

CS319290

Reality Capture: What Turner's \$600 Million Project Can Teach You

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Learning Objectives

- How to break the taboo of discussing money as it relates to reality capture.
- How to adapt and adjust a well-functioning Reality Capture Plan to suit your own needs.
- Justify the need for reality capture to coworkers, senior management, and more.
- Learn how to align owner's expectations vs trade partner deliverables concerning reality capture.
- Emphasize how and why it is necessary to communicate early on in a project about Reality Capture expectations and its uses.

Description

This course, at its most fundamental level, will cover what goes into a successful reality capture guideline and how it looks in practice. We will touch on the software and hardware used to develop and maintain a successful reality capture program. There is quite a bit of pliability in this category, but you will learn about a simple, real-world workflow that can be scaled as desired.

The topic of money is a common thread throughout because, as we well know, budget and schedule drive everything. The AEC industry is moving towards using reality capture in a more robust way as a standard, but we will discuss how to justify the cost in a way that is easy for all levels to understand.

We will also cover the client and trade partner expectations that should come into consideration when beginning a reality capture workflow. These expectations should be aligned within, from bottom to top, before the scanner ever hits the dirt.

We will touch on our own lessons learned throughout, with an emphasis on the fact that you can't expect any job to be 100% perfect when it comes to reality capture: at this point, we should all be looking to facilitate an environment of learning, collaboration, and flexibility as the AEC industry moves into a period of innovation.

About the Speakers

Jonathan Evans, Turner Construction



Jonathan enjoys being on the cutting edge and loves a good proof-of-concept. He is a Mechanical Engineer turned VDC Engineer with Turner Construction and has been in the AEC industry for two years. He started his career in 2017 as a Technical Management Associate for a steel mill in Texas, then found himself in Iowa working as a VDC Engineer for Turner Construction. Though his job description concerns the management of the reality capture process and BIM coordination, he also enjoys championing VDC innovations that can be applied across jobsites and regions.

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Suman Paneru, Turner Construction



Suman Paneru has a passion and dedication for the practice of virtual design and construction in the AEC industry. He has over five years of experience in the implementation of cutting-edge technology, especially on industrial and commercial buildings in the US and abroad. He holds a Bachelor's in Architecture and a Master's in Construction Management. He is currently working as a VDC Engineer at Turner Construction where he is pushing for the "build virtually first" approach, specializing in BIM Coordination.

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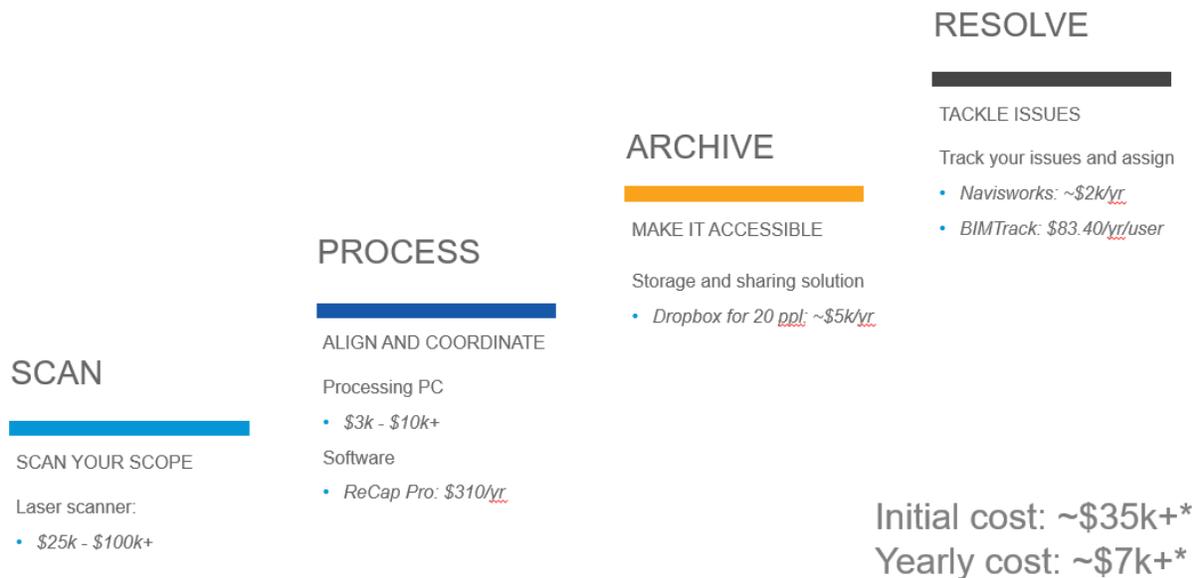
Breaking the Taboo: Money and Reality Capture

Introduction

In all aspects AEC, but especially in reality capture, it is important to get everyone on the same page early on: after all, laser scanning isn't cheap, especially if you're new to it. Your goal, however, is to guide others to the realization that the dividends reality capture pays back need to be fully realized for total buy-in. This section highlights a laser-scanning workflow that can be scaled as necessary, the associated costs, the capabilities of said laser scanning process, and what you can do to better "pitch" the potential pay-off. It then touches on drone scanning, what it can do, and helps you determine if it's possible, or worth it, for you.

Laser scanning workflow

Seen below is a basic laser-scanning process:



*Assuming a team of 20 active software users

A BASIC, SCALABLE LASER-SCANNING WORKFLOW WITH APPROXIMATE COSTS

There are many opportunities for adjustment to better suit your project's needs. For example, in order to save money on arguably your highest expense (the laser scanner), most manufacturer's offer refurbished units for sale at a drastically reduced rate. When our previous project purchased a laser scanner, it was about \$100k new. If we would have purchased used, we could have saved almost 25%.

The above sample is for a team of 20 active users, so bear in mind your own numbers as you put your plan together. Also note that 20 is just an example: it's likely that smaller jobs may only have a few folks needing access, thereby further scaling down costs.

Drone scanning – is it for me?

Drone scanning, like laser scanning, provides a wealth of data. The key to determining whether or not your project can (or should) utilize it is quickly answered by a simple series of questions.

1. Does your company have a policy for or against drone usage? If you are able to fly per your company, does the area that the project is in legally allow for drone flight?
2. Is there vital data that can be captured by drone that is either not capturable by terrestrial photos or laser scans or that is better suited to drone capture? “Vital data” can mean many things: determine what this means for your project using the info provided throughout this handout.
3. Do you have (or will you have) someone who can be responsible for managing this data?

Once you’ve answered these, you should have a good picture of the prospective status of drone scanning. We quickly discovered that once a drone was used and its capabilities realized, suddenly everyone wanted access to the scans. This sparked many new and innovative ideas that were specific to the team that brought them forward, thereby increasing collaboration.

How do we pitch this? Here are some use-cases to help

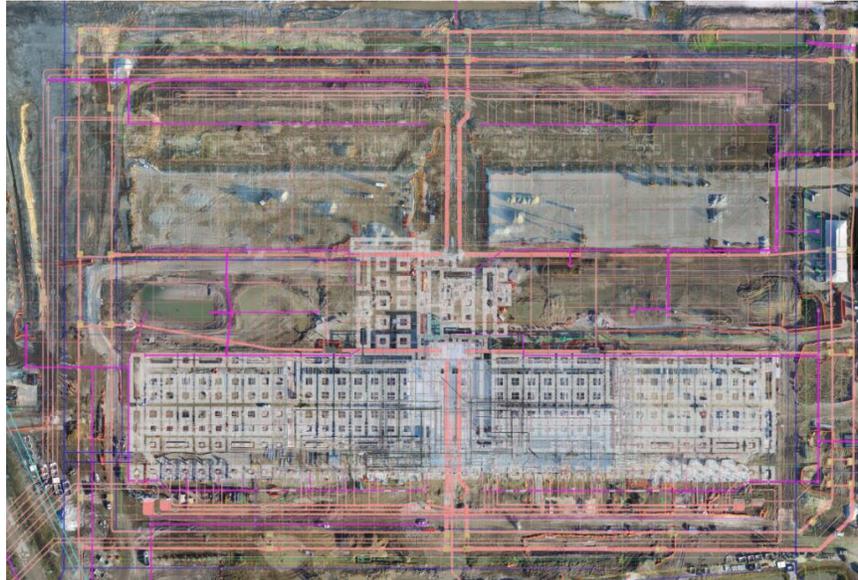
Every project with a laser scanner can name a “gotcha” moment where a laser scanner picked up on an unforeseen issue or a problem not caught anywhere else in the process. A “gotcha” can be defined as a big problem that, had it not been for laser scanning, would have been caught at a later point, affecting budget, time, schedule, or all of the above. See the use-cases below:



SCAN OF AN AREA FOR FUTURE RENOVATION

The example seen above is an excerpt from a point-cloud on a project with no existing model. The scans are accurate enough to model from and can be brought into Revit easily. Taking field measurements and modeling out from those for an area like this is a multi-person, multi-week job. Contrast that scenario to what actually occurred, where turnaround from scan to fully ‘cleaned and ready’ point-cloud was a 2 person, 3 day job. You can calculate what this would be for you, but for us it represents a savings of tens of hours and thousands of dollars.

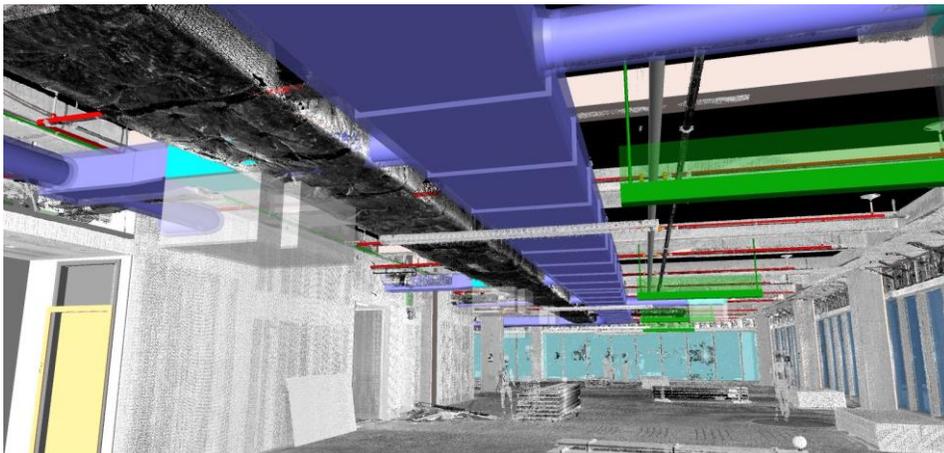
Below is an orthomosaic shot from a drone flight with our key underground models overlaid. Orthomosaic refers to an aerial photograph that has been geometrically corrected so that the scale is uniform and dimensions are accurately measurable.



DRONE ORTHOMOSAIC WITH UTILITIES OVERLAID

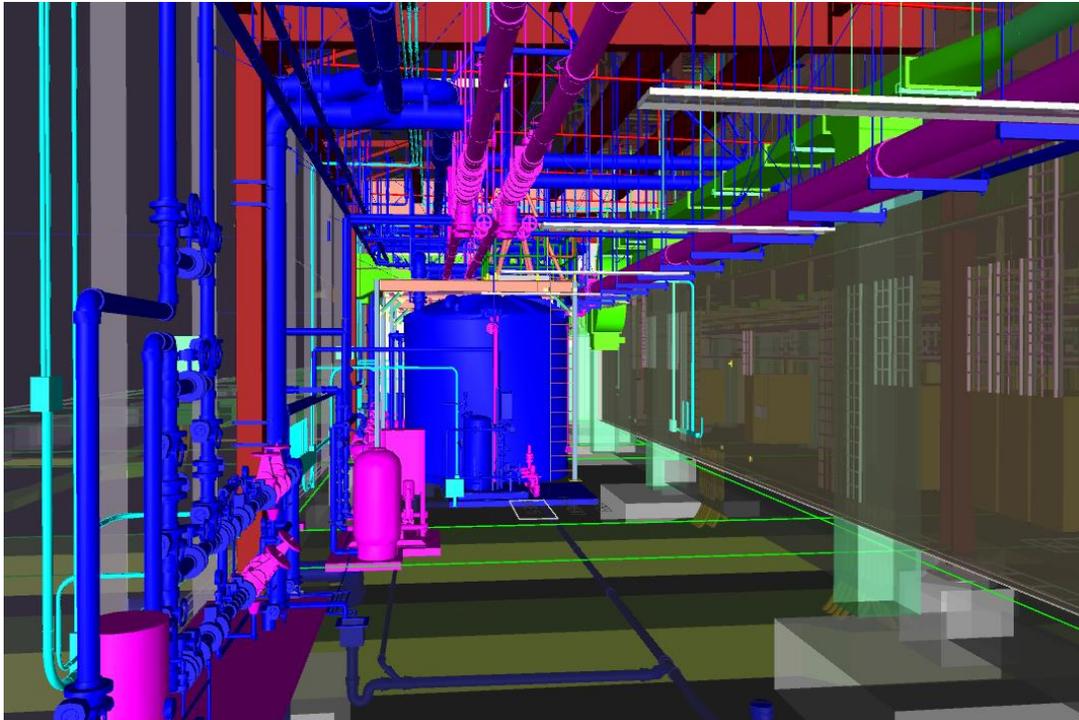
On our site, we utilize these orthos mainly for logistics and dig permit assistance. However, our team on this project has been very open-minded and helped us pioneer some innovative new uses, as well. One such innovation was the usage of these drone shots to determine the location, approximate dimensions, and access to/from a new laydown yard.

Keep in mind, the precision of drone info isn't quite that of laser scans, which is sub-inch, but the overall content is data-rich and beneficial to safety, site, and management teams.



SNAPSHOT OF AN "AS-BUILT MODEL" (HVAC, IN PURPLE) VS A POINT-CLOUD (GREY POINTS, LEFT OF HVAC)

Seen above is an example of a “gotcha”, like we discussed. The purple HVAC model vs the point-cloud adjacent to it is the highlight of the snapshot: as you can see, there is a large discrepancy between the two. However, this is not a result of a field adjustment: this is what was handed over as an as-built model. It is nearly impossible to quantify the re-coordination that would have been required had the project proceeded with an incorrect as-built model, but it would have been quite an undertaking.



A WATER-TREATMENT ROOM, SHOWCASING THE MANY DIFFERENT TRADES IN THE AREA

As you can see above, the water treatment room on our project is a coordination hotzone. The “supply chain” of coordination in this area showcases how heavily each trade affects the ones around it. On our site, you can have a near-perfect, clash-free BIM model, but field installation isn’t always done precisely per the model. However, when you utilize reality capture, and specifically smart laser scanning, you help mitigate the nightmare that a room like this can easily become.

Reality Capture Plans and You

Introduction

It’s easy to spend pages and pages of text on the differences and variances across all possible reality capture plans, but instead we’re going to hit the high-points and delve into what helps make plans successful and what to look out for as stumbling blocks. There are a plethora of templates available for review that are publically accessible and these can serve as a good starting point. In fact, your company may already have a reality capture plan template that you don’t know about. With that said, let’s start with the features of a successful plan.

Features of a successful plan

It's easy to refer to the AEC industry as a whole when we say that the Client has expectations, but you have the means and methods. This is why it is vital to set the guidelines together with everyone at the table.

This is the section where you can incorporate what you've learned about breaking the taboo about money to utilize some ROI justification. To get you started with the right mindset, here are some questions to ask as you're going through the process of putting together a guideline:

1. Be realistic: how much needs to be scanned? What do you gain by scanning for this project specifically? Will you be using your resources effectively throughout the life of the project?
2. Can you meet the expectations of all parties? You can't scan 24/7, you have to prioritize key areas, and you have to be smart about it: does everyone realize this?
3. What is the precision level? How many scans are required to achieve this level of precision? Be sure you look at the specs of your specific laser scanner coupled with the density of scans for an area to get an idea of what is feasible for your specific project. If you need help with this, reach out to the manufacturer of the scanner and they can guide you.
4. Always ask yourself: is there a leaner way to do this? This shows the client that you care about time, money, and schedule.

These questions are all vital and help align everyone from the very beginning.

What to look out for

"What to look out for" doesn't necessarily have to be a negative, but the cautionary tone here is used to convey items that can increase costs, liability, and time beyond what is expected. As a guide, see below for what to be on the lookout for:

1. Vague wording: this only increases the chances of miscommunication in a field that needs no ambiguity.
2. Unrealistic expectations: these can include such things as "scan 100% of a space", "make sure all underground utilities are captured", and other highly ambitious asks. In AEC, there will always be mitigating circumstances and it's important that all parties are aware and expectations are reasonable. In our experience, it is especially effective to relay the cost associated with the ask. If need be, turn the question around and say, "This is possible, but will require x amount of additional time at a rate of \$y, and z extra personnel. Here is what that looks like as an item in the budget."
3. Rapid desired turnaround times: everyone involved must take into account items such as the area scanned per session, staff allocation to reality capture, hardware limitations, and separate workflows that may be impacted. See the next section for more.
4. Strict hardware, software, or workflow practices: technology changes all the time and you should have the freedom to innovate and improve as necessary, especially on larger and/or longer projects.

Overall, the number of pages devoted to reality capture and its usage on our job is over 100, and we didn't get there overnight. There was a lot of time devoted to reviewing, adjusting, re-reviewing, and re-adjusting as everyone gave their comments and attuned their expectations. However, hopefully now you're starting to see why this is time well-spent.

Managing Expectations: We're All In This Together

Introduction

As I'm sure you can see, reality capture should not be a point of contention, it should be just the opposite: new innovations and applications utilizing this data are discovered daily and all levels, from bottom to top, can benefit from it. However, in order for everyone to benefit, everyone has to have the same definition of 'benefit' as it relates to reality capture.

When we're aligned, we all win: here's how

To quickly showcase how valuable reality capture is, below are just a few examples of standard job positions on a project and how they uniquely benefit from reality capture:

1. Safety – logistics planning, location and position of underground utilities, site access points, muster point planning
2. Superintendents/field team – field measurements while not being in the field (including distances, volume, and area)
3. QA/QC – quick, in-office quality checks, floor flatness/levelness, and heatmaps of defects
4. BIM – as-built updates, shop drawings, and more precise coordination
5. Design team – see what is installed vs what was designed and why it was changed
6. Client – as-built model turnover for verification and future renovations
7. Upper management – room build-out and nice graphics for presentations

As you can see, this is a considerable amount of usefulness and yet another way to justify your ROI statements.

Turnaround time

Turnaround time can be a point of contention for everyone involved: who doesn't want all of that scan data *right now*, packaged up and nicely cleaned? Unfortunately, no amount of money invested into a fast PC can make this conversion instantaneous. What we've found instead is a ratio that you should keep in mind – 1:3. This means that for every 1 hour you spend scanning, it takes up to 3 hours to process that resulting data. For example, if you have a large project with 2 separate scan personnel working a single 8 hour day ($8hrs * 2 people = 16hrs$), it can easily take a single scan processor over a week ($16hrs at 1:3 ratio = 48hrs$) just to catch up! These are the types of things that you want to make sure that everyone is aware of so that not only is a pace determined, but also so that bottlenecks are reduced.

Trade partner expectations

Much like the expectations of your team and the Owner, trade partners' expectations play a valuable part in the decision-making process. However, when 70%+ of a subcontractor's overall team does field work, how often do you think about pulling a representative into an office meeting? Chances are, you may not have even thought of this until you saw the section title!

What do the trade partners' expectations look like for your specific job? Trimble points for all underground utilities? As-built level models a week after install? Area-specific logistics plans?

Now, did *they* play a part in setting these or was it something that the higher-ups wanted done? Once it's laid out like this, in a very blunt way, it's easy to see how all of these items, and more, can be affected by reality capture and its usage on your site.

For us, we started laser scanning in the middle of our previous project, meaning the trade partners' deliverables changed, as well. Once they were reassured they would be compensated for this, their next reaction was pushback: after all, this is a huge amount of data and a brand new expectation of never-before-seen precision. However, once a workflow was established that followed the reality capture guidelines, everyone started to grow used to the new expectation and evolved with us. Take it from this hiccup just how necessary making sure that these folks are pulled in early and always have a seat at the table is.

“We Never Talk Anymore”: Keeping Communication Alive in the Reality Capture Process

Introduction

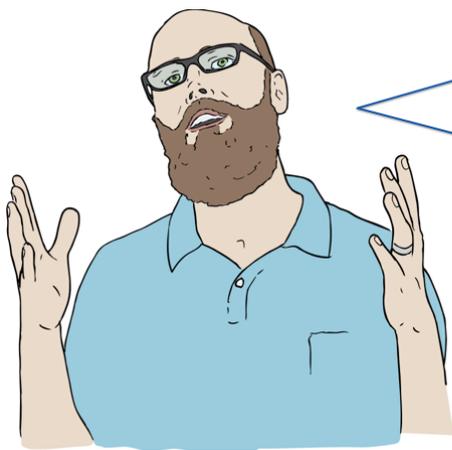
By now, hopefully we've *communicated* just how vital communication is. Even so, here's a section devoted solely to keeping communication alive as it relates to reality capture.

Reality capture touches every piece of whatever project it is utilized on: like we've discussed, from the bottom to the top, each team has expectations, goals, use-cases, workflows, and restrictions. It's important that this is acknowledged and built upon organically as the project progresses.

Who and what is driving communication?

With reality capture, an important piece is making sure there is someone responsible for “selling” this information: it's ideal to have this agreed upon early and written in your guidelines. We've discovered that when these duties are passed off to an existing team with other workflows, it's hard to adjust to adding in new expectations while retaining old ones. Therefore, it's ideal that some shuffling happen so that you have someone devoted to being the ‘reality capture person’ to the rest of your personnel.

With this new point person comes some heavy responsibility: depending on how your guidelines are written, this person may have the ability to make or break your project. So what are some tips to keep everything afloat? You guessed it! They all start with good communication. Below is a snapshot of some verbiage from our reality capture guidelines and a few of the techniques we've found useful:



Construction

During the course of construction, a laser scan update should be presented in every OAC meeting. This update should allow all stakeholders to understand and visualize any field construction and installation that deviates from coordinated BIM models. The status update will include at a minimum the following items:

- Number of scans in the previous week
- Area of scans covered in the previous week
- Focus (ACS, MEP, finishes, etc.) of scans in the previous week
- Number of field conditions and changes that are beyond allowable tolerances
- Coordinated BIM model status according to accepted field deviations
- Percentage of the building that has been final scanned versus overall program (percentage is measured by square feet covered by as built models divided by square feet of the total building)
- Heat map to confirm poured concrete slab and equipment pad level flatness
- Two-week scan area look-ahead

SNAPSHOT OF LASER SCAN UPDATE, PRECISELY AS SEEN IN OUR GUIDELINES

1. Owner and contractor meetings (OAC): as you can see above, a weekly reality capture update is part of our scheduled progress tracking meetings.
2. “Live” pdf with access to key players: for our job, this looks like an overhead view of all site models with mark-ups. The mark-ups show the content of what was scanned, when it was scanned, and why. The ‘why’ can be used to justify the time taken or used to determine time best spent elsewhere.
3. “Public” document control: any qualified person with the right permissions can access what is necessary to them, when convenient for them.

The day or so of set-up that these items require will manifest into hours and hours of time saved as the project moves along. For us specifically, this day of set-up involved putting together the pdfs, setting permissions for users, and making sure everyone was clear on the rules of usage.

Something that should also jump out to you in the graphic above is the precision of language. This was mentioned earlier when discussing the dangers of vague language, but seeing precision in practice makes it obvious why it’s so important. With the guideline so simply laid out, it’s impossible not to know what is expected at these OAC updates.

Buy-in at all levels

It is necessary to have buy-in up to the top, not just someone driving communication. If you only have half of these pieces, then you have a loud voice in a quiet room. What we’ve found particularly useful is establishing at least one point of contact for everyone at the table: each team should be able to speak to each team as necessary and without a “translator”. This means that if your laser scanner needs to communicate updates to the owner, they can do so easily and without changing the way the information is transferred. This is perhaps even more applicable the other way around: a “higher-up” should be able to understand enough of the process to speak intelligently about their needs and wants to those doing the field work.

In Conclusion...

We hope that you benefited from this topic and found at least one thing to take away from it. Our goal is not to be the end-all, be-all perfect guide, but to help illuminate the process of reality capture, provide some help to those either not altogether familiar with the process or who are looking to improve existing processes, and to facilitate further collaboration. We hope that you found our Turner Construction and project-specific lessons learned and use-cases helpful.

For further information, or just to chat about reality capture, please feel free to reach out to Suman Paneru or Jonathan Evans using the info provided at the beginning of this handout: we would love to hear from you.