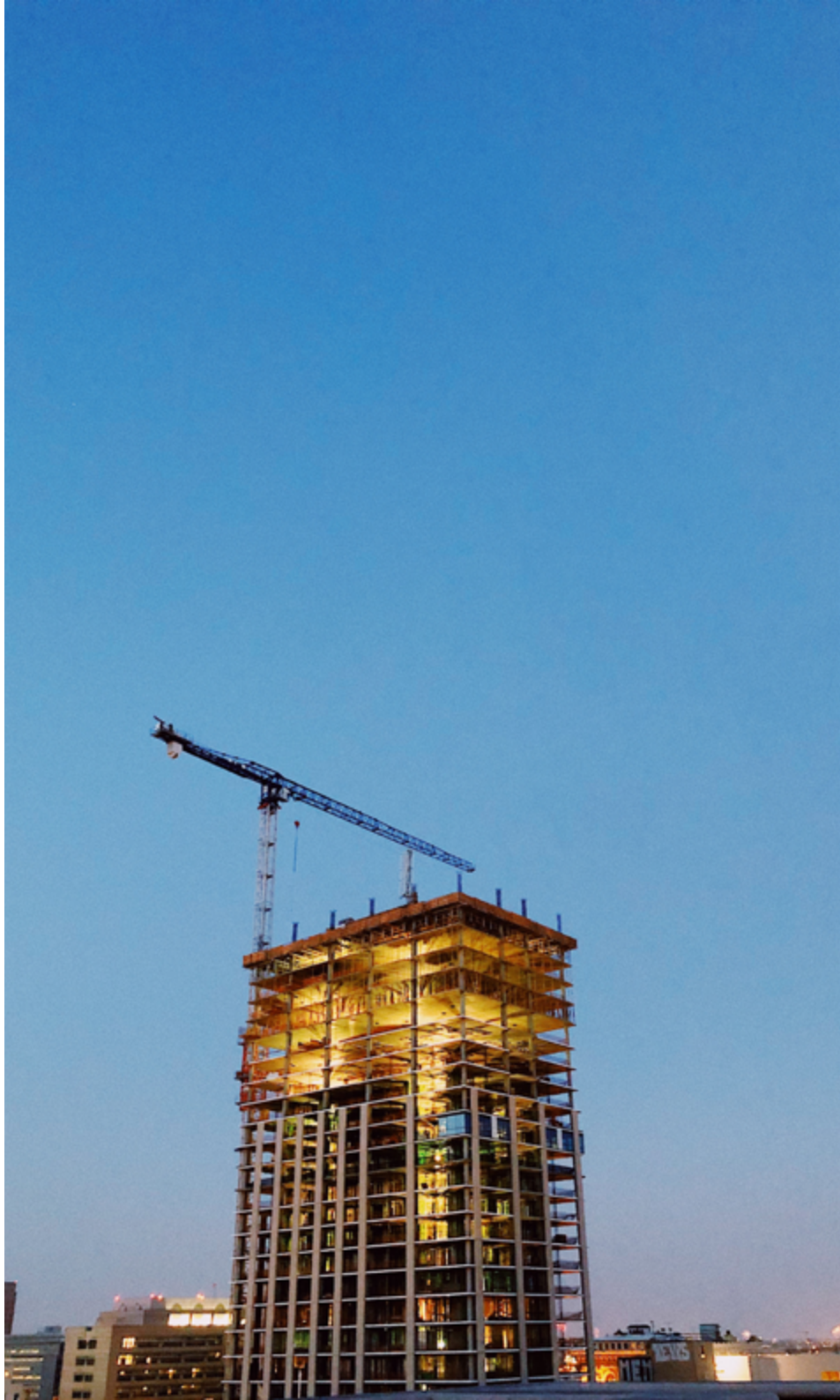
PIX4D

Pushing the limits of construction monitoring with the Crane Camera

2D and 3D aerial as-built data automatically and daily



Industry challenges

Every industry has its challenges. In this section we'll lay out some of the most recurring ones the construction industry is facing - and how you can overcome them.

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Rework wastes time and money

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01. Rework: 28% of the problem

There's no feeling more satisfying than a job well done. And nothing more frustrating than having to undo good work and do it again.

Rework wastes time and money, and can severely impact budgets and schedules. Sources[1] say rework can eat up as much as 28% of your profits.

Rework may be caused by misunderstanding or miscommunication of client requirements. Or schedule pressure, inadequate supervision or poor collaboration. If none of that impacts your project, you may be tripped up by design changes, errors or omissions.

Whatever the cause, the consequences of rework are lost time and money. Overruns impact relationships between contractors, subcontractors, owners and employees.

How to avoid construction rework with as-built updates

You wouldn't work on-site without safety gear, because sometimes mistakes just happen. Your project needs protection too.

If no one ever made mistakes, you wouldn't need steel-capped boots or a hardhat. But in the real world, safety gear and backup plans are necessary. The project-management equivalent of a safety net is timely as-built information.

As-built information gives an overview of the project's progress, gives the team status updates - and most importantly helps you spot build errors early on. Being able to recognize errors before they influence the whole project can prevent rework and save a lot of time, money and frustration.

[1] Love *et al* (2018). The Costs of Rework: Insights from Construction and Opportunities *for Learning, Production Planning and Control*, 29(13).

But collecting as-built information isn't as easy as it sounds.

Walking a site can take hours - not to mention manually generating a report and escalating any issues. Construction sites can change drastically in just a couple of days or even hours, so as-built information is needed several times a week, or even daily. But even just creating an as-built report can take a day or more.

"Creating reports" sounds like a desk job, but you'll need that safety gear we mentioned earlier. Sites contain hazards you just don't find in an office, from dangerous structures to flammable materials. Others may be difficult or even impossible to access. Safety needs to be considered and risk estimated before sending a surveyor on-site.

It may be a challenge, but that's not a reason to skip monitoring the as-built. We've got some ideas about how best to do it we'll share later in this ebook.

4 steps to avoid construction rework

- Automate your processes and forget the paper
- Establish better team communication and collaboration
- Set flexible schedules
- Gather timely as-built information

02. Surveying: laying the foundations

Surveys are the keystones of any construction project: everything depends on accurate and timely survey information.

Before any soil is broken on any construction project, you need an accurate and up-to-date survey of the site. And a lot more during the project. And then again after work wraps up. Surveying isn't just about laying a foundation for a great project: it's also a keystone, supporting every element around it.

Traditional surveying	VS	Laser scanning
• Slow and intrusive		• Faster and less intrusive
• Total station requires relatively little skill		• High-skilled operator needed
• No overview - just disconnected, discrete measurements		• Expensive investment
		• Complete and accurate 3D results

An ancient profession, modernized

The first surveyors used sticks and string. Today's surveyors have a few more tools in their belt.

What we now call "traditional surveying" isn't so traditional. Ancient Roman agrimensores mapped an empire which spanned half the globe with little more than a stick and bit of string. Today an old-school surveyor is armed with a total station and GPS as well as a tape measure.

Laser scanners are a higher initial investment than a tape measure - smaller businesses may not be able to afford them. Or store them: a laser scanner can be the size of a refrigerator. But some scanners can capture data up to 10 times faster than a total station. Which is the best choice? Well, that depends.

However the data is captured, the next step is importing it to Specialized software to create point clouds for 3D modeling and visualization.

Needless to say, every step of the way you need a trained surveyor. Later in this ebook, we'll discuss how to make the most out of your surveyor's time - and get better return on your investment.

03. Drones: a bird’s eye view

Drones have taken off in the construction industry. But a flying camera isn’t a magic bullet.

A decade ago, the only way to get a bird's eye view of your entire site was to take a plane or helicopter up - something out of reach for all but the biggest projects. Now, drones are affordable, accessible and can be found on just about every job site.

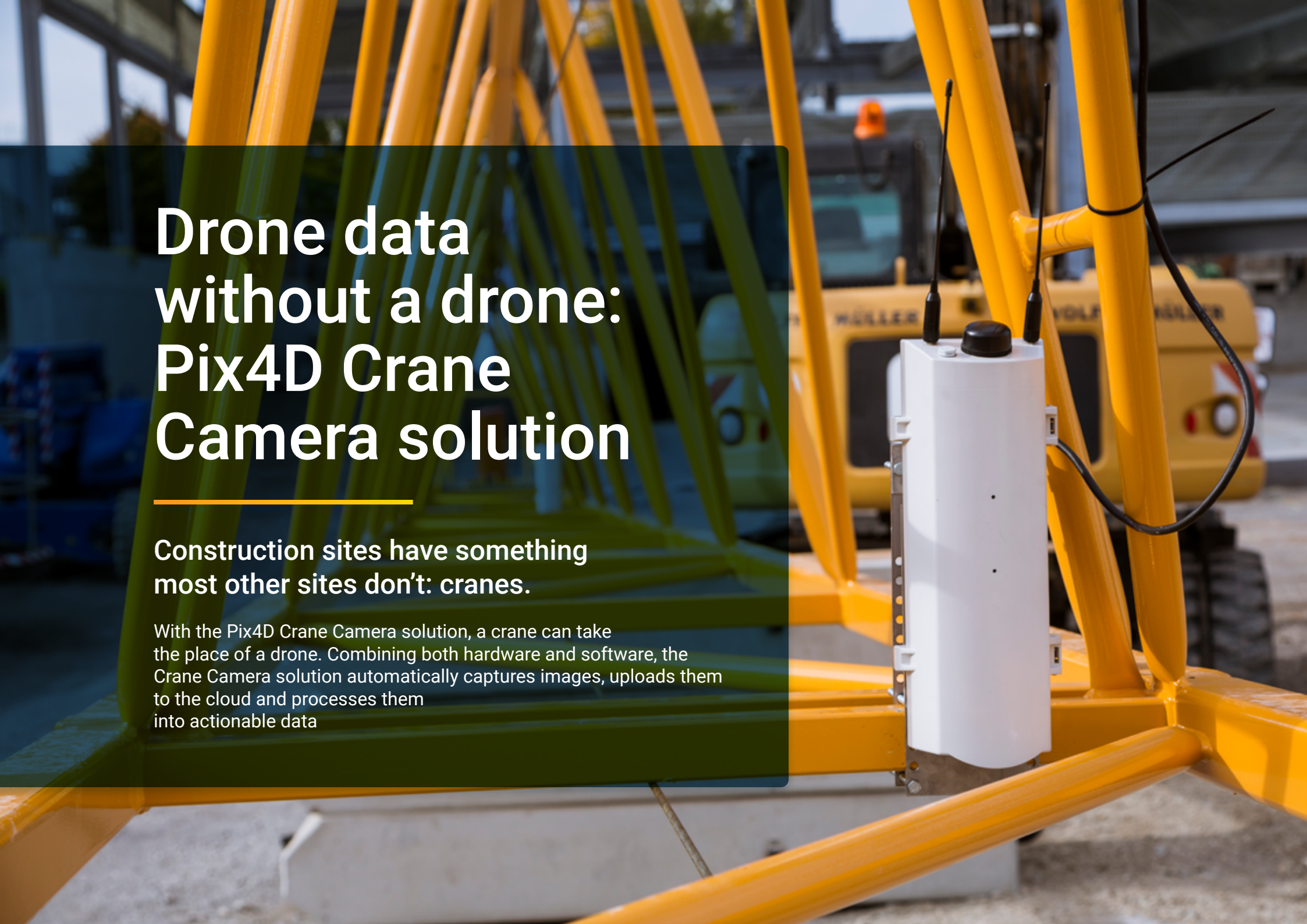
Drone technology and mapping software are changing the construction industry as we know it. The rapid growth of the technology shows the sector recognises the value in drones. But a flying camera isn't the same thing as a magic bullet.

If the conditions are right, drones can capture more data, quicker. But the technology isn't without its challenges.

In under a decade, drones have gone from an expensive professional tool to something on every kid's wishlist. But just because you have a drone, it doesn't mean it's always ideal to fly one. For a start, there's the legal angle to consider. And without a skilled drone pilot, well, you may not have a drone for very long.

5 scenarios you can't fly a drone

- Without a trained pilot
- In bad weather
- Near an airport or military base
- Near crowds or sporting events
- In dense urban areas



Drone data without a drone: Pix4D Crane Camera solution

Construction sites have something most other sites don’t: cranes.

With the Pix4D Crane Camera solution, a crane can take the place of a drone. Combining both hardware and software, the Crane Camera solution automatically captures images, uploads them to the cloud and processes them into actionable data

4 things the Pix4D Crane Camera solution does better than a drone

Works automatically: no need for a drone pilot

Weather independant

No flying - so no need to get permission to take off

Delivers jobsite data daily

How does the Crane Camera solution work?

The Crane Camera is based on photogrammetry which is the art and science of extracting information from images. The process involves converting overlapping images into measurable 2D maps and 3D high precision models, which allows making real-world measurements from images.

1.

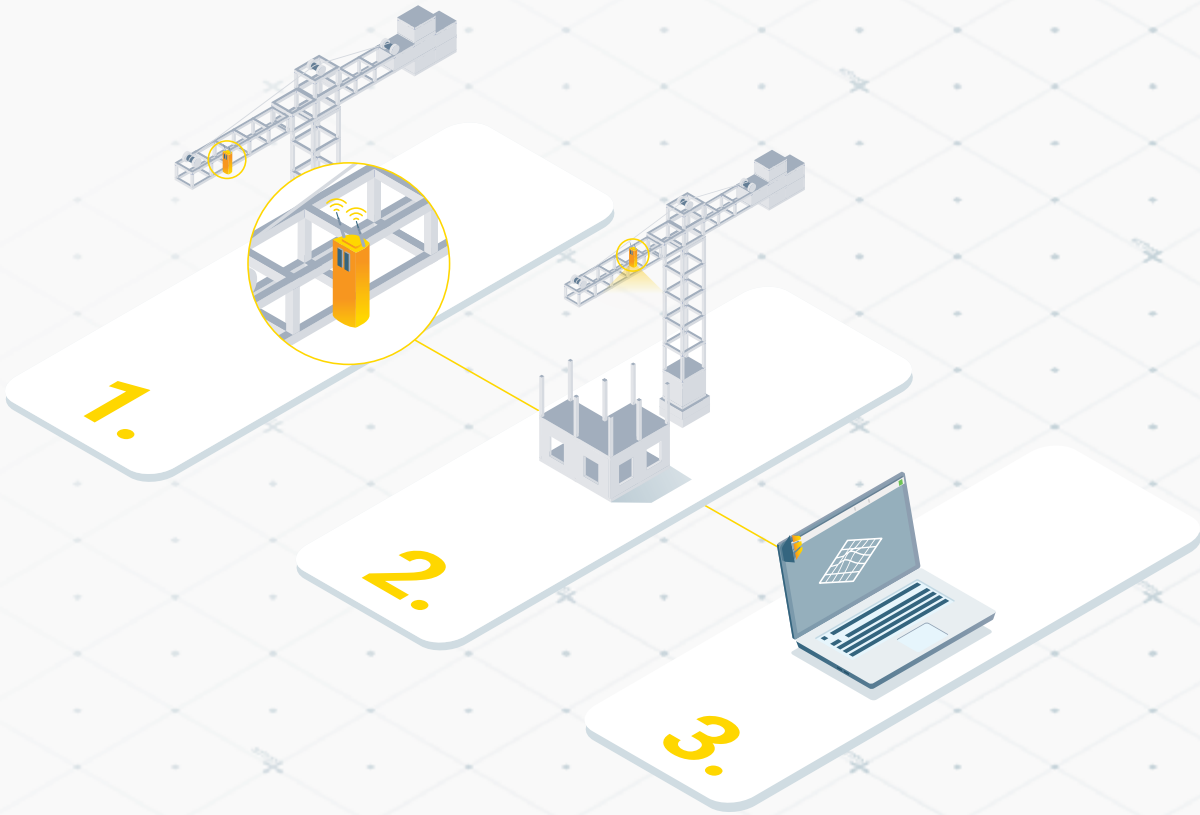
The Crane Camera solution is mounted on a tower crane jib and connected to Pix4Dcloud Advanced photogrammetry solution.

2.

The Crane Camera is connected to the crane's power source and begins to capture images when the crane moves.

3.

Once enough images are collected, they are automatically transferred to Pix4Dcloud Advanced and processed into accurate orthomosaics and 3D models. The results are securely displayed online - ready to use whenever you are.

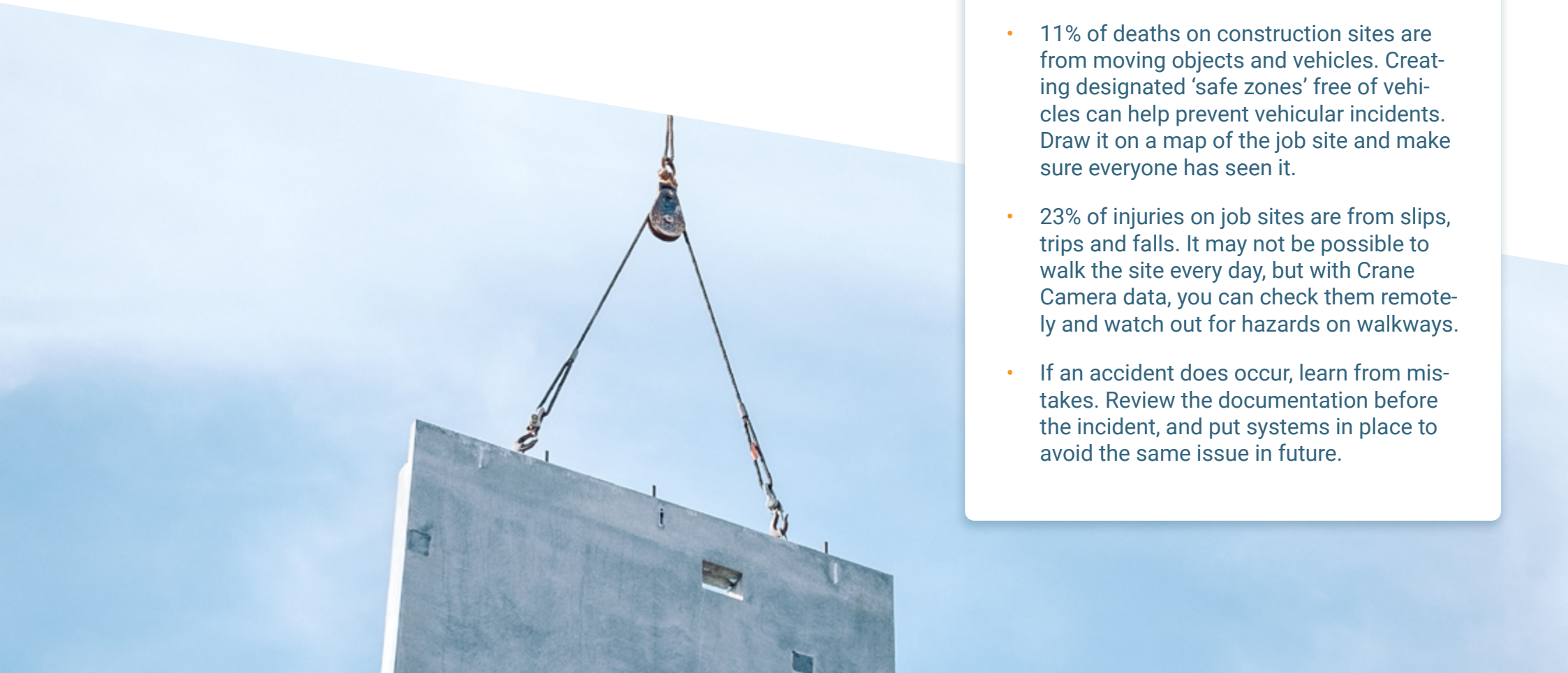


What can you do with a tool like the Crane Camera?

The Crane Camera offers an updated view from above. That's a nice-to-have, but is it necessary? Like any other tool in your tool box, it depends on what you do on it.

Onboardings and safety briefings

With an updated daily overview of your site, onboarding new team members is easier. From access points to no-go areas, you can quickly give an overview of the site. Creating a ‘culture of safety’ is easier said than done - but onboarding new employees as they come on site will go a long way.



Staying safer on site

In the USA, construction has around 6% of the workers, but 17% of the fatalities. That’s the largest number of reported fatalities in any industry sector.

Stay safer on site by including safety in the project planning process.

- 11% of deaths on construction sites are from moving objects and vehicles. Creating designated ‘safe zones’ free of vehicles can help prevent vehicular incidents. Draw it on a map of the job site and make sure everyone has seen it.
- 23% of injuries on job sites are from slips, trips and falls. It may not be possible to walk the site every day, but with Crane Camera data, you can check them remotely and watch out for hazards on walkways.
- If an accident does occur, learn from mistakes. Review the documentation before the incident, and put systems in place to avoid the same issue in future.

Make meetings easier

Having all the information makes meetings easier. Share progress status in almost real-time: Crane Camera data collected in the early morning will process automatically and be ready to view from anywhere in the world by late morning. From daily briefings, to project meetings, to last-minute scheduling, the 2D and 3D data gives a full overview of your construction project.

Remote progress tracking

No need to leave the office to check progress status - with the Crane Camera, you do it remotely, saving time and resources you would typically spend to go on the jobsite to check the status.

Plus, you can easily share selected results with the public - or non-project stakeholders like the owners, finance institution and authorities.

BARNHILL CONTRACTING COMPANY

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Use case with Barnhill Contracting Company: “Something we would never be able to do with regular or drone surveys”

The Barnhill Contracting Company lives by the motto: we make complex projects simple. One way they do that is with Crane Camera data.

Layton Lomax, Virtual Construction Manager at Barnhill Contracting Company explains that the team relies on the Pix4Dcloud Advanced platform during their daily meetings with the project subcontractors. “Most of the time, we use Pix4D on a big screen and point out the areas they need to work on or areas we can move equipment to - it’s kind of a logistic tool for those meetings, definitely used daily!” explains Lomax.

“I look at the results every day, and so does the team. This is something we would never be able to do with regular or even drone surveys. It’s a good way to track our progress and document the site. Every day, I send our higher-level management a link to the cloud and they’re able to check what has been done - we’re able to keep them up-to-date.”

How else can the data be used?

During the building of a new hotel in a busy city center, VolkerWessels' team used the Crane Camera data daily. And so did different stakeholders.

- **Superintendent** - checked the formwork and the floor steel every day, and used the Crane Camera information to plan daily work and logistics.
- **Project manager** - used the data mainly for visualization and to show the project progress to the client.
- **Earthquake specialist** - as the hotel was going up in an earthquake-prone area, a specialist checked the installations and made sure the building met earthquake regulations.
- **MVP subcontractor** - to check installations, such as ventilation and electricity.

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Keep schedules on track

We all know how important it is to keep construction projects on track, as schedule deviations can slow down a whole project and significantly increase the project's costs. But keeping schedules on track can be difficult at times.

With the Crane Camera, daily schedule verification is easy. Planning the use of various resources such as equipment or labor, or coordinating deliveries and installations is simple as opening the project and checking the progress. With the daily as-built data if any deviation occurs, schedules can be modified immediately.

Use case with The Beck Group: avoiding schedule deviations

Building a 22-story hotel in a congested urban area was always going to be a challenge. The tight space made it harder

The team had to coordinate material deliveries efficiently and minimize overlapping deliveries which would lead to traffic congestion and being unable to unload, requiring rescheduling and risking the delay of the entire project. A lack of space also meant the Beck Group had to take full advantage of every available square foot, and store materials on top of the ongoing building.

Coordinating the deliveries required continuous collaboration with the suppliers and within the team as well as constant site progress tracking to avoid any mistakes and keep the traffic flowing during the day, and get the hotel built on time.

BECK

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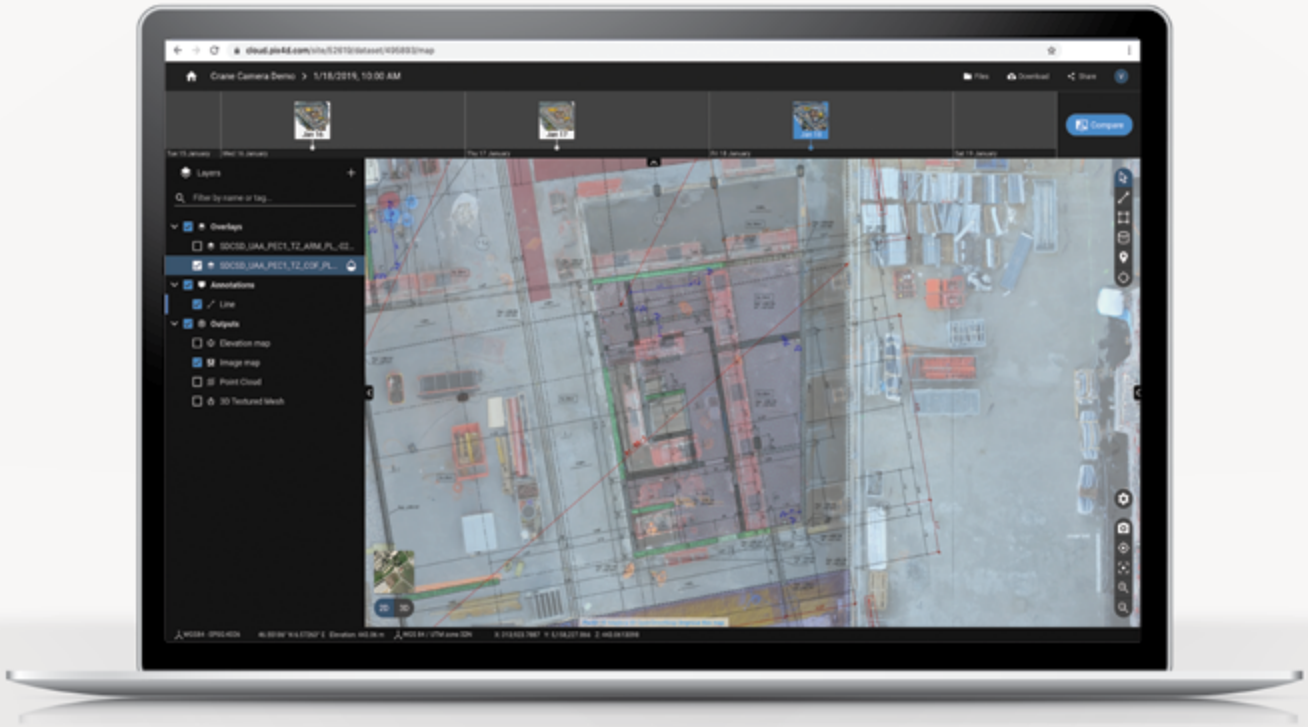
Comparing as-built vs. as-designed to prevent construction errors

We all have heard the old saying, ‘measure twice, cut once’ - but how many of us live by it?

As mentioned earlier in this ebook, construction rework can eat up as much as 28% of your budget. The best way to prevent errors is to check everything’s in place before it’s too late.

By default, the Crane Camera solution delivers data daily, making double-checking and spotting errors early on easier than ever. Upload your plans to the software, and use the Overlay tool to compare the as-built to the as-designed. Because it’s cloud-based, you can check on the progress from anywhere in the world.



Use case with VolkerWessels: avoiding “the worst case scenario”

Every day, VolkerWessels’ superintendent looks at the Crane Camera data. Comparing the as-built with as-designed using the Overlay tool only takes a few minutes. One such check revealed a major issue: the floor formwork deviated from the correct place by a full 35 centimeters.

“In the field, you cannot see such an issue immediately, you discover it later on in the process. But with the Crane Camera, you can see it on the same day,” says Arnold Pit, BIM Process Manager at VolkerWessels.

“The superintendent shared the project with the people on site and asked them to check it. Before the mistake really happened, they had already corrected it - and that is really powerful. I cannot imagine how we could have discovered this error so early without this tool.”

Without the Crane Camera solution, the superintendent would have to physically go on the site and make their own measurements but this would “not happen very often since it takes too much time.”

Pit explains: “If the error was not spotted in time, the worst case scenario would be to pour the concrete for the floors and discover that the structure is unbalanced. This could be very dangerous and result in building failure. This would have irreversible consequences.”

“Another possibility would be to discover that there is not enough support for the elements on the floor while laying the concrete on the formwork. In this case the team would have to uninstall all these elements, and re-make them. This would delay the project and lead to increased costs and extra efforts.”

A two-minute check prevented days of expensive rework, or risk of the worst case scenario of building failure.

VolkerWessels

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Documenting site progress and resolving disputes

Even the “best projects” need to be documented from start to end. Anyone who’s ever visited a building site will tell you that the longer a job goes on, the bigger the gap between the original vision and the finished project. These changes are most often for the better, but the reasons - which range from legacy documentation to fire safety plans - need to be written down.

Unfortunately, on a busy construction site, as-builts are often overlooked until the end of the project, when they’re harder to pull together. Monitoring and documenting a project as it’s on-going means more complete records, and a smoother end to the build.

Also, what better way to avoid tedious ‘he-said she-said’ conflicts than with cold, hard facts.

Being able to prove what was done when and by whom could cut out the vast majority of disputes. Is there a better way to provide those facts than with images?

The Pix4D Crane Camera solution captures an overview of the site automatically. With the Overlay tool, it’s easy to compare the 2D maps with the original plans. Plus, with the Timeline, you can scroll back through the progress, and see exactly what was done when.

5 situations as-built drawings are essential

- As-builts offer **protection from liability**. Deviating from design may lead to failures. Documenting changes can help your team pinpoint potential issues before real problems arise.
- In many cities, **underground pipes and utilities** were laid a century or more ago. Make a note of where they are actually located on your as-built, and your fellow townspeople will thank you.
- **Ease of renovations**: perhaps it doesn’t matter where that electrical conduit was placed in the south wall today, but it will matter a whole lot in ten years time. An unclear as-built is almost as bad as no as-built.
- Check your contract: you may not receive the **full payment** until you deliver the as-built.
- **Protect your reputation**: handing over the as-built is often your last contact with a client. Finish strong with a great as-built document.

Importance of regular as-built reports

When performing major activities, such as concrete installations, regular as-built reports play an important role in making sure the work is done right the first time, and therefore costly and time-consuming rework is avoided.

Now, rather than depending on time-consuming and expensive ground-based surveys and outdated plans, project teams can use a Crane Camera based aerial mapping solution to access 2D and 3D as-built data automatically and daily. So did Barnhill Contracting Company.

Layton Lomax, Virtual Construction Manager at Barnhill Contracting Company explains: “We have a lot of post-tensioned concrete slab work on this jobsite. We really wanted a way to document the location of the post-tension cables and reinforced slabs. We needed complete as-built reports of all the structural components. That’s why we chose the Crane Camera.”

With the Crane Cameras solution, all work on the site is monitored and documented, enabling Lomax and his team to verify the project is rendered as defined in the design phase and any errors or construction rework is avoided. “I’ve used the measuring tools to locate penetrations through the slabs and check on what’s been installed in the field through the slab work. I was pretty impressed with the measuring tool that will give you a cross section view of the different elevations of what you’re measuring. That’s definitely useful.”

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What's next?

We've presented some exciting new technology, based on the oldest value: communication. The key to a successful project is a good overview, and clear communication.

So let's keep talking. Get in touch with us to discuss how to integrate the Crane Camera on your construction sites. We would love to hear from you.

Get in touch

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