BEFORE YOU BUY: SEVEN CRITICAL QUESTIONS TO ASK ABOUT LASER SCANNERS

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INTRODUCTION

\$4.9 billion—that's how big the 3D laser scanning market worldwide is expected to be by 2020 as fields as diverse as manufacturing, civil engineering, public safety and architecture increasingly see the value of this high-tech data capture method.

Choosing a 3D laser scanner is a quantitative process with significant ramifications for your company's project deliverables, project workflow, resources, personnel, time and cost. The initial step is to define your deliverable's specifications and the necessary workflow to create the 3D model, and then match these with the laser scanner specifications. Before making the final decision to invest in laser scanning technology, be sure to ask the following seven questions to ensure that you have a clear understanding of how the 3D laser scanner specifications, workflow and upfront cost will impact your long-term operations and productivity.



Does the manufacturer publish the 3D positional accuracy of the scanner?

Laser scanners can dramatically increase the safety, speed, accuracy and comprehensiveness of documentation compared to manual methods, and they do this by measuring millions of 3D positions. These 3D positions are the fundamental measurement result from any laser scanner. If a manufacturer doesn't clearly call out the accuracy of these positions along with the range at which these results will be achieved, confidence in the integrity of the data is lost.





Every mechanical device has some level of systematic error; even with the most rigorous manufacturing methods and quality standards, it is impossible to manufacture a laser scanner or any other instrument with zero error. The key to using a laser scanner with confidence is understanding precisely what that error is and how the instrument compensates for it during actual operation.

Information such as the horizontal and vertical angular accuracy (and not just ranging error) should be readily available from the laser scanner manufacturer. If the manufacturer does not disclose the horizontal and vertical angular accuracies of their product, the data collected by their instrument is simply a general observation and not a scientific and verifiable measurement. In applications such as surveying, crime and crash reconstruction, manufacturing and others, this is a critical distinction. To put it another way, consider a thermometer for temperature measurement. A thermometer purchased at a retail store cannot be considered a scientific instrument when compared to a calibrated thermometer that is sold with a statement of uncertainty about the temperature measurement it provides. When accuracy is critical, published details are vital.

How does the laser scanner handle movement?

Having an understanding of horizontal and vertical angular accuracies is an important first step, but it's equally important to consider how the accuracy of 3D scan positions will be affected by situations commonly encountered in the field, such as wind (either natural or from the "wash" of passing traffic), vibrations, or unexpected tripod movement due to placement on a soft surface (such as hot pavement) or being bumped. Intelligent laser scanners employ a real-time liquid dual axis compensator (DAC)—the same type of technology that land surveyors have relied upon for decades to ensure the accuracy of total station measurements.





This method is very different from a tilt sensor, which typically takes readings after the scanning process (and thus after the potential movement affecting level) and averages them together, then applies the correction later during post processing—materially changing the raw data collected in the field in the process.

A real-time liquid dual axis compensator continuously tracks both the pitch and yaw of the laser scanner during operation and applies a real time correction on a line by line basis during the scanning process onboard the instrument. Furthermore, an intelligent laser scanner alerts you while you are still onsite to any extreme deviation in level as it occurs so that you can make the required adjustments while still in the field. Without this information, the resulting dataset can have errors and areas that appear "wavy," bent or misaligned, which will impact the accuracy of your product.

What is the useful range of the scanner versus the absolute range?

There is a tendency in the laser scanner marketplace for manufacturers to showcase the extended range capability of their scanners. This is all well and fine; however, the value of a position collected at these extreme ranges must be considered suspect if the point density (resolution) is not dense enough for the user to be able to visually see and determine what was actually scanned—it's just a dot way down range with unknown accuracy. This is known as the "absolute" range. Far more important to the end user is the "useful range," or "3D modeling range," which is the recommended distance based upon the best practices recommended by the manufacturer.





Using an intelligent laser scanner with a real-time liquid dual axis compensator will allow you to establish scan control at a longer range and will reduce the number of moves required to cover the same distance, thereby improving your productivity, reducing the risk of error and increasing the accuracy of your data. Be wary of any scanner that promotes long-range data capture but whose technical specifications do not describe the 3D position accuracy achieved at those long ranges.

What are the environmental limitations and IP code of the scanner?

When evaluating the robustness of a given scanner, consider the temperature and dust limitations of the product since these will define and limit where and when you can actually use it. This is one of the most straightforward quantitative comparisons that you can make when comparing manufacturers since all of them publish the operating temperature range. Furthermore, be sure the scanner is fully calibrated over the entire temperature spectrum. Instruments that are not carefully calibrated over the entire temperature spectrum can produce different results in different weather, which can affect the quality and integrity of your data.





Another useful comparison is the IP code, which is an international classification which rates the degree of protection (mechanical casings and electrical enclosures), provided against intrusion by body parts such as hands and fingers, accidental contact, dust, and water.

A scanner with an IP code of 54 or higher will allow you to work in the rain, snow, dust, etc. A scanner without an IP code must be evaluated more carefully, along with what kinds of usage (such as in rain) will invalidate the manufacturer's warranty.

How complex is the workflow?

Most modern laser scanners feature an intuitive interface and are relatively easy to operate. The challenge for new users is how to manage the data efficiently. Look for a solution in which the software seamlessly integrates with the hardware and allows you to easily view and measure from the point cloud as well as export standard industry file types.





Combining multiple scans together—a process known as registration—should be fast and easy, and produce a detailed report. The process should also allow you to create an accurate site representation through a variety of different methods. Look for software that can bridge the gap between the point cloud and common drawing and modeling software with the least number of steps. Additionally, consider how well the laser scanning workflow integrates into other aspects of your process, both now and in the future. Will the data flow smoothly between teams using GPS and total stations and those using laser scanning? Will you be able to easily add capabilities such as mobile mapping or unmanned aircraft systems? Look at the big picture to make sure the solution provides a good value.

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Point cloud captured at Florida Gulf Coast University.

How much support is available from the manufacturer?

Training, service and support are the hallmarks of a professional organization. If the manufacturer doesn't support its technology with in-house trainers, beware. Independent "recommended" trainers might be highly skilled and well-qualified, but you'll need to invest more of your time making sure they will be able to meet your needs. A package that includes a dedicated manufacturer-driven training program with full-time, experienced trainers will be much more likely to provide consistency and ensure user proficiency.





Likewise, how does the manufacturer handle support calls? If you need assistance on a critical project after hours or on the weekend, will you be able to reach someone who is qualified to help? If your instrument needs service, how quickly will it be returned to you, and how can you make sure it is calibrated correctly? These are all questions you should explore as part of the decision-making process.

Are you completely confident in the results?

Before you invest in laser scanning technology, make sure the 3D accuracy of the instrument is published and certified over the entire operational temperature range of the system, that any movement out of level is tracked continuously, that the range of the scanner is adequate to minimize multiple setups, and that the operational temperature range is practical for the real-world conditions you encounter year-round. Talk to other users to learn about their experiences with both the hardware and software, as well as manufacturer service and support.





Simply having the ability to capture 3D data isn't enough. The data must be accurate and verifiable, with field-to-finish workflows that empower you to quickly and easily create high-value deliverables. By performing due diligence before you make your investment, you will be able to build your 3D laser scanning capabilities with confidence.

About the Author

Robert Gardiner is a 3D laser scanner and 3D computer modeling specialist and is principal of Gardiner Consulting Corporation. He earned his Bachelor of Engineering (Civil) degree from University of Melbourne, Australia in 1977 and has been a member of the Institution of Engineers Australia since 1980 (MIE Aust, CPEng 191871). Robert has worked as a professional in many countries and many industries, including offshore oil and underwater, mining, steel, and survey/engineering. He started laser scanning in 1999, and Gardiner Consulting Corporation has been performing 3D laser scanning and 3D computer modeling services exclusively since 2002 in industries including movies, forensics investigations, survey/engineering, aerospace, and ship repair.

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