppliers and experts in the design of the final product, working remotely from different countries

There are many errors during conception, which leads to costly rework or downtime. Avoidable errors happen frequently during the design process, which causes many delays and force you to redo most of the work. Therefore, the design process is more expensive, and production takes more time and resources.

The training and work processes are inefficient Your company is unable to meet the demand for speed, capacity, or quality with your current processes.

The need for documentation is rising which keeps engineers from conception work and is a significant driver of cost and effort in R&D departments. Having a common (virtual) place where all engineers can take notes and measures, link photos or simulations will be a great help, especially when multiple partners are involved in the project.

The staffing shortage and turnover all companies are struggling to hire, retain and train skilled workers, especially experts. There is also a lack of skills in the new hire, and knowledge transmission can be difficult in a short period of time, or when the more experienced workers are not available.

Travel restrictions and costs prevent your company from running smoothly You must frequently book trips for experts to inspect or maintain equipment, or to show a client how to use your product.

Globalization is leading to an increasing number of variants across different countries. You must either invest in costly rework to attain the requirements in each market or pull out of it. The gap between tailored solutions and standard products is too wide, and the cost of physically prototyping each product is too high.

The pressure of the "winner takes it all" economy. Product lifecycles are shortening, while product improvement is coming onto the market faster. When versions are released, manufacturers must adapt their production fast. Technical innovation in components fuel customer demand, however they expect the same innovation in more complex products, from cars to washing machines

The need to develop new technologies while still maintaining old ones is making design even more difficult. By the time the innovation replaces the old versions in the market, it can take decades. In the meantime, you must keep engineers and workers for prototyping, testing, and producing in both technologies (ex: the electric drive did not replace the internal combustion engine and lead to hybrid models).

Most of these challenges can be met using XR technologies, as it speeds up the engineering phase and accelerates the overall process from design to market.

More than 46% of the companies who invested in VR for Enterprise and more than 47% who invested in AR/MR for Enterprise have had a strong or a very strong growth.

According to Capgemini, around 46% of companies in the automotive and manufacturing industries think VR/AR will become mainstream for their company in the next three years.

TOP USE-CASES FOR XR

Here are examples on how you can use XR in your business and produce value. They can apply to any industry such as manufacturing, architecture, engineering, construction, healthcare, telecommunications, energy, utilities, defense, retail, transport…

1 – Design review and decision-making

Multiple users (contractors, engineers, specialists, etc.) can visualize and review 3D models in a real-like environment. Inside an immersive room or with a Powerwall, you can test a model for issues, evaluate different propositions and co-create with all the project's stakeholders. This helps shorten time-to-market without relying on expensive and time-consuming physical prototypes.

2 – Visualize task instruction and complex data

Workers can view task instruction, data and 3D models while working hands free. They are also able to collaborate on the same project separately and asynchronously, while making less errors.

Mixed reality increased task efficiency by 60% and reduced rework by 50%, saving $6,540 annually per onsite task worker (Forrester study)

3 – Remote collaboration

Users can collaborate in the same virtual environment, in real-time with people located on other sites. From project review, to training, to maintenance, remote collaboration enables many scenarios with minimal deployment effort.

4 – Remote maintenance

It provides the technician with many features such as overlaying relevant data or simulations with the equipment, the possibility to take notes or measures inside the XR application and share them in real time with an expert while they are conducting the maintenance.

5 – Cockpit ergonomics

It guarantees the safe and comfortable use of a car or an airplane's dashboard by integrating the human factor in the conception process. Instead of needing a physical prototype to test whether every part of the dashboard is easy to access and use, every test can be done in the virtual environment. It allows manufacturers to be more agile and launch new models faster.

6 – Workstation ergonomics

You can identify the issues that may arise from workstation ergonomics, by visualizing their 3D model and running simulation. You can evaluate comfort, safety, and efficiency during the design phase, and even test them with a virtual worker. It will ensure a safe and comfortable environment for workers.

7 – Specialized training

XR training immerses the learner in a real-like simulation tailored to his needs. It helps them pick up new skills faster, and better memorize the new information. Plus, it can address unusual situations that are difficult to test in real life such as unexpected start-ups of shutdowns of the factory line.

Mixed reality increased training efficiency by 60%, saving $1,440 per trainee while improving knowledge acquisition and retention.
(Forrester study)

The benefits of using XR in your business

Streamlined and accelerated processes:

XR can help businesses to save time and money by streamlining workplace practices, from making prototyping easier, to improving the picking and packing productivity of warehouse workers wearing AR glasses, to providing information for technicians in the field.

A 2019 study in the AEC sector showed that 93% of projects surveyed identified direct cost and time saving from the use of virtual mock-ups to replace physical ones

SEAT's use of VR led to a 50% reduction in the number of prototypes needed to be made physically prior to launching a new model. Using VR also lowered SEAT's production time by 30%

Improved product and process quality:

With 3D models that can be shared at 1:1 scale during a presentation to shareholders, or streamed to engineers all over the globe, you will need fewer physical prototypes. Iterations cost less in virtual reality and can be done much faster, allowing engineers and designers to reach the right compromise faster by testing more possibilities.

Suntory employees converted a 200-step procedure into step-by-step holographic instructions using a Hololens 2. This mixed reality solution reduced the time to master tasks and execute them by 70% (Microsoft)

Reduced time-to-market:

XR improves processes in many departments from production, to sales, to support teams. It gives organization a way to develop products more quickly and more efficiently reducing time-to market while taking cost and complexity out of the process.

For example, in 2019, Bugatti used VR to design new model, enabling them to reduce the design time by a factor of three!

Reduced errors and rework:

Workers are more efficient when they can add heads-up, hands-free instruction and detailed visualization overlaid on the real world. Consequently, it helped them save time, prevent errors and rework, avoid extra trips, and increase their capability.

MR increased Task-efficiency by 60% and reduced rework by 50% leading to $1.4 million saved in labor (Forrester)

Better remote collaboration:

Videoconferencing tools allows to share knowledge an information from a distance. XR takes remote collaboration further as it enables accurate real-world overlay of 3D assets, instructions, and collaborative markup while leaving workers free to see their surroundings and use both hands. It makes the design process easier, as well as solving maintenance issues with minimal deployment efforts.

Mixed reality increased expert work efficiency by 30% and prevented 75% of major trips, saving $58,512 in annual labor costs per specialized expert. (Forrester)

Minimized operational costs:

Because it allows teams to work remotely, XR helps to reduce a lot of costs like travel expenses or training expenses because it can be done remotely, and avoid wasting resources with rework, noncompliance, and warranty claims.

According to the Forrester report:

- **Mixed reality minimized consumables usage by 80% for instruction and training, material costs by 10% for design, testing, and enablement and 60% for using safety equipment.**
- **Mixed reality reduced annual travel and incidentals costs by $31,500 for specialized experts and by $2,950 for field task workers.**

Better training efficiency:

Learning with virtual instruction, models and simulations overlaid on the real world helped workers learn faster, to understand content faster and practice their skills in real-like conditions. Fast and effective training is crucial, as all industries suffer from a shortage of skills and struggle to hire and retain new talents. XR has significant advantages for technical skill acquisition over simple video and 2D materials.

- **Mixed reality increased training efficiency by 60%, saving $1,440 per trainee while improving knowledge acquisition and retention (Forrester)**

Overall, business units leveraging mixed reality increased annual revenue by 4%.

XR use also enabled qualitative benefits to companies who start using them in their process:

Companies find it easier to attract, hire and retain skilled employees, which is crucial for sectors experiencing labor shortage because of the aging population. XR technologies helped capturing senior employee's expertise and translating it into virtual training and simulation to help the less-experienced employees.
The use of XR technologies also made companies more attractive as employers to prospective job seekers.

Safety and health risks were reduced thanks to training in XR, implementing safer protocols and ensuring the work was completed qualitatively and safely. Also, faster task completion with fewer people onsite reduced both the number of people exposed and the duration of exposure to hazards such as falling objects or COVID-19.

Job satisfaction increases, as employees are progressing in their work thanks to XR. It helps them work more efficiently, hence avoiding overtime and find a comfortable work-life balance.

Workers are better equipped against downtimes and potential disasters, as these scenarios can be trained better in a virtual simulation. Using XR, workers or users without expertise could deploy equipment, learn to perform critical tasks, or fix issues without needing to wait for help to physically arrive.

The costs of implementing an XR solution in you company

To give you a proper vision of the cost of an XR solution, we have detailed some of the expense items:

XR hardware costs

One of the main concerns of companies who have never tried XR is the hardware cost. **In 2019, 46.2% of companies thought the biggest barrier to XR adoption was the price of the devices (VRX report).** This rate is down compared to the same survey done the year before, where 60% said that the cost of XR hardware was holding back adoption. This shows how enterprises are less driven by cost concern because they anticipate the tangible benefits from investing in XR technologies.

Depending on your professional use case, you will either use:

Head-mounted display
on average you will pay
between $300 to $900 per headset

PowerWall
on average **6K$ to 15K$**
(it also depends on the product and your specific installation)

Immersive Room
minimum 500K$
(the investment depends on your specific setup)

If your company needs to collaborate remotely with teams and experts in different sites, the best solution is probably a set of tethered headsets. Their flexibility allows them to adapt to many use cases.

PowerWalls and Immersive rooms are better for workshops, training sessions and presentations. The investment may seem steep, but it is worth it. For example, **the cost of a mixed reality training room at the Loviisa power plant in Finland was found to be only 10% the cost of a physical room** (VRX VR Insight Report).

XR software costs

The choice of a software is very dependent on your use cases and your company process. It is difficult to estimate a global investment without a proper context, such as:

- The 3D software you are using
- The 3D software used by your subcontractors (if different than yours)
- The amount of data / number of software
- The number of users simultaneously
- The PC or Mac system you are using
- Etc.

Planning, implementation, and management costs

XR success requires more than deploying a software, as it will transform engineering process for the better. These changes will affect the way you design, produce, and test your products. According to Forrester, MR trimmed total business operating costs by 0.2% through better processes, quality, and maintenance

The deployment costs of an XR solution is entirely dependent on your use case. For instance, remote collaboration can often be implemented quickly and easily with minimal change management. Ans as XR is getting more and more used across the industry, these costs will continue to fall every year.

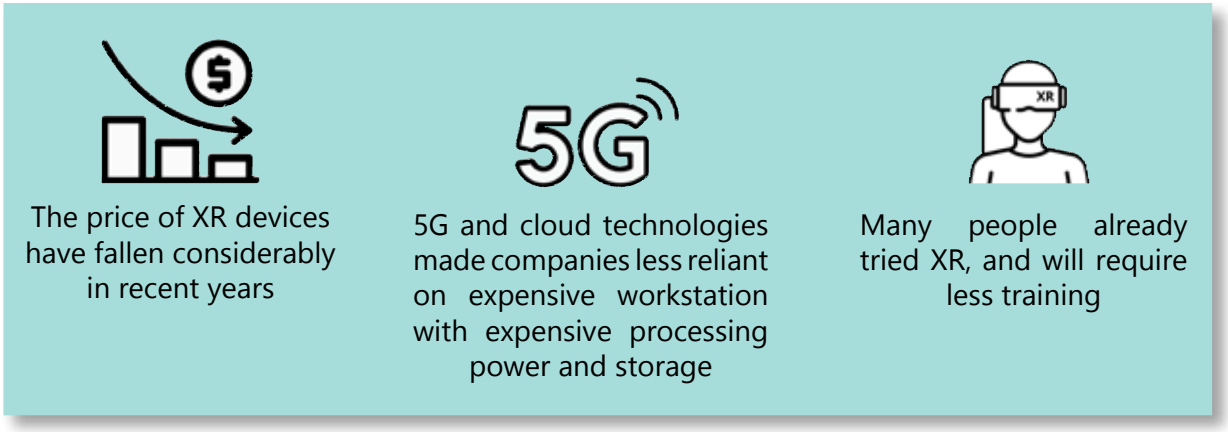
Training costs

Training costs can vary immensely from one business to another, depending on:

- The chosen use cases
- The number of users you can train simultaneously
- The number of training sessions required
- The level of process change induced by using XR

Focus on ROI rather than costs

Most of the costs will soon be reduced:



But even more important than cost reduction, will be the **development of new use cases**. Faster time-to-market, reduced training needs and improved workforce productivity are measurable benefits. XR is a game-changing technology with tons of use cases. Forrester's review showed that for many companies, only 3 years were necessary to achieve a significant return on investment: up to 177% percent and a payback of 13 months.

XR's efficiency has already been proven. Therefore, companies are charging ahead with the investment and adoption of XR technologies. They have seen tangible benefits in areas like design, prototyping, remote collaboration, training, and education. When asked how they would describe the impact of immersive technologies onto their organization, **over 90% said that VR made a positive impact, and 88% for AR/MR**

Conclusion

Many companies experienced challenges related to remote work, physical prototyping and complex engineering projects have started to implement. It led them to invest into XR technologies. And they are already feeling the difference!

Although there are a lot of different use case, and many more to discover, all of them realized huge benefits and high ROI. XR can be used in multiple ways across many industries. The ability to merge 3D models with real and virtual environments has helped many sectors.

The ecosystem is improving as well. From the likely dropping of the next-generation consoles into the market, to the development of 5G/6G and cloud technologies, the market is likely to evolve rapidly and for the better.

Because businesses are seeing the benefits XR can bring to their projects, hardware and software are improving as well, allowing for easier product development, better collaboration and cheaper training costs across complex projects and vastly improved visualization.

At TechViz, we think the 2020's are critical years to invest in XR technologies in your company. AR, VR and MR are already being used by the biggest companies, and widely integrated in business practices across the industry. With its short breaking point, and high ROI, XR is the best investment you can make.

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