

Applications of Virtual Reality in Construction

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Virtual reality, a technology that has just been recently introduced to the construction industry, has gained popularity for its many practicalities which include but not limited to; cost savings, time savings and detections of design errors. This case study summarizes the applications and benefits that virtual reality brings to the industry, in particular to Lendlease's Oceanwide Plaza project located in Downtown Los Angeles alongside drywall subcontractor, Martin Bros. The information for this case study was gathered through means of a phone call interview with Martin Bros' foreman, Gilbert Benavidez and face-to-face interviews with Lendlease's field superintendent Wade Nevitt and assistant project manager Evelyn Policchio. The results from this case study showed a divided 50/50 in terms of user friendliness. Seasoned field veterans exhibited a hard time grasping the new software and changing their ways of getting things done, whilst the office staff and the executive levels push the technology in order to save time and most importantly, money.

Key Words: Technology, Virtual Reality, Savings, Practicalities, Design Errors

Introduction

Virtual Reality (VR) is a computer-simulated environment that allows you to interact in a realistic and/or physical way within the environment (Campbell, 2017). Virtual Reality is an upcoming technology that is becoming admired in the construction industry as younger generations are graduating construction management programs. It is no secret that technology is revolutionizing the way we live and accomplish things much more differently than how they were done in the past. It's no different in the construction industry, BIM modeling has changed the way owners and designers alike do business nowadays. Virtual Reality is an emerging technology that has gained popularity through such applications via smart phones in which it submerges the user in a three-dimensional world making them believe to be a part of the interface. These applications can easily be applied to the construction field side of operations. It has numerous usages and advantages, one of which is augmented reality. Augmented Reality (AR) is any technology that superimposes spatially contextual information over the user's view of the real world, providing additional data while still permitting interaction with the real environment (Campbell, 2017). During my summer internship subcontractor, Martin Bros. whom specialize in intricate drywall applications, began the use of virtual reality and augmented reality (VR/AR) in the wall layouts at one of the three towers at Oceanwide Plaza. Precise measurements are done without the aid of hand tools other than the software itself seen in a virtual world through the aid of a head mounted display (HMD). Drawings are uploaded with the dimensions necessary to efficiently and quickly pinpoint the layouts of top and bottom drywall tracks, thus mitigating human error. Lendlease, being a company that is known for its sophisticated and difficult projects, has shockingly barely begun to implement this innovative software to its current projects.

What is Virtual Reality

“Paradoxically, Virtual Reality (VR) technologies are still lagging behind the visions that people have for their use. However, VR has already demonstrated its capacity to change the ways we design, make decisions about, and produce built environments” (Heiskanen, 2016). Safety being one of the biggest concerns in any industry but most importantly in the construction industry due to it being the trade with the highest mortality rates of any industry in the nation, is a reason alone why VR is to be incorporated by all construction companies. The Daqri helmet, for instance, can improve situational awareness for the wearer by calling attention to important features of the environment, such as temperature differentials and unsafe conditions. It can also send information back to a central

location for supervisors and managers, so they can help workers avoid potentially hazardous situations (Campbell, 2017). An estimator’s main obligation is to perform quantity take-off’s in which the general contractor uses to figure out how much quantity of everything will be needed to perform the job. Now imagine using the help of augmented reality to control material waste, collecting data in doing so and using that data for future projects in which the estimator can base off of from historical figures. “A drone was providing a real-time VR simulation of the project, feeding an up-to-date view of conditions on the ground directly to the management team in the trailer. When they compared this view to the plan by overlaying plan data, they discovered an eight-inch misalignment between where ground was broken for the foundation, and where the plan called for it to be laid. This discovery saved the project millions of dollars in rework by preventing the \$400,000 concrete slab being poured in the wrong place, and potential subsequent work being placed on the misaligned foundation” (Campbell, 2017).

Despite being a seasoned foreman, Gilbert Benavidez, acknowledges that changes are part of the business and they are for the better. Gilbert is a skilled foreman who knows the trade fairly well, yet this is the first project that he has taken on with the aid of VR, “It’s a weird feeling having to be taught how to do my job through this new software by someone nearly half my age when I have been doing this nearly my entire life” stated Benavidez as he explained how he felt towards the innovations that Martin Bros has begun to incorporate into their work.

Acceptance or Apathy

There is no doubt that the construction industry took a major hit during the Great Recession. Thousands of skilled craftsmen lost their jobs with no telling when or where they would find a job. Most, simply changed skills and started a new life afraid that construction had no future. Many construction companies were badly affected by the recession. While some had to make severe cost-cutting measures, such as laying off workers, others did not survive the tough times. “According to the US Bureau of Labor Statistics, approximately 2.3 million construction employees lost their jobs during the recession, close to 30 percent of the total number of jobs lost” (McMalcolm, 2014). Despite this drastic loss, those that managed to stick to their trade are now the veteran craft skilled men and women who are beginning to think about retiring. However, until that day arrives they must adapt to changes that millennials are beginning to bring to the job sites. Someone who has been performing the same task for a given amount of years is odd to have a difficult time adapting to change, especially coming from a person with a quarter of their experience and field knowledge. “I’ve been doing this my entire life, my old man taught me how to do things and always hammered it to me to grow a thick skin. Coming to work and having a college kid show me how to use an iPad software and all these new technological advancements really makes me question how valuable my skills really are” said field superintendent Wade Nevitt as he was asked what how he feels about millennials entering the work force with their own ‘set of skills’. With BIM program courses being integrated into many construction management institutions, it is no wonder why the new generation is beginning to replace the old-timers. Figure 1 demonstrates the swift growths in internet users globally in the recent years. This goes to prove how technology is swiftly becoming an important asset for any employee to be knowledgeable with.

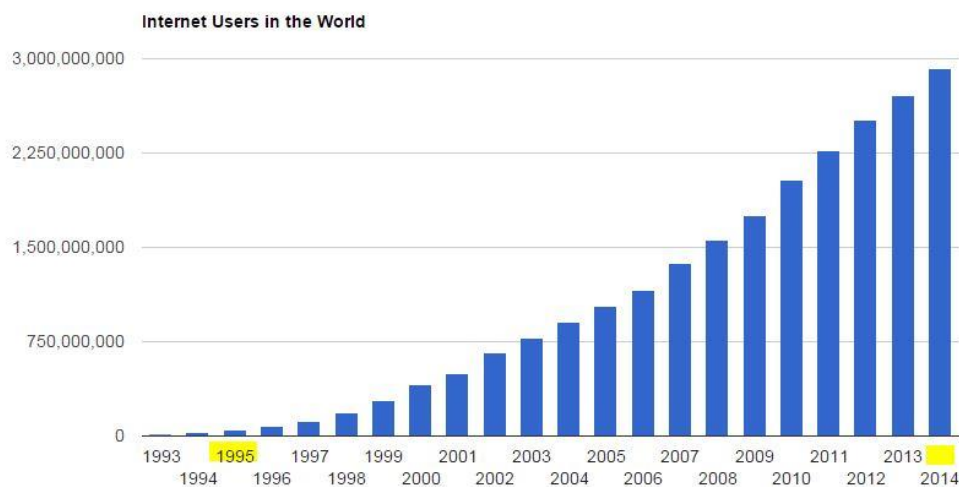


Figure 1: Number of worldwide internet users over the years (Relatively Interesting, 2015)

Figure 1 shows how the number of users has increased throughout the previous years. Despite this graph not being up to date it shows that in just two decades the number of online users has quadrupled. This statistical date is more than enough to support the fact that people are turning to technology for everyday use. “The opportunity for a virtual reality construction industry to emerge and thrive with the technology available is here right now. With companies like Mortenson already reporting savings in the millions of dollars through successful applications of VR, more and more companies will likely become adopters of this technology in the future (Tyler, 2016).

Virtual World Active Users

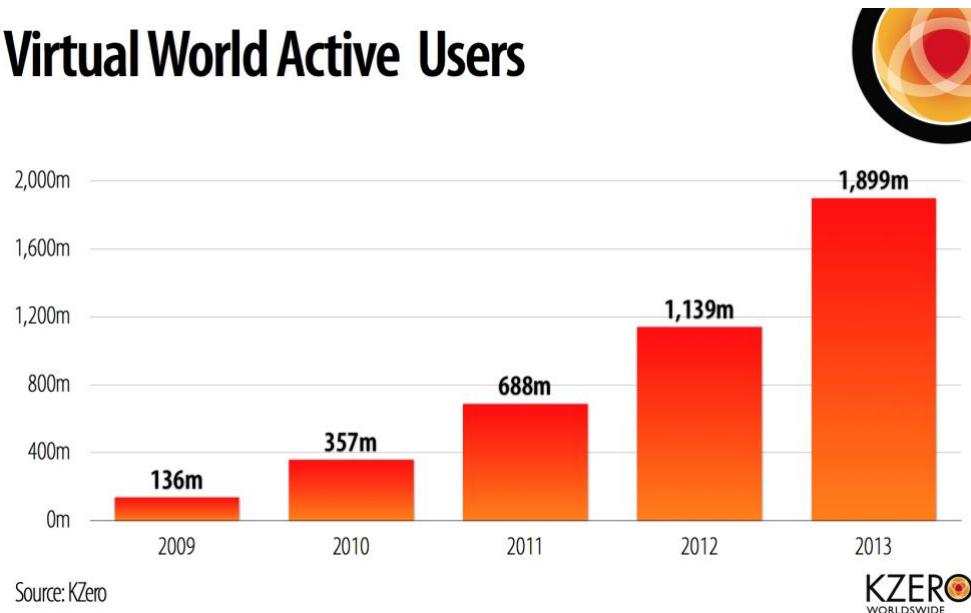


Figure 2: Number of worldwide virtual active users (KZero, 2013)

Even if some many consider this ‘toy’ nothing more than just a ‘toy’, statistics are showing that more users are finding themselves being active virtual users. Virtual reality in construction falls into the innovator and hardcore gamer user category which has the highest forecasted growth over the next few years (Tyler, 2016). Tyler explains how the construction industry falls under the highest forecasted growth of gamers. Ultimately, the construction industry will benefit from the perks of having modeling software as part of their business. Those opposed to it will eventually have to give in to the changes that are predicted to occur, and the acceptance of virtual reality being part of their work will have to be part of their life.

Methodology

The objectives of this case study are as follows:

- The demonstrate how Lendlease/Martin Bros. are using virtual reality.
- To highlight the applications of virtual reality in construction.
- Expose the benefits/disadvantages of virtual reality.
- Explain how the labor force feels about this virtual reality.
- Describe how the owners may feel about this equipment.

The methodology chosen for this case study was a qualitative approach. This qualitative cast study was primarily possible through interviews with industry professionals and their personal opinions. The opinions and interviews of these employees were solely based out of Lendlease’s Oceanwide Plaza project in downtown Los Angeles alongside subcontractor Martin Bros. As an intern during the summer of 2017, I was first exposed to the idea of virtual reality and its main applications in the construction industry. The following personnel were contacted and asked to participate in this case study and thus have agreed to voluntarily be part of this study.

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|----------------------|-----------------------------------|------------------------|
| • Evelyn Policicchio | Assistant Project Manager LEED AP | Lendlease Construction |
| • Wade Nevitt | Superintendent II LEED AP | Lendlease Construction |
| • Gilbert Benavidez | Lead Foreman | Martin Bros. |

Case Study

This project is one of first for Lendlease to be incorporating and managing a subcontractor using virtual reality. Martin Bros. based out of Gardena, CA, known for taking on intricate projects like the famed Walt Disney Concert Hall and the doing the tallest core and shell building west of the Mississippi River, was awarded for yet another complex project on two out of the three towers at Oceanwide Plaza. Unfortunately, the bid amount was an undisclosed amount thus not being able to be discussed during that phase of the project.

Project Specifics

The following are project specifics that are related to this case study:

- Estimated at \$1 billion.
- 2.7 million total square feet featuring mix-use retail/office/residential space.
- Client is Oceanwide Group.
- 32,000 square foot ribbon shaped L.E.D screen, second largest in the United States.
- Architect is CallisonRTKL Design.
- Scheduled completion date set to Spring 2019.

Results and Discussion

The following information was gathered through phone call interviews and in-person interviews throughout the past months but after my internship at Oceanwide Plaza. The goal of these interviews was to gather as much information as possible in regard to the usage and applications of virtual reality in the everyday life of these individuals and how it has impacted their duties in a positive or negative manner.

Lendlease Interview 1

1. Despite the challenges that arise with incorporating virtual reality into any project, this project team is very supportive of this technology. Assistant Project Manager, Evelyn Policicchio, says it has made her job less stressful at times as well as her co-workers. "I'm on the interior team for tower two and it that's one of the three towers that is using virtual reality by Martin Bros. Our BIM team works hand in hand with their software engineers to help the office project team with any technicalities that may arise or if RFI's are requested. Martin Bros. has done an excellent job at coordinating the logistics of this project and has prevented many headaches and long office hours". She goes on explaining how the team executives are responding seemingly well to the way Martin Bros. is moving along with the project. One of the most important and convenient ways that augmented reality has been used is the way that they show the owner representatives visual representation of the project prior to it being constructed. "Tower one has an offsite warehouse where they have built a mock-up room of their interior. It's located about 15 minutes away in the industrial part of L.A and driving there during peak hours of the day can sometimes take up to 30 minutes, that's an hour of our work day just to reach a mock-up room. Martin Bros. makes this obsolete by having a virtual cave in their office."

Lendlease Interview 2

2. Field superintendent, Wade Nevitt, as explained earlier isn't very fond of the assistance of augmented reality. His reasoning is that it makes his knowledge and skills less valuable. Wade has been in the industry for well over 20 plus years working his way up from an apprentice to a foreman starting as a carpenter and working his way in to the role of a foreman. To a certain degree he is against the idea of technology being the future of construction but at the same time he accepts that it is an accurate tool to consider for more than just the installation of interior walls. He goes on to explain that despite the obstacles that he has faced with this new addition to his work, he's learned a lot from it. "It's different, I'll admit it, but there is something good seeing innovation taking place in the construction industry. People like myself and a handful of others don't like change, it's tough for us to accept change but sometimes we have to accept change." Surprisingly, Wade has come to accept that the future of construction is in innovation and the involvement of developed technology that suits the challenges faced by high rise construction crews.

Martin Bros. Interview 3

3. Out of the three interviewees, lead foreman Gilbert Benavidez from Martin Bros. seemed to show the most apathetic behavior towards the idea of virtual reality. He likes certain concepts that it brings to the industry, "The only good thing I see from starting to use this is the safety of my crew". High rises are becoming more and more complex with complicated interior designs calling for potentially dangerous tasks. As a foreman, Gilbert's main priority is the safety of his crew and making sure they go home every day. Gilbert was asked why was he reluctant to accept change in his work, he responded by saying that it's hard letting go of old habits. He lives by the saying that you earn your respect on the field by proving yourself capable of carrying out the given tasks whilst keeping a clean safety record, thus the reason why has some faith in the future of the industry with the aid of virtual reality.

Pros of Virtual Reality

Despite having some negative feedback from the people actually using the software, VR comes with a good amount of advantages. One of the most important ones is safety. Construction alone is already one of the most dangerous industries. Employers can use this as a method of training their workers, going in a virtual world and seeing dangers before actually performing the duty or even practicing on how to use tools like a ladder and the handling of tools. The more practice and safety measures workers are exposed to, the safer the job sites become.

Clash detections is something new and in development with virtual reality. This software allows multiple trade models to be uploaded to programs and run clash detections. Essentially what this does is it finds clashes between MEP trades or anything that isn't supposed to be where it currently is located. Time and money savings are indispensable making this a great necessity for any construction company.

Probably the single most important usage of virtual reality is not for the laborer or even the general contractor, but for the client. Companies can use this as a way of showing the client how a certain part of the building will look prior to laying down a single brick. "Using VR to stream from a 3D camera, executives and other responsible parties can receive a convincing and accurate tour of a jobsite, regardless of where they are physically located. In this way, VR can prevent miscommunications, keep plans on track, and prevent wasted time and work" (Reality Technology).

Cons of Virtual Reality

Even the virtual world has its drawbacks. The software and technology are there, but not necessarily being applied to the construction industry. The majority of the technical support is in gaming and movie making where 3D technology is currently thriving. It was not until a few years ago that companies began implementing the usage of BIM modeling and thus the arrival of virtual reality. Since the programming of VR with other software's like; Revit, Tekla and ArchiCad doesn't have very much support, the cost of implementation can be very high. The lack of technical users and subject matter experts raise the price tag making it a tough decision for smaller companies to begin implementing this technology.

For field crew to be receiving live feed on their mobile phones and tablets, a cellular signal is required. WiFi will need to be taken into account when using virtual models on the field. This is something that Lendlease began implementing in order for their field crew to be kept up to date on the changes taking place in the project or making live notes on a certain sheet for the office to see.

Seeing that virtual reality is in its beginning stages in 3D modeling, errors are bound to occur. The efficiency is questioned by many, like Gilbert. That was another of his concerns, how accurate can a virtual model be over someone with years of skills and experience. Virtual reality has come a long way and has great advantages but let us not forget that it is far from a perfect software. Every software has its glitches and malfunctions, unfortunately these will need to be picked and found before this technological advancement can find really make a solid impact in the industry.

Conclusion

The construction industry has remained traditional in terms on work getting done. With the implementation of virtual reality though things are changing. People will either hate it or learn to love it, those that show apathy to changes will only make their lives harder by neglecting this change. Millennials are moving in to the industry now that it is booming while the older generation are beginning to consider retirement. Virtual reality is in its beginning stages, in the coming years better technology will be developed and those bugs and issues that software developers encounter will be obsolete making the efficiency of the software that much better. As the use of augmented reality and construction increases, so will the need for those knowledgeable in the field will to thus making it a necessity to become familiarized with the virtual world.

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