HP SitePrint Robotic Layout Solution Instructions

HP SitePrint
Value Pack 3.0

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SitePrint Robotic Layout Solution

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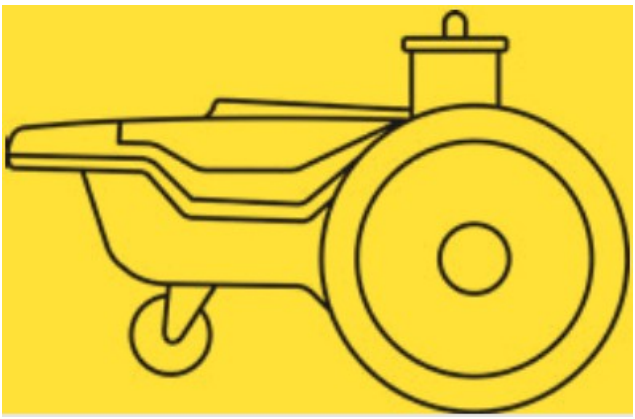


HP SitePrint, the autonomous layout robot for construction sites, is introducing the Value Pack 3.0 upgrade to further enhance productivity and autonomy for MEP/FP professionals, interior finishing trades, and others in the construction industry.
Previous versions of HP SitePrint have already achieved up to 10x greater productivity in layout tasks compared to traditional manual methods, and with Value Pack 3.0, HP continues to drive the industry’s transition from the physical to the digital world. This upgrade is available to both new and existing users, allowing them to easily upgrade their current robot with a simple software update + robot upgrade kit, allowing them to benefit from all the new features.
The fact of upgrading for existing users confirms HP SitePrint as a future-ready platform, designed not only with its current capabilities in mind but also the infinite possibilities it holds for the future of the construction industry.

Construction’s productivity challenge

Labor-productivity growth in construction lags far behind that of manufacturing and the total economy

A McKinsey[1] study highlighted a significant issue in the construction industry: compared to manufacturing and the overall economy, construction fell notably in productivity gains, largely due to its slow adoption of new technologies that could improve efficiency.
Compounding this challenge, the American construction industry faces a shortage of around 650,000[2] workers, leading to delays in numerous projects.
This workforce gap is attributed to factors such as outdated technology and a poor career image. Experts suggest that embracing new technologies and enhancing the industry's appeal could help attract workers and meet project demands.

Why productivity matters in construction layout

- Construction projects are complex undertakings involving numerous processes, and enhancing efficiency through new technologies can be a key differentiator for contractors, regardless of project size.
- Marginal improvements in smaller processes can lead to faster project completion and significant benefits for both owners and developers. For commercial construction clients, this translates into the ability to start generating revenue from the project sooner. For developers, timely project delivery not only helps avoid costly penalties for delays but also establishes them as reliable contractors who embrace new technology.
- Studies and industry reports indicate that layout work can account for about 20% of the total time spent by trade contractors, though this can vary by project. In one LEVEL 5 case study, using HP SitePrint to lay out interior walls across a 30,000 square foot area[3] reduced the project schedule by nearly two weeks.

"We're geared for projects costing less. Now, instead of taking three guys to do a layout, you've only got one and the other two are already laying track. You can move weeks ahead [of] schedule with HP SitePrint."—G. Rivera, Level 5 Drywall VP Operations

Value Pack 3.0: Doing more with less

Value Pack 3.0 focuses on increasing the productivity and autonomy of the layout robot.
Traditionally, productivity is defined as the ratio of output produced to the input resources used, such as labor, materials, and capital, with higher productivity indicating more output from the same or fewer resources. Value Pack 3.0 enhances HP SitePrint's ability to produce more with fewer resources through two key improvements: first, by enhancing the robot's print outputcapacity through increased movement efficiency, and second, by improving its autonomy with the addition of new sensors.
These advancements allow the robot to operate more independently in construction environments with obstacles, thereby freeing up HP SitePrint operators to focus on other tasks.

Faster site printing with Value Pack 3.0

Which factors influence the speed of the HP SitePrint layout robot?

1. Navigation Speed refers to how quickly the robot moves from one point to another, transitioning from the end of printing one element to the start of the next.
2. Number of Alignment Maneuvers affects the printing time, as HP SitePrint performs maneuvers to ensure precise positioning of each element, with the time taken to print a CAD file being more closely related to the number of alignment maneuvers than to the average length of the elements.
3. Printing Speed is the rate at which the robot moves while dispensing ink to mark elements in the drawing.
4. Braking Efficiency determines how quickly the robot stops before printing an element, impacting the overall speed of the printing process.

Value Pack 3.0 nearly doubles the robot's navigation speed and enhances braking efficiency.
Maximum navigation speed has increased from 1.31 to 2.30 feet per second (0.4 to 0.7 meters per second).
This means the robot now navigates 75% faster at top speed, significantly boosting overall productivity.
Improvements in breaking efficiency have reduced the time the robot is not moving by 33%. Each time the robot prints an element, it stops 3 times (4 times if printing a point with a text tag): once at the start of the alignment maneuver, again at the end, and once more after printing the element. Currently, the robot takes about 3 seconds per stop. With Value Pack 3.0, the robot takes 1 second less in each stop.
The impact of these two improvements on a layout professional tasked with marking 10,000 points is significant, resulting in a time savings of nearly 3 days (17 man-hours) in layout activities compared to the previous software version.

Increased productivity for MEP/PF trades

HP SitePrint users can now print 200 points per hour with Value Pack 3.0, representing a 33% increase in productivity compared to the previous software version.

	Traditional Layout (Manual)4	Manual Total Station	Robotic Total Station	HP SitePrint VP1.0	HP SitePrint VP2.0	HP SitePrint VP3.05
Workers on Layout Crew	2	2	1	1	1	1
Layout Points per hour	9	19	38	110	150	200
Speed Increase vs Traditional Layout	NA	2x	4x	12x	16x	21x
Speed increase vs Robotic Total Station layout	NA			3x	4x	5x

This table highlights the productivity comparison between conventional layout methods and HP SitePrint across its software releases. Key findings include that HP SitePrint is now 21 times faster at marking points compared to manual layout methods and 5 times faster than a Robotic Total Station. Additionally, HP SitePrint's productivity in marking points has seen a 33% improvement over VP2.0.
Since its launch in summer 2023, HP has achieved an impressive 80% productivity enhancement for MEP/FP professionals with HP SitePrint.

"I could mark more than 40 points per hour for short periods, but sustaining productivity above this rate throughout an entire workday is unfeasible, particularly due to the physical strain of repeatedly kneeling to mark each point." -Anonymous Surveyor

Increased productivity for interior finishing trades

Value Pack 3.0 is 11 times faster than the traditional wall layout process and requires half the crew, which typically involves manually measuring wall corners with a tape measure from established on-site references and then marking the line between these points with a chalk line.

	Traditional Layout (Manual)6	HP SitePrint VP1. 07	HP SitePrint VP2. 07	HP SitePrint VP3.07
Workers on Layout Cre w	2 or 3	1	1	1
Printed ft² (m²)/hour	330 ft² (31 m²)	2,300 ft² (214 m²)	3,330 ft² (307 m²)	3,600 ft² (334 m²)
Printed ft (m) of track *Assuming average of 1 .3 ft	43 ft	29 ft	429 ft	468 ft
of wall every 10 ft² and t wo lines per wall	(13 m)	(91 m)	(131 m)	(143 m)
Speed increase vs Tradi tional Layout	NA	7x	10x	11x

With VP 3.0, interior designers benefit from a print output rate of 3,600 ft² per hour, approximately 10% faster than the previous software version.
HP SitePrint also reduces the interior wall layout crew from 2 or 3 operators to just 1, allowing other professionals to begin installing track while the layout is being completed. In a 6-story building with 10,000 ft² per floor, HP SitePrint VP3.0 can save more than 3 weeks on the project schedule compared to manual layout methods.

Greater robot autonomy lightens workloads

HP's goal is to advance towards a fully autonomous robot capable of operating throughout the workday without user intervention, with Value Pack 3.0 being a key step in this direction.
While layout robots significantly boost productivity and efficiency in the layout process, we are still far away from achieving full autonomy where these robots can operate for an entire 8-hour shift or work overnight without human supervision.
Human intervention is still necessary for tasks such as setting up the Robotic Total Station, initiating the printing job, changing ink or batteries, and using the robot's remote control to guide it to specific areas.
The most frequent user interventions are:

- Setting up the Robotic Total Station once the robot has finished printing all elements within its current line of

sight.

- Using the joystick to navigate around unexpected obstacles not mapped in the CAD.
- Preventing the robot from entering areas where it might lose sight of the Robotic Total Station.

To enhance robot autonomy, Value Pack 3.0 introduces two new technologies: the HP Smart Navigation System and a new shadowing feature, which improve the robot's adaptability to the job site and enable longer uninterrupted operation without requiring user intervention.

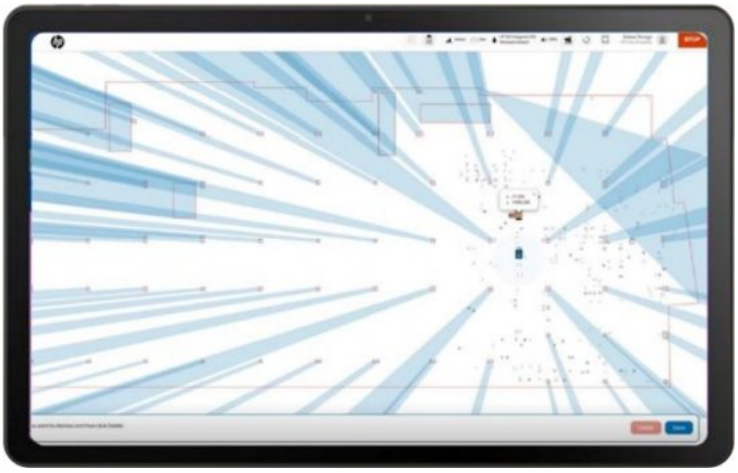
Introducing the HP Smart Navigation System

Value Pack 3.0 integrates a front-facing camera into the robot, enabling the HP Smart Navigation System.
This new camera allows the robot to create a 3D representation of its surroundings, allowing it to detect unmapped obstacles on the job site and intelligently adjust its navigation route in real-time to avoid them.
This advancement enhances the robot's existing obstacle avoidance capabilities, which previously relied on three LiDAR sensors to detect obstacles and prevent collisions but did not support alternative route finding.
With the Smart Navigation System, more print jobs can now be completed autonomously from start to finish, reducing the need for user intervention to pause and restart print jobs or navigate around obstacles with the joystick.

1. Reduce the need for extensive site preparation.
2. Minimize the amount of manual joystick internventions.
3. Enhance the robot's autonomy and intelligence.

New shadowing feature prevents navigation pitfalls

Value Pack 3.0 introduces a new feature in the control panel designed to prevent the robot from navigating into areas where it might lose line of sight with the Robotic Total Station.
When the shadowing feature is activated, shadows are projected onto the map, factoring in mapped obstacles and using the Robotic Total Station's location as a reference point. This allows users to designate which mapped obstacles represent visual obstructions, ensuring that holes like elevator shafts, mapped in the CAD, do not cast unnecessary shadows the robot would need to avoid.
This feature enhances the robot's autonomy in two keyways.
First, it allows the user to prevent the robot from navigating into blind spots, avoiding pauses in the print job and increasing the percentage of jobs completed from start to finish.
Second, it reduces the number of setups required for a given area, as shadowing ensures the robot prints 100% of the available space from its current position—simply click "Select all" and "Print."



Early deployment of Value Pack 3.0 with select Beta customers revealed significant improvements in productivity due to the new autonomy features. VP 3.0 delivered a 20% productivity boost on top of the speed improvements already seen, thanks to fewer setups, reduced reprints, and extended print runs that minimized user intervention. Telemetry data showed that for existing HP SitePrint users, VP 3.0 increased average print job length by 30% and reduced reprints or job submissions by 27%.

VP3.0 Delivery

All HP SitePrint units sold after the release of Value Pack 3.0 on September 10, 2024, will include the new software and hardware components. Users who purchased an HP SitePrint before the launch of Value Pack 3.0 can opt for a hardware upgrade, which can be installed on previous versions of the robot by HP SitePrint Specialists.

1. McKinsey & Company. (2024, August 9). Delivering on construction productivity is no longer optional.
2. Miller, C. “The Hard Hat Job with Highest Level of Open Positions Ever Recorded.” CNBC, 29 July 2023.
3. HP Inc. Level 5 Drywall Reduces Layout Time by Eight Days on a Medical Project with HP SitePrint.
4. Productivity data for conventional layout methods were sourced from a report by Construction Executive.
5. The productivity data for HP SitePrint were obtained through internal tests, printing plots with the average density of MEP/FP customers (one point every 15 square feet), along with a 2-inch text label.
6. Productivity data for conventional layout methods were sourced from a customer estimation published in HP SitePrint success stories.
7. The productivity data for HP SitePrint were obtained through internal tests, printing plots with the average element density of Interior Trades customers.

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Documents / Resources

	HP SitePrint Robotic Layout Solution [pdf] Instructions SitePrint Robotic Layout Solution, SitePrint, Robotic Layout Solution, Layout Solution, Solution

References

- User Manual