

Drones Improve Oilfield Operations

A 2020 Technical Paper

*“The many benefits of using drones
in today’s oil and gas industry”*



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EXECUTIVE SUMMARY

Drones save time and money. Today's use of drones combines artificial intelligence and 3D Cad technologies that save time and money, opportunities that didn't even exist a few years ago! Drones can and are helping us manage our assets in new ways that were inconceivable just of a few years ago, and at a fraction of our "normal" costs.

In a few minutes a drone can "fly" a gathering line, detect its integrity, and report its status ... all in real time!

In a couple of hours, a drone can survey a complete facility, make a 3D record of it using its built-in GPS, capture thousands of 3D vector points, and transfer those data points into 3D Cad. Overnight you can have an interactive 3D model of your facility on your computer without ever leaving your desk! Your asset managers can inventory components, your facility engineers can measure pipe sizes and check pressure drops, your land men can measure boundaries, your process engineers can view and correct bottlenecks and confirm proper vessel sizing, and your safety personnel can manage the OSHA requirements of the facility without, all leaving the office!

The results are far better asset management, quicker, more convenient, and at a much lower cost. Accounting can have the asset information they need; engineering has a view of each facility at their fingertips, maintenance can know see what's needed before they leave, and you can see your facilities in interactive 3D any time you like.

Today's drone technology is simply marvelous, and it's getting even better! If you haven't tried it lately, maybe you should!

2020 DRONE AI



Just a few years ago drones were considered toys. Then refineries and gas plants started using them to inspect tall towers, eliminating the need for plant personnel to inspect the plant's tall fractionation and distillation towers, it's tanks, and its flares. Personnel safety was in the forefront of drone use for these inspections, and rightly so.

After all, drones can go almost anywhere!

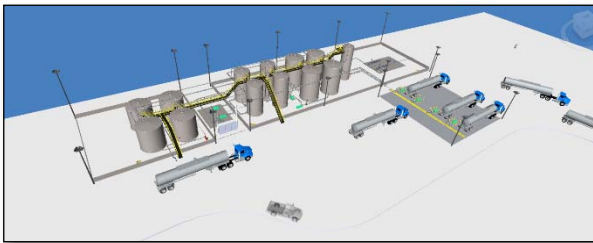
As the use of drones grew, Phase1 and others began experimenting with the integration of global positioning technology with vector camera point capturing and LIDO



Today the drones are programmed to collect vectored data points in the real world using its fine-tuned GPS system. Precision is the key here. Once the drone flies a system, the points are downloaded into an algorithm that then generates a very detailed 3D image. The image is then converted into a 3D model that can be manipulated using AutoCAD's Navisworks software. Using Navisworks is intuitive; no special skill set is required. When a model is opened in Navisworks it can be fully manipulated. The viewer can zoom in and out, turn the model in any direction, and even measure components. It's almost as if the model was created within AutoCAD, but in a small fraction of the time and cost involved if it were. The combination of these AI technologies has created a new and very affordable tool. And more and more firms are using it.

THE VALUE OF 3D MODELS

For decades industry has relied on 2D drawings. There were originally drawn by hand on a drawing board in pencil or India ink. As we entered the age of personal computers some clever "coders" developed rudimentary software that enabled them to draw lines and circles on a computer screen. This soon advanced to dedicated drawing programs like SolidWorks and AutoCAD, created specifically for desktop and laptop computers. It took nearly two decades for these programs to evolve to the point where CAD designers could create renderings in three dimensions.



Three dimensional models are amazing. They are identical to the item after it is built or constructed, but exist before the real-world equivalent. This allows the designers, engineers, planners, accounts, and executives to view a structure or a facility before the money is spent to build it. If something needs to be changed, it is first changed

in the virtual model, where costs are almost nothing.

The only real problem with 3D models is that they are VERY time consuming and costly. This is particularly true for existing facilities where as-built dimensional drawings can cost tens of thousands of dollars, or more, and can take months to generate, or longer. This is the reason that few firms invest in as-built drawings, or 3D models of structures or facilities after they are built.

Enter the Phase1 drone! From the inception of first flight the drone "knows" why it's there. The pilot flies it near one side of the facility, then around all sides, and over the top. The drone pauses as it goes on to



generate locational vector points which the CAD software converts into images of all of the details of the structure or facility

This all sounds tedious, but in fact, it's all based on the combination of the right AI software, and it happens almost instantaneously!



The result, whether a train like the one pictured here, or a building, a pipeline riser, or a production facility, is a dimensional 3D interactive depiction of the real thing!

THE VALUE OF ASSET MANAGEMENT

Business assets represent significant investments that can make or break a company. As in all parts of a successful business, knowledge is everything, and up-to-date knowledge of assets critical. With current asset files like those generated using drones to translate asset pictures into interactive 3D models, managers and accountants have the tools they need to accurately identify, locate, and record inventory in total detail so they can correctly report all of the company's physical assets. Having access to 3D files takes all of the guesswork out of this effort, adding credibility. All of this combines to make better budgeting, inventory, operating, and overall financial decisions possible. Once done, these give the user a competitive advantage over competitors who struggle with this issue.



VISUAL DRONE INSPECTIONS INCREASE COMPANYWIDE SAFETY



Employing drones increases employee safety. When drones are used, employees have no risk of OSHA related safety issues like being in confined a space, having to work with encumbering safety harnesses, the worry of tripping or falling hazards, and others like exposure to hazardous chemicals and/or killer vapors like H₂S. Every accident avoided can save employers tens of thousands of dollars ... many times the cost of drone usage! Drones can spot issues and problem areas without human exposure, providing the intelligence needed for trained technicians to resolve problems with the right facilities in a single trip, saving time and money. The results are obvious; you can get more done, more safely, and with fewer people.

LOGISTICS AND COMMUNICATION

The remote nature of oil and gas facilities creates a logistics and communication challenge for management. Wells, tank batteries, compressor stations, gas and salt water disposal plants, warehouses, etc. are often quite remote from the staff. Drone use rings these all together. Drones can fly a problem facility and the fly-by video can be uploaded so everyone involved can

see it in real time. If an engineer needs a close-up of a pressure gauge, or an electrician needs a closer look at a transformer, this is all possible remotely and in real time! It's like having boots on the ground 24/7 ... but without any of the personnel leaving their office!



MAPPING ACTIVITIES SIMPLIFIED!



Another creative and economical use of drones is to fly an existing location and then overlay it onto a possible future location found on Google Maps. The possible locations can also be flown and perimeters outlined so the overlay is precise.

In addition, drones can use their GPS coordinates to accurately map topography. In undulating land areas this is valuable in preplanning grading plans to minimize the need for additional soil, saving even more money. Topographical drone surveys cost a very small fraction of the cost of a topographical survey done by a human survey team.



Pipeline rights of way are another area of keen interest for drones. Drones can fly proposed pipeline rights of way in the planning stage to determine the best routes, least topographic changes, needs for bridges of trenching through streams and ponds, and/or clearing of trees and shrubs. Drones can also fly existing rights of way to record the exact location of risers, cathodic protection stations, pig launchers or retrievers, and any other components. Thermal imaging, a standard component of Phase1 drone pipeline surveys, has the added advantage of detecting the difference between native soil and the components being transported by the pipeline itself. This imaging immediately detects any and all leaks, and their precise location, making all associated activities more timely and less costly.

DRONES ARE ENGINEERING TOOLS

When drones fly a facility, they gather special data which Phase1 combines with a proprietary photogrammetry technology to create a “digital twin” of the facility. The digital twin can then be rendered and viewed in Autodesk’s free 3D viewer/manipulator program, “Navisworks”.

Once engineering has this 3D image (model) of the facility, all related engineering activities can begin. Pipe sizing can be reviewed for debottlenecking exercises. Areas needing cleaning or pigging can be identified and isolated for future maintenance. Instruments, valves, and controls can be checked for proper functioning. Tanks can be checked to assure that all thief hatches are closed, and all vent valves are in place. Flame and detonation arrestors can be checked for signs of



internal fires; a condition that should trigger immediate inspection and/or replacement of the flame/detonation elements.

Phase1 can include LIDAR® technology to improve digital accuracy even more. While not normally needed, this level of precision may come in handy when conventional images need higher resolution.

THE COST IS AFFORDABLE!

No discussion of any new technology would be complete without considering the cost. Phase1 has approached this issue VERY aggressively. Where others charge \$25,000 or more for similar drone services, Phase1 uses a much lower sliding scale:

One-three drone surveys:	\$5,500/each
Three-seven drone surveys:	\$4,500/each
Eight to 20 surveys:	\$3,500/each
More than 20 surveys:	\$3,000/each

The prices above are current as of the date of this paper. All prices are subject to change as times and conditions change.

IN CONCLUSION

Phase1 is proud to have served the oil and gas industry for nearly 20 years. We have successfully provided engineering and CAD services to hundreds of oil and gas companies, exceeding expectations in every case. The 21st century has ushered in many new and useful technologies. Among them is the use of drones in combination with AI (artificial intelligence) to produce results quicker and more economically than ever before. Chief among these is Phase1's drone service. Phase1 is currently drone flying 72 oil and gas facilities for a major client, and is anxious to fly yours too! Phase1 also has its own airplane, so commercial airline travel is not a constraint. Phase1 can go almost anywhere almost any time on a moment's notice!



Please contact Kris Yates (pictured here), Phase1's owner and CEO, whenever you want to try this unique service.

Call Kris at (801) 971-7994 or find Phase1 on the web at www.phase1web.com.