An aerial, dark-themed photograph of a construction site at night. A yellow autonomous vehicle is positioned on the right side of the frame, emitting a series of blue, fan-shaped sensor waves that spread outwards. The background shows various construction structures, including cranes and scaffolding, illuminated by site lights. A solid red square is located in the top-left corner of the image.

# 5 WAYS MACHINE CONTROL BENEFITS FROM Duro's PRECISE POSITIONING



Historically, machine control utilized the global navigation satellite system (GNSS)—of which GPS is part—as a component of a sensor network to guide and automate equipment and tasks.

Today, with the utilization of advanced positioning technology as part of your application, one can reap benefits that go beyond the completion of one task and broaden the benefits of machine control.

Navigation's ecosystem of precise positioning GNSS solutions is ideal for implementing machine control. By utilizing the easily integrated Starling® positioning engine or ruggedized Duro® and Duro Inertial receivers that receive precision corrections from RTK, operators can automate equipment and improve efficiency with reliable, accurate positioning.

This e-book explores five ways that Precise Positioning from Swift Navigation benefits machine control:



**Achieves the accuracy your job site requires**



**Delivers reliable positioning you can count on**



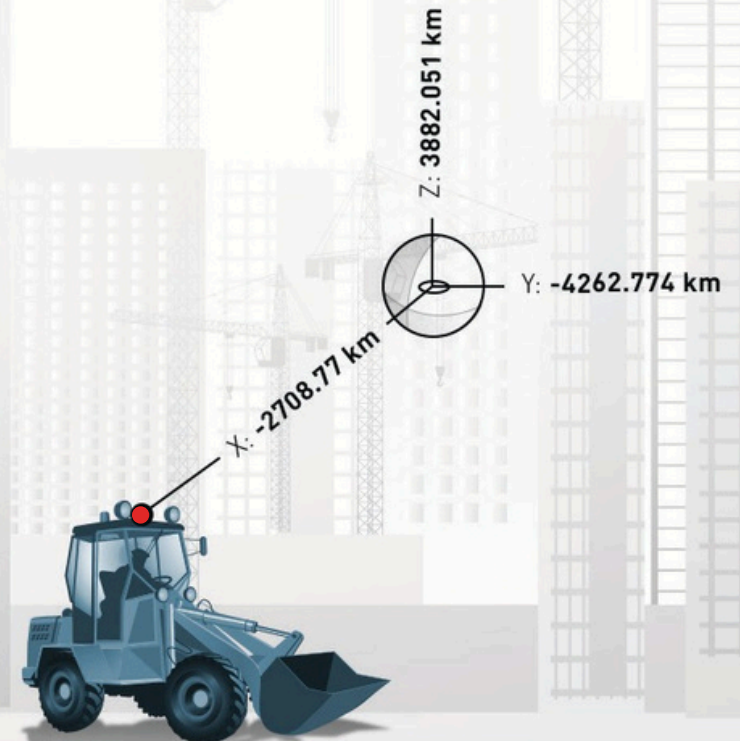
**Ensures equipment operates where intended**



**Is an easily implemented, end-to-end solution**



**Is cost effective**



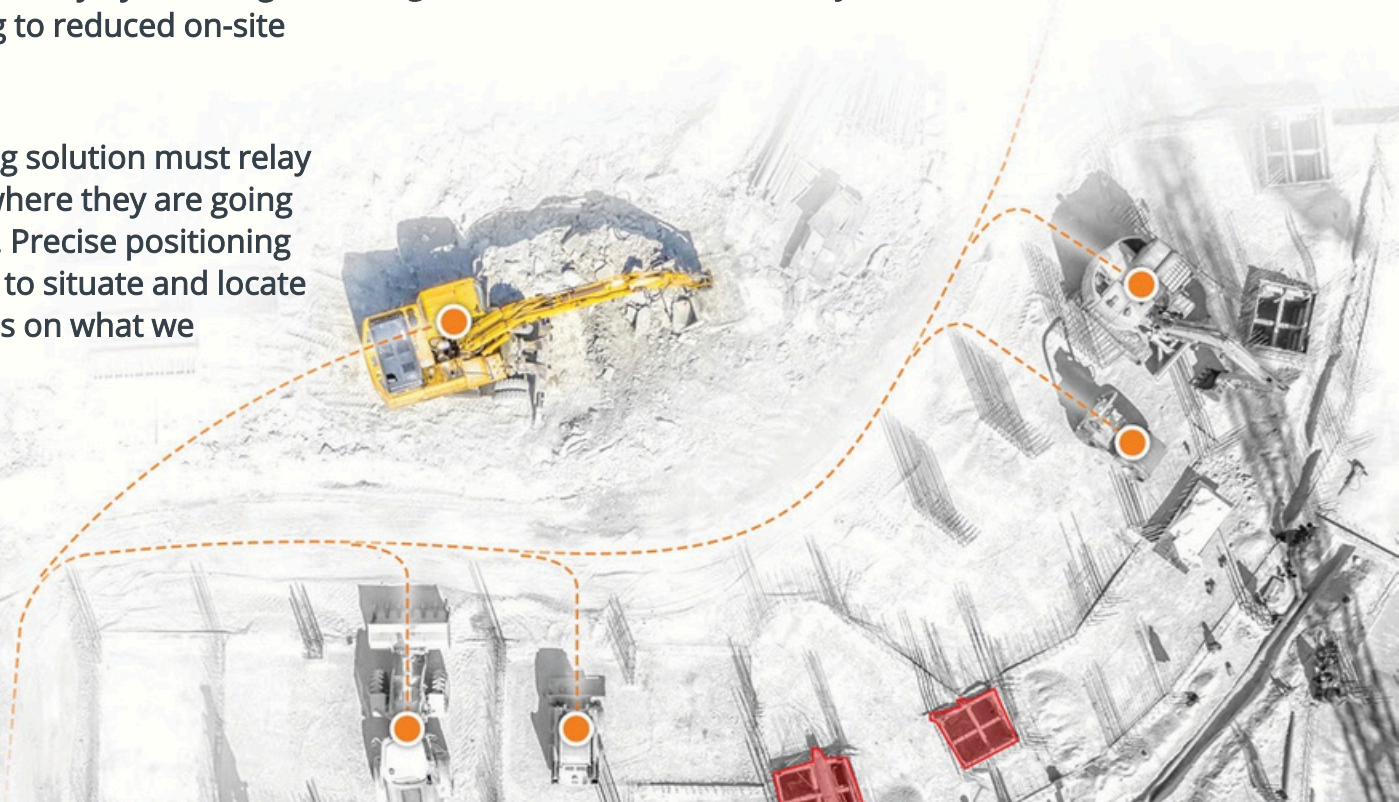


# #1 | **PRECISE POSITIONING ACHIEVES THE ACCURACY YOUR JOB SITE REQUIRES**

Machine control delivers clear advantages like improved efficiency and safety on job sites and in fields. Efficiencies are gained through the automation of tedious, labor-intensive and repetitive tasks. The automation of tasks reduces errors and ensures work doesn't need to be corrected or redone. Automated tasks also means that lower-skilled operators can be utilized. Automation also increases safety by reducing operator stress and fatigue, leading to reduced on-site errors.

To reap these benefits, a positioning solution must relay exactly where devices are placed, where they are going and where they are expected to go. Precise positioning consistently and quickly allows you to situate and locate assets. Precise positioning improves on what we historically

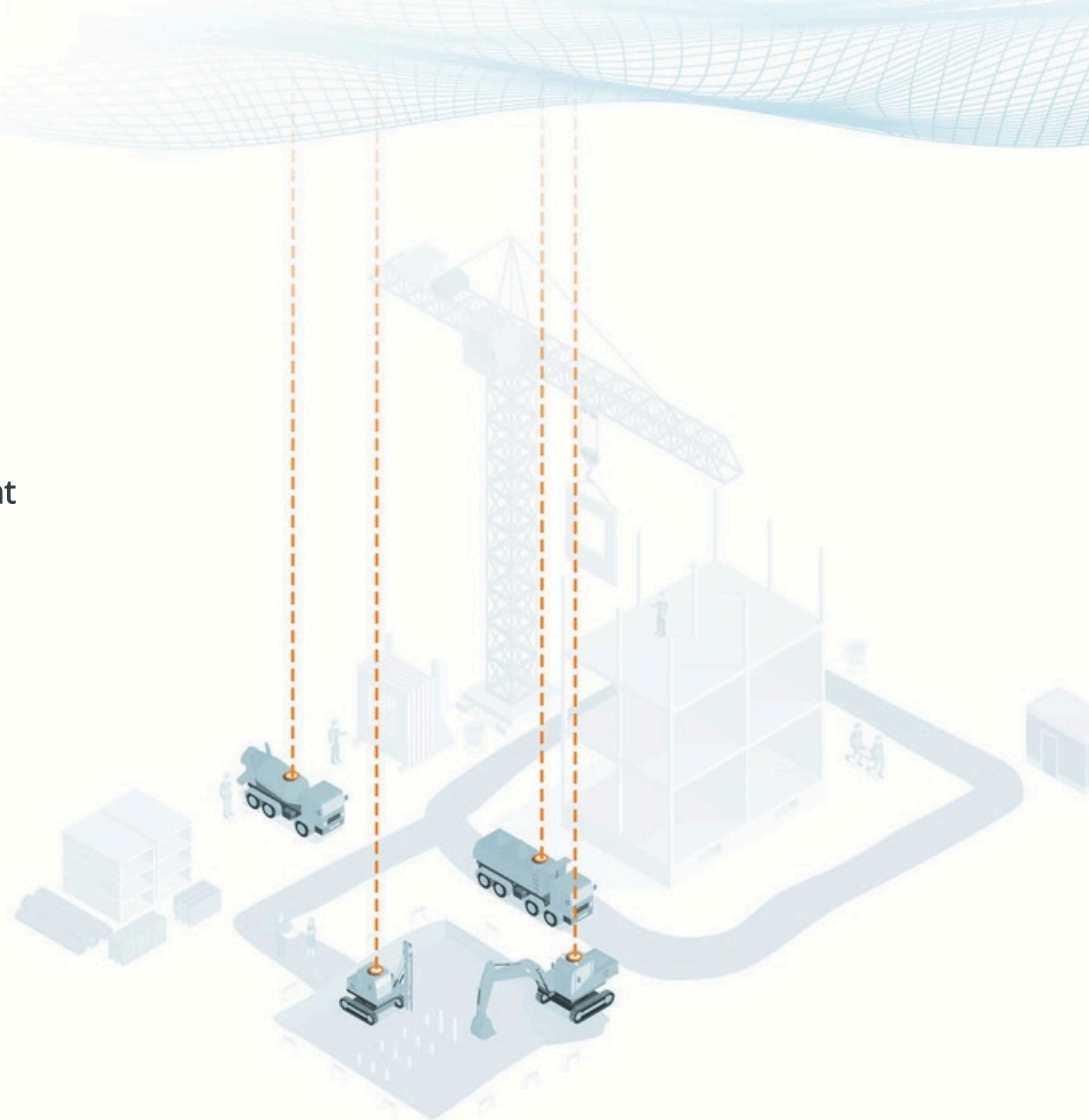
accept from location data to identify the position of assets well beyond the standard location data accuracy of 3 meters and provide positioning at decimeter-level accuracy. Standard GNSS solutions can indicate that you are in the correct general work area but with Duro's improved accuracy you can be certain you are digging where intended, even when within a few centimeters of a gas line or other hazard that you must avoid.



## #2 | **PRECISE POSITIONING DELIVERS RELIABLE POSITIONING YOU CAN COUNT ON**

High-accuracy is one of the most important elements of precise positioning, however what makes it critical to industrial applications is reliability. Reliability is the confidence in the position and velocity provided by the positioning system to ensure safe operation. Precise positioning delivers reliable, seamless location data by utilizing the cloud to deliver corrections via cellular signals.

Duro's network of reference stations—in operation across the globe—accounts for errors (both environment and atmospheric) that come from satellite signals and sends them to the cloud-based Skylark precise positioning service that calculates detailed corrections and sends them down to the user via an Internet connection. The Starling positioning engine that resides in the vehicle (in the form of integrated software or housed in one of Duro's hardware components) incorporates these corrections, along with other applicable sensor inputs, to produce a reliable, accurate position for that piece of equipment. Utilizing

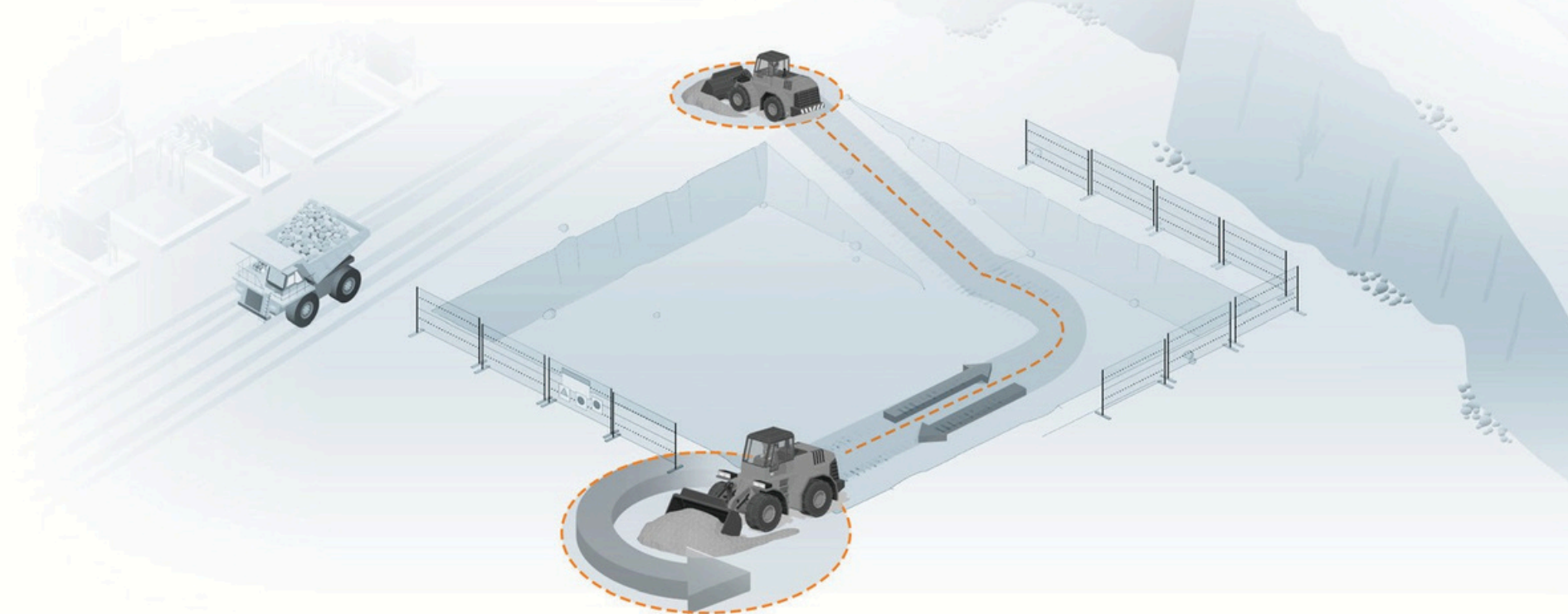




# #3 | **PRECISE POSITIONING ENSURES EQUIPMENT OPERATES WHERE INTENDED**

The accuracy delivered by precise positioning is what makes automated equipment operation possible. The implementation of geo-fencing capabilities to ensure machinery operates within its designated work area is only as reliable as the positioning used. With precise positioning you can be confident in the accuracy and reliability of positioning signals so that equipment will operate where intended and when intended.

The confidence gained in the position and operation of equipment also adds to increased efficiency and job site safety. Machinery can proactively avoid collisions, user error is removed and you are able to avoid equipment mishaps like digging through underground cables.



## #4 | **PRECISE POSITIONING IS AN EASILY IMPLEMENTED, END-TO-END SOLUTION**

We know that a one size fits all approach does not make sense for industrial applications. Swift offers an end-to-end positioning and automation solution that allows the implementation of both partially and fully autonomous or remote-monitored automation.

Duro offers a variety of hardware options—including evaluation platforms—to meet your needs and the Starling positioning engine that is designed for industrial applications that require high accuracy using GNSS and dead reckoning sensor fusion.





## #5 | **PRECISE POSITIONING IS COST EFFECTIVE**

Historically, cost was a primary barrier for the implementation of machine control. Utilizing years of GNSS and robotic experience, Duro has demonstrated that accurate positioning technology can be affordable.

Duro's precise positioning solution does not require the purchase of expensive hardware, though Duro does offer hardware solutions at a fraction of the price of legacy systems. Duro's precise positioning can easily be integrated into existing equipment and can be built into navigation systems or added to equipment as an aftermarket capability.

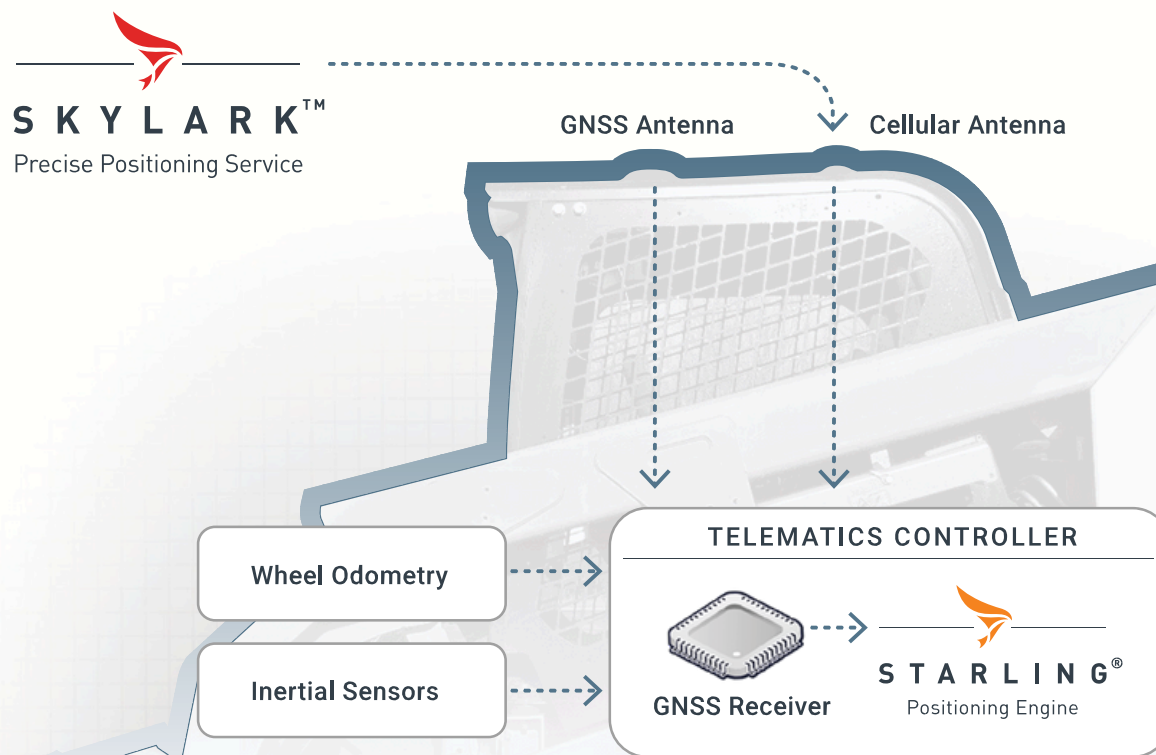
The savings compound when you factor in improved operating costs and efficiencies gained.



## SWIFT'S SOLUTION

Swift is your partner when it comes to the implementation of precise positioning and brings benefits beyond these five starting points. Precise positioning delivers reliable accuracy and increased efficiency through a cost-effective machine control solution that is easily implemented to automate existing equipment.

And though the benefits abound in the ability to effectively control and operate machinery, if machine control relies on its position to be effective, then you must utilize positioning you can rely on. Swift's Skylark delivers reliably accurate corrections to your equipment using the Starling positioning engine to enhance the measurements of commercially available GNSS receivers.







# GET STARTED TODAY

Visit [www.carnegierobotics.com](http://www.carnegierobotics.com) |  
[@carnegierobotics](https://twitter.com/carnegierobotics)

THE CRL TEAM IS HERE TO  
HELP YOU EASILY IMPLEMENT  
PRECISE POSITIONING INTO  
YOUR EQUIPMENT!

©2024 Carnegie Robotics Inc.

