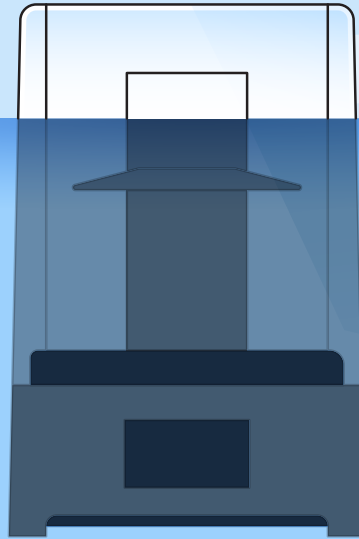


VISIBLE COST
20%



HIDDEN COST
80%

WHITE PAPER

Uncovering the Hidden Costs of Low-Cost Resin 3D Printers

When selecting a 3D printer, it is critical to understand all costs associated with the system for optimizing resource allocation and maximizing productivity. This report compares the cost and experience of operating a low-cost resin printer and a Formlabs Form 3+ stereolithography (SLA) printer, demonstrating how hidden costs are dramatically different between these products.

Executive Summary

Resin 3D printing is a well-established manufacturing method to achieve cost-effective rapid prototyping, rapid tooling, on-demand production, and more. While the base price of low-cost resin printers is only \$600-\$900 versus \$2,499 for the Form 3+, our cost analysis shows that for an average business producing six parts per month:

<p>Operating a low-cost resin printer will cost</p> <p>130 hours or \$6,240</p> <p>per year more than operating the Form 3+.</p>	<p>The Form 3+ will become more cost-effective than a low-cost resin printer in about:</p> <p>53 prints</p> <p>or 9 months of operation.</p>
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This is due to some key benefits of the Formlabs ecosystem, summarized in the table below.

	Form 3+	Low-Cost Resin Printers
Material range	Library of 40+ advanced materials, including a wide range of engineering, biocompatible, and specialty materials	Limited material selection with basic properties, often smelly and brittle
Print completion	94% rate	65% rate
Labor time per accepted part	26 minutes	135 minutes
Print settings	Validated by Formlabs for each material to ensure print completion and ease of use	Self-tuned, requires searching on the open web
Slicer software	Developed and maintained by Formlabs, free, and easy to use	Third-party software with a limited range of paid advanced features
Material handling	Cartridge-based, automatic dispense	Manual and messy
Connected ecosystem	Remote printing, monitoring, advanced fleet management, automation solutions	None
Post-processing	Custom, automated accessories for washing and curing	Third-party accessories and manual tools
Support	Best-in-class service package, including rapid phone and email support by Formlabs or certified partners in multiple languages	None, or basic email support

This report details each of these characteristics, explaining the technical differences between both solutions and how the cost of unreliability from low-cost resin printers hinders innovation and business growth.

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Introduction

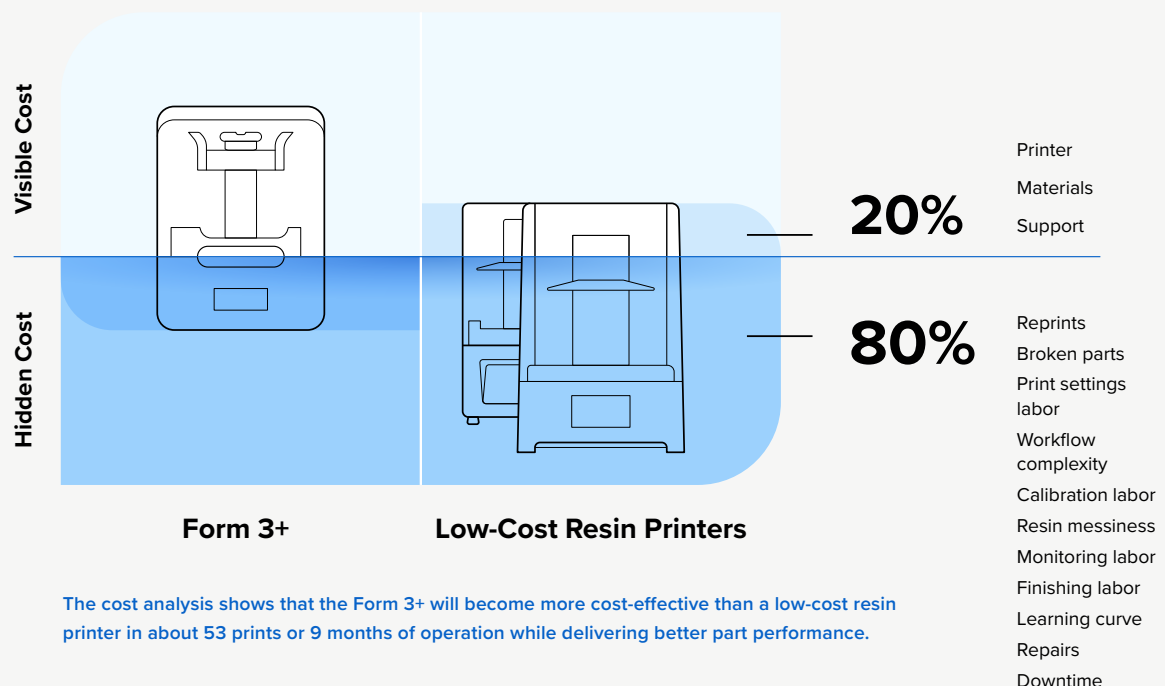
Additive manufacturing (AM), also known as 3D printing, is a powerful tool to accelerate product development and manufacturing across many industries. However, it can be expensive for businesses to purchase and operate AM equipment. Most professionals are aware of the predictable, visible costs of 3D printers: machines, materials, and services costs. But there are also several hidden costs of operating 3D printers that have a major impact on the total cost of ownership. These hidden costs consist of labor, frustration, uncertainty of results, and missed deadlines that busy professionals don't have time for.

When evaluating different 3D printers, it is critical to understand these hidden costs in order to spend budgets efficiently, increase productivity, and achieve long-term cost-effectiveness. To help uncover these hidden costs before purchase, four key characteristics of the printer should be evaluated: **the learning curve, the workflow complexity, the printer reliability, and the part quality and performance.** These factors drive the time required to print a part and influence the total cost of ownership by increasing both the cost of labor and the cost of slower product development or missed part orders.

Over the last 10 years, resin 3D printing (vat photopolymerization) has become one of the leading solutions for quickly and cost-effectively producing prototypes, manufacturing aids, rapid tooling, and some end-use parts. There are now more resin 3D printers on the market than ever before, and choosing the right printer can be challenging. Recently, a new segment of low-cost resin printers (\$600-\$900) emerged for 3D printing enthusiasts who are printing at home. Now, businesses have started to consider whether they could save time and money with a low-cost resin printer.

Low-cost resin printers are appealing to businesses exploring additive manufacturing because their visible costs — the printer and materials — are low. However, these printers come with high hidden costs that have a significant impact on labor costs, operator frustration, part performance yield, product development timelines, and ultimately business growth. For professionals, these hidden costs often cancel out the initial savings compared to more expensive desktop printers, like the Formlabs Form 3+ (\$2,499), which minimizes hidden costs with superior product reliability, ease of use, and materials performance.

This report compares the workflow of a low-cost resin printer and a Form 3+ printer. Then it assesses the labor costs and lost opportunity costs associated with each workflow.

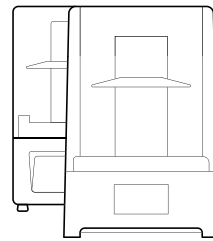
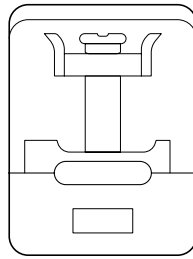


Workflow: Low-Cost Resin Printers vs. the Form 3+

When operating a resin 3D printer there are several activities that influence the total cost of ownership: selecting the material, preparing the digital file, setting up the hardware and material, starting and monitoring the job, reprinting in case of print failure, post-processing, and maintenance.

This study considers two main metrics: the labor time to operate the printer and the part outcome. The latter is quantified with different rates, that are evaluated later in the report:

- **Print completion rate:** The percentage of prints that were volumetrically completed when they are removed from the printer.
- **Part acceptance rate:** The percentage of completed prints that met the customer's dimensional, mechanical, thermal, chemical, biocompatible, surface finish, and feature resolution requirements.
- **Overall yield:** The percentage of prints that met the customer's requirements. It can be considered as the print completion rate multiplied by the part acceptance rate.



3D PRINTER	Form 3+	Low-Cost Resin Printers
Print completion rate	94%	65%
Part acceptance rate	90%	70%
Overall yield	84.6%	45.5%

Material Selection

The first step for turning a design into a physical part is to select the 3D printing material that best suits the use case.

Low-cost resin printers usually have a limited selection of materials, with basic properties.

Available resins have minimal mechanical, thermal, and creep performance, leading to parts that are often brittle, dimensionally inaccurate, not functional, or not fitting together. The part may fail during use or simply not meet the specifications and needs to be reprinted or even outsourced. If this happens during time-sensitive projects, the risks of missing a deadline are high. This can hinder team progress, slow down product development, and prevent a company from seizing new business opportunities. The part acceptance rate is estimated at 60-70%. Most low-cost resins also have strong odors requiring ventilation and may contain more hazardous chemicals.

Formlabs' SLA resin library currently offers 40+ advanced materials to fabricate high-performance parts for various demanding applications. Formlabs' team of 50 material scientists continuously develops new resins with a wide range of properties: tough, durable, rigid, flexible, biocompatible, ESD safe, flame retardant, temperature resistant, and more. According to Formlabs print production quality control standards, the part acceptance rate for the Form 3+ is 90%. The resins are designed with user safety and minimum odor in mind.

"In my attempt to save money on "good-resin" by going open source, it ended up costing me more in terms of time, settings, and resin compared to using the Formlabs ecosystem."

William Titus, R&D Manager at Haygor Instrument and Company, Inc.



Formlabs library of 40+ SLA resins, developed and manufactured in the US.

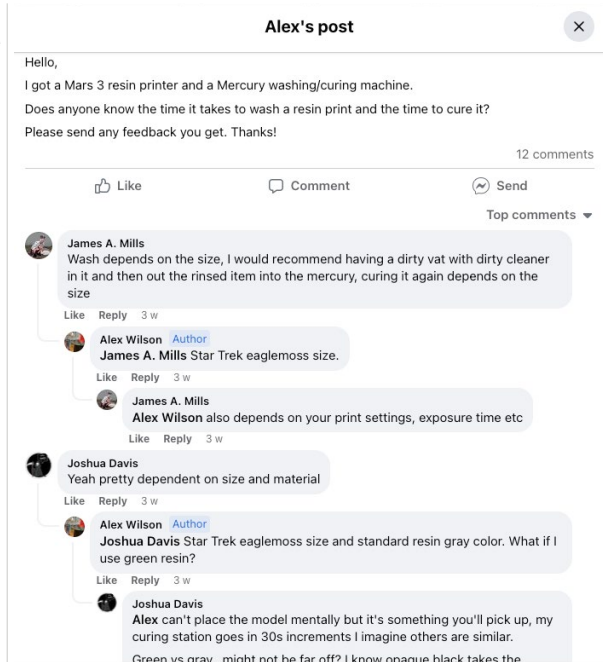
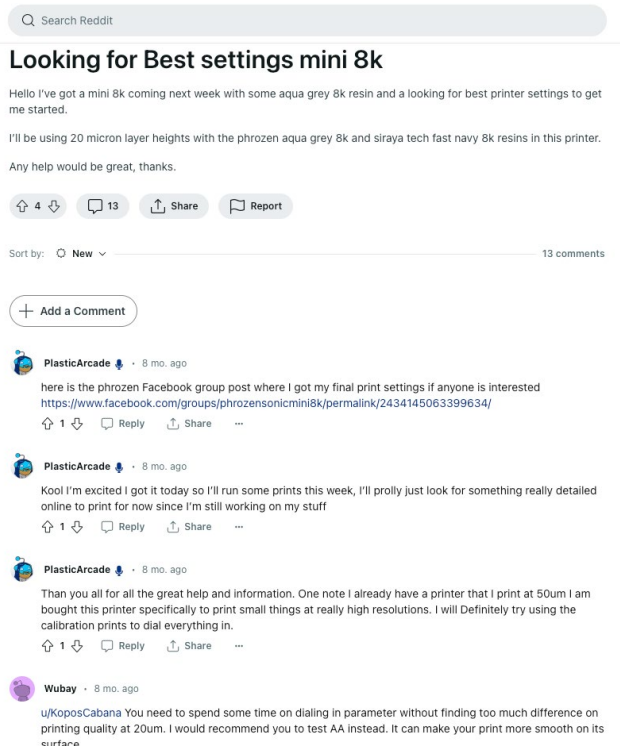
Print File Preparation

Prior to printing, the print should be digitally prepared and the print settings defined in a slicer software that gives instructions to the printer. Support structures are the foundation of any resin print and should be addressed in this step.

TUNING PRINT SETTINGS

Print settings are critical parameters that control the behavior of the printer. They include layer height, speed, temperature, layer exposure, support structures, and more. Print settings directly influence print completion, part performance, print speed, surface quality, and post-processing labor. With resin 3D printing technology, print settings need to be tuned by the user and optimized for every combination of printer, material, and layer height. Tuning is the iterative process of setting a value for each print setting, printing several models, evaluating the models, and then changing the values again.

Most low-cost resin printers require the user to tune print settings themselves. Because the printer manufacturer often differs from the resin manufacturer, the settings need to be searched on unofficial social media sites and forums that are a jarring and hugely time-consuming exercise. This misalignment between the resin and the printer manufacturers also makes troubleshooting difficult. For each new material, time should be allocated searching for the right settings, entering and fine-tuning them in the software, manually adjusting the supports, as well as printing multiple iterations to get it right. This is a trial and error process that can easily take up to an hour or even days for reprinting.



Reddit and Facebook posts from unofficial user groups for low-cost resin printers.

Formlabs print settings are pre-defined and optimized for each resin. All Formlabs materials are tailor-made in-house for the printer by a team of over 50 material scientists and 30 settings optimization engineers. The print settings are optimized to consistently deliver the exact material properties listed in the technical data sheet, with the right balance of print quality, part properties, print completion rate, and print speed. The supports are dialed in for each resin, delivering a highly reliable, light-touch structure. Precise post-curing profiles are integrated to ensure the right resin properties. It not only saves print setup time, but also ensures part quality, repeatability, and dimensional accuracy.

“The dimensions of the parts that came out [of the low-cost resin printer] were not accurate so we ended up changing the CAD so the parts could fit, and that was not satisfying at all. Now that we are using the Formlabs printer, we can design parts that are one-tenth millimeter, and the accuracy is very good.”

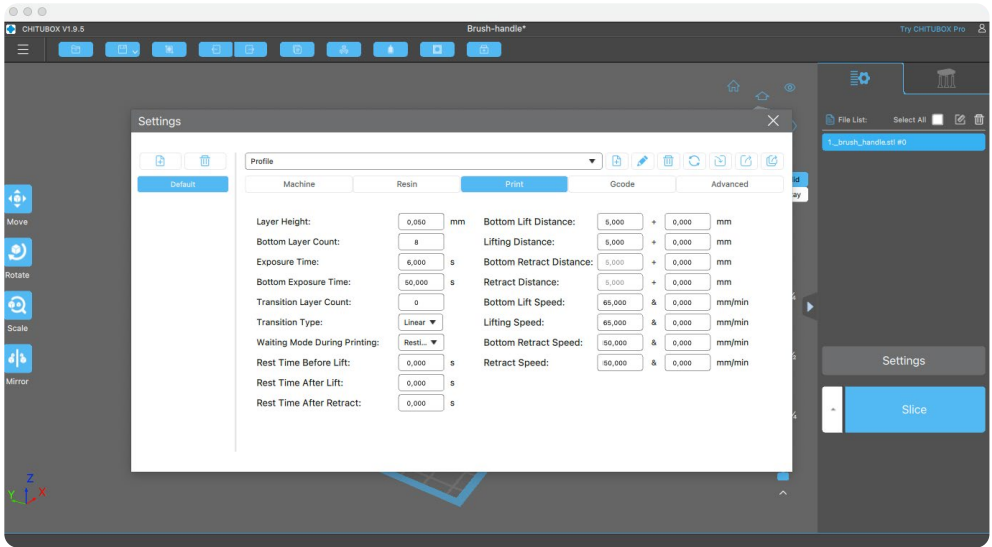
Dutch Defence Miniatures, modelmakers.

USING SLICER SOFTWARE

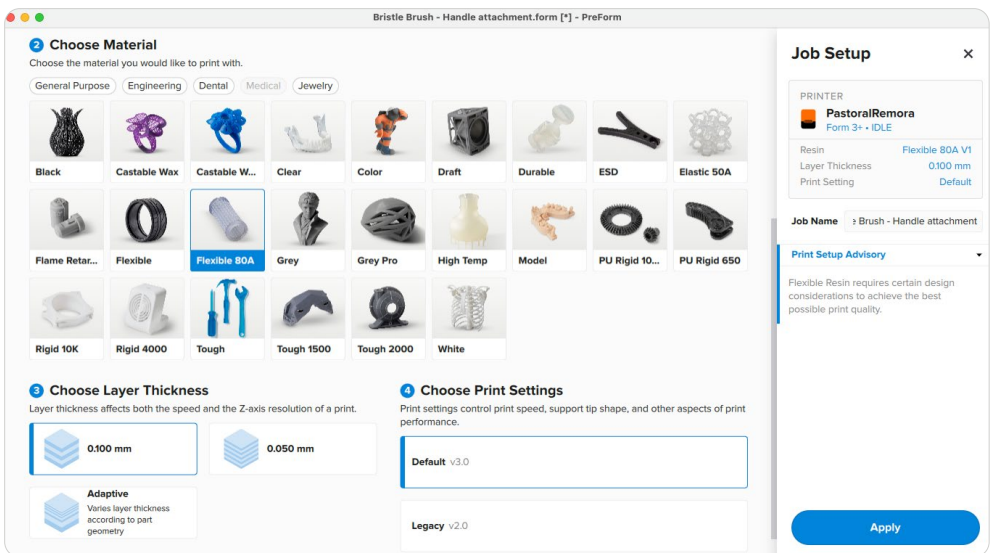
Most low-cost printers use complicated third-party slicer software. They require multiple steps to start printing and incompatibility issues often arise. Additionally, users are often charged to access advanced features.

Formlabs' free and easy-to-use software, PreForm, automates print file preparation.

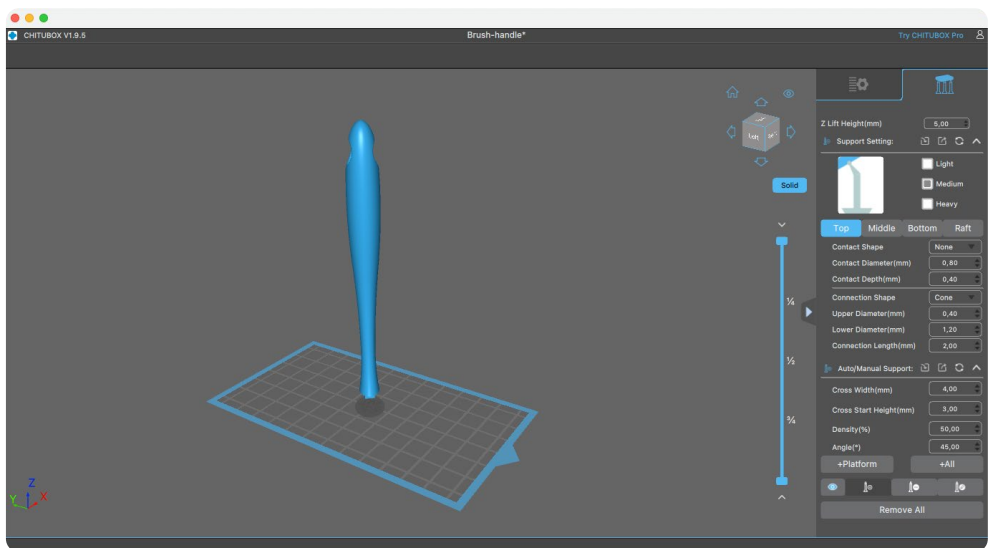
It sets up the print's layout, orientation, supports, and other print settings thanks to a built-in library of material profiles. There are five clicks between importing a CAD model to starting the job, as well as a “One-Click” print mode which orientates a part and applies the supports. Preparing a print file for the Form 3+ takes less than 10 minutes, which can be reduced to a few minutes with practice.



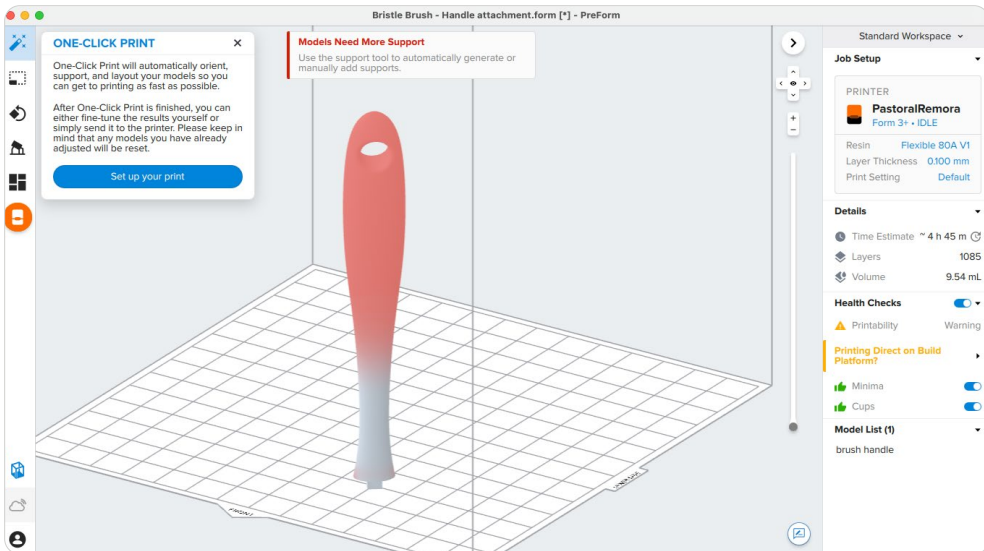
Low-cost resin 3D printers require you to search for the right settings and fine-tune them for each new material in a third-party slicer software, such as Chitubox.



Formlabs resins come with predefined and optimized material profiles for each resin in PreForm, saving you print setup time, while also ensuring part quality, repeatability, and dimensional accuracy.



Part orientation and support placement in a low-cost resin printer slicer software, Chitubox.



Part orientation and support placement in Formlabs PreForm software. PreForm provides real-time feedback on the printability of your print job while you are setting it up to maximize your print completion rate.

Printer and Material Setup

Before printing, the printer needs to be set up and the material and resin tank installed on the printer. All 3D printing resins are viscous chemicals; gloves should be worn when handling liquid resin or resin-coated surfaces.

Material handling with low-cost resin printers is a manual and messy process. Users have to fill the resin tank manually from a bottle and calibrate the build platform level every 10 prints. Because tanks are often designed with low walls, they are difficult to carry and install without spilling resin and it is common to spill resin during tank installation or removal. In that case, the resin can cover some critical optical surfaces of the printer that need to be cleaned thoroughly. To change the resin tank or to clean it after a print failure, users need to replace the tank film by unscrewing multiple screws from the tank. These small steps contribute to a poor user experience and increase the setup time and the risk of hardware damage.

Formlabs ecosystem is designed for safe and easy material handling. On average, it takes less than 5 minutes to prepare a Form 3+ printer for a new print, thanks to specific features:

- **Consistent printing without user interaction** enabled by resin dispensing systems that automatically monitor the amount of resin in the tank and dispense resin as needed.
- **Quick and clean resin changeovers** via an innovative tank system, that optimizes a multi-material workflow.
- **Minimum resin spills** from the tanks as they are designed with high-side walls.
- **Preemptive tank change alerts:** all 3D printing resin tanks have a finite lifetime. The Form 3+ monitors the usage of the resin tank and alerts the user when approaching the recommended lifetime limit.
- **Protective tank film:** the tanks have a **longer lifetime** thanks to the two-layer film that protects the bottom from scratches and damage during handling and storage. Low-cost resin tanks have one layer of FEP film which is a soft plastic that is prone to scratches and damage.

Print Management

Low-cost resin printers usually do not offer any solution for workflow automation or remote printing.

Formlabs offers remote printing, advanced fleet management, and automation solutions.

Form Auto is a hardware extension that automatically removes finished parts from the build platform and starts the next print without the need for operator interaction, enabling 24/7 3D printing with no printer downtime.

Print Completion

Print failures happen and represent a significant amount of waste in time and material to reprint.

Low-cost resin printers typically have 60-70% print completion rate out of the box. This causes project delays from unexpected failures, resin waste from failed prints, extra labor costs from reprints, and worry from not knowing what will happen after pressing “print.” Tuning the printer can increase the print completion rate but requires time and experimentation. Some common causes of print failures with low-cost resin printers include:

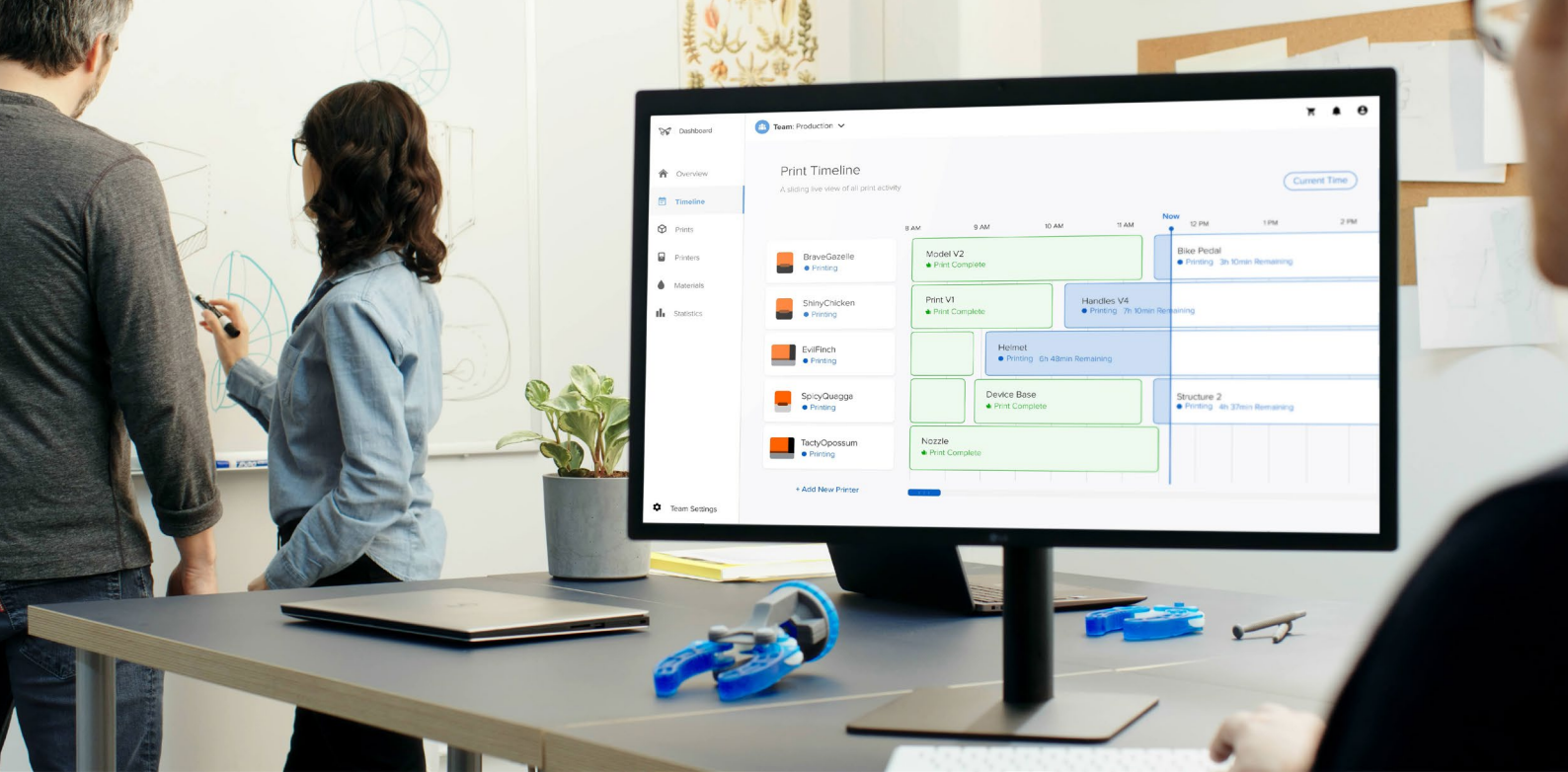
- **Lack of heating systems** to maintain the resin temperature consistently throughout the resin tank and print. Resin temperature fluctuations can cause unexpected defects, dimensional accuracy issues, and print failures.
- **The resin tank film suction** on the glass above the optical module and creates high peel forces that can damage the printed layers.
- **Print settings are not tuned and validated** for reliability across various materials and part geometries.
- **Lack of sensors** to detect and prevent common failure modes.

The Form 3+ delivers a print completion rate of 94% out of the box, reported by customers across tens of millions of prints. This is achieved thanks to some key features of the Form 3+:

- **Built-in heaters** monitor the temperature and precisely heat the resin and print chamber to 35° C. Resin and part temperatures are always consistent, regardless of the ambient temperature. This delivers excellent repeatable dimensional accuracy, print completion rate, and part quality.
- **Formlabs' patented Low Force Stereolithography (LFS)** technology minimizes peel forces during printing to reduce the chance of layers being damaged during printing.
- Formlabs continuously tunes and validates print settings, releasing updated versions of software and firmware regularly.
- **Sensors detect common failure modes** and alert the user in order to minimize wasted time and material. They control the presence of the build platform, the resin quantity in the tank, the resin temperature, and potential shards left on the build platform that could puncture the tank film.

“Over 5-6 years, I’ve had almost zero failed prints [with the Formlabs printer] for anything that wasn’t something I did wrong.”

William Titus, R&D Manager at Haygor Instruments and Company, Inc.



Formlabs' online Dashboard.

Print Monitoring

Print failure can happen with any 3D printing equipment. Being able to control print failure and react quickly will help save time and material, and maintain the hardware in good condition.

Most low-cost printers demand physical monitoring of the print. The printing status is controlled in person and the tank is filled manually during printing when it is empty. Because of the lower print completion rate, print monitoring is particularly necessary on low-cost resin printers. The user should plan at least 15 minutes to start and control a print.

Formlabs' Dashboard allows operators to start and monitor jobs from anywhere, anytime. Dashboard enables online management of multiple printers, materials, and teams. Then, during the print, resin is filled automatically. A normal print does not require any user interaction.

Post-Processing

All resin 3D printing technologies require the part to be washed and post-cured after the print. Because resin printers build parts with support structures, the supports then need to be removed and sanded to eliminate marks.

Most low-cost printers build supports with large tips and dense structures. It adds time for sanding, reduces surface quality, and brings the post-processing time to at least 25 minutes.

Formlabs made post-processing simple thanks to automated solutions, Form Wash and Form Cure, and pre-tuned support settings. Depending on the part, this step can be completed in less than 10 minutes with the Formlabs ecosystem. To achieve this, Formlabs develops precise post-processing parameters as part of the material development:

- Pre-tuned support settings with light touch supports are available for every material to facilitate support removal.
- Form Wash automatically cleans the parts directly on the build platform to avoid any resin contact and uses optimum preset wash time for each material.
- Form Cure post-curing profiles use a combination of light, heat, and time to bring parts to their maximum mechanical properties and ensure repeatability.

Maintenance and Services

Workflow disruption and troubleshooting are common concerns when it comes to implementing a new technology like AM.

Most low-cost printers come with minimal customer support. Given their low price, there is little or no support provided for customers other than self-service online. Manufacturers' knowledge bases are limited and more often customers need to rely on community forums to debug their printers. Replacement part stocks are low and involve long lead times resulting in long machine downtime. Optical modules need replacements when they are damaged from resin spills, become cracked, or reach their end of life. Most hobbyists do not print enough to necessitate a replacement, whereas a business printing multiple times a week may need a yearly replacement.

Formlabs offers best-in-class services with a fast and local team of experts. The Form 3+ integrates component end-of-life tracking and long-lasting optical modules to reduce machine downtimes. An extensive knowledge base is available and critical elements are sealed inside an enclosure to facilitate troubleshooting. Every printer comes with a one-year limited warranty which includes component replacement and email support. The Pro Service Plan can be purchased to extend coverage with live training, priority email, phone support, extended warranty, and hot-swapping quickly the printer or critical components to ensure constant uptime.

Beyond Formlabs' Customer Care, multiple specialized teams are available to help a company adopt and grow its AM capabilities. The Sales team helps identify and develop use cases, Business Development builds partnerships and factory solutions for production, and Application Engineering researches and educates on 3D printing applications. Additionally, Customer Success ensures ongoing value in Formlabs products as well as product integrity, exploring any failure patterns and rolling out fixes through software.

“We are really happy with the technical support we receive from Formlabs, the service is excellent. Responses are quick and helpful and when we had an issue that we couldn't resolve ourselves, we were able to get a hot swap printer as part of our Pro Service Plan membership”

**Kals Wilde, Director, JR Design + Fabrication,
Pro Service Plan Customer.**

Cost Analysis

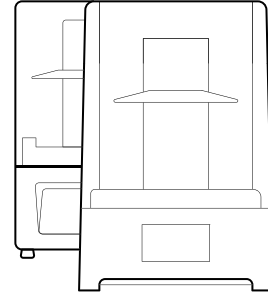
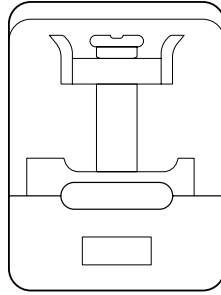
The previous section details how low-cost resin printers have a more complex workflow with longer learning curves, lower reliability, and reduced part performance compared to the Form 3+. This chapter analyzes how these trade-offs translate into increased material waste and labor costs.

The model below uses the prices of Formlabs products and the prices of a popular low-cost resin printer brand. From data collected across tens of millions of Form 3+ prints, it assumes an average user prints 6 jobs per month with 100 mL of resin per job. For simplicity, it estimates that one printing job fabricates one part. For building this cost model, Formlabs used information from qualitative user research (surveys and interviews), online community forums, and internal testing of several low-cost resin printers. Some assumptions were made based on user feedback and market research.

Labor cost calculation. The table and chart below display an estimated breakdown of labor time required for each workflow step.

3D PRINTER	Form 3+	Low-Cost Resin Printers
Print completion rate	94%	65%
Part acceptance rate	90%	70%
Overall yield	84.6%	45.5%

LABOR TIME (MIN)	Form 3+	Low-Cost Resin Printers
Tasks done for all prints		
Part orientation and supports placement	2	4
Print upload	5	5
Printer and resin setup	5	10
Build platform level calibration (every 10 jobs)	0	0.5
Refilling resin tank during print	0	10
Checking for failures during print	0	5



LABOR TIME (MIN)

Form 3+

Low-Cost Resin Printers

Tasks only done for completed prints

Post-processing wash and cure	5	10
Supports removal and sanding	5	15

Tasks only done for failed prints

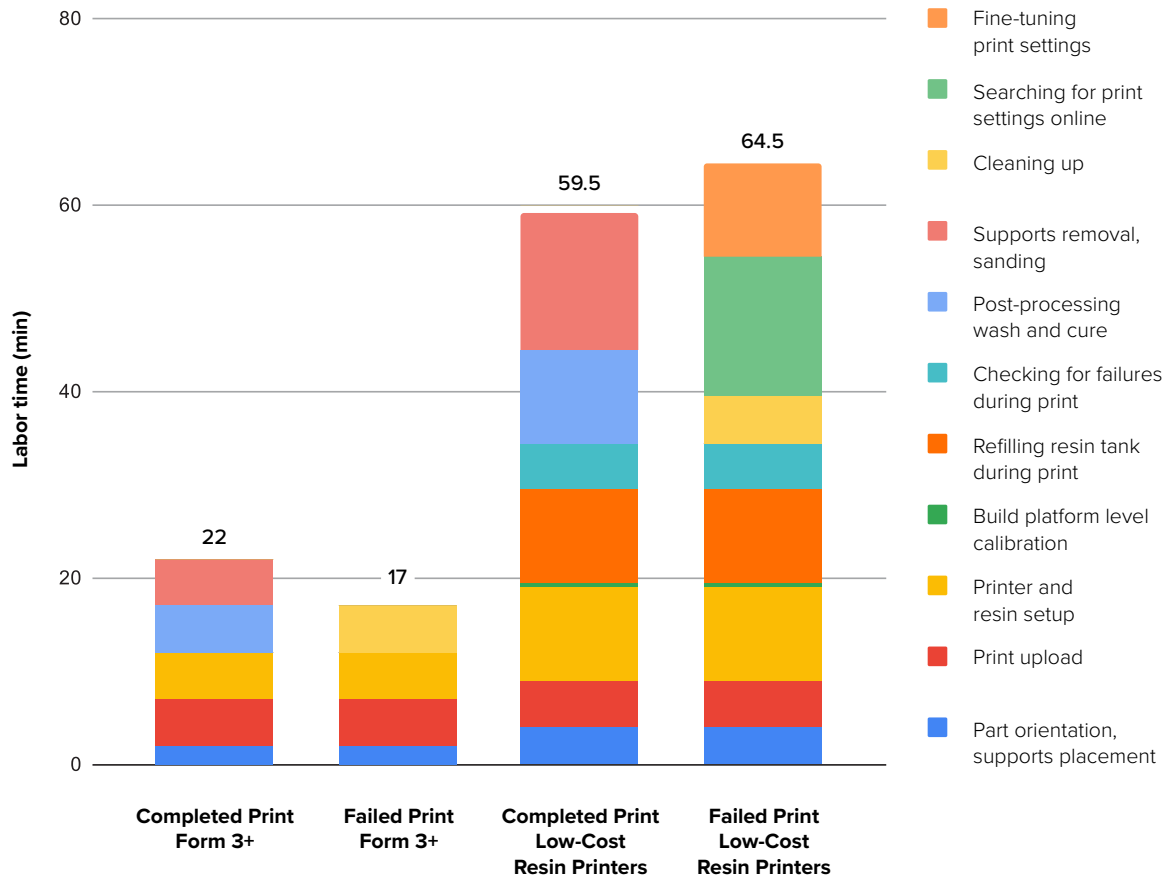
Cleaning up	5	5
Searching for optimal print settings online	0	15
Fine-tuning print settings to get the desired result	0	10

Results

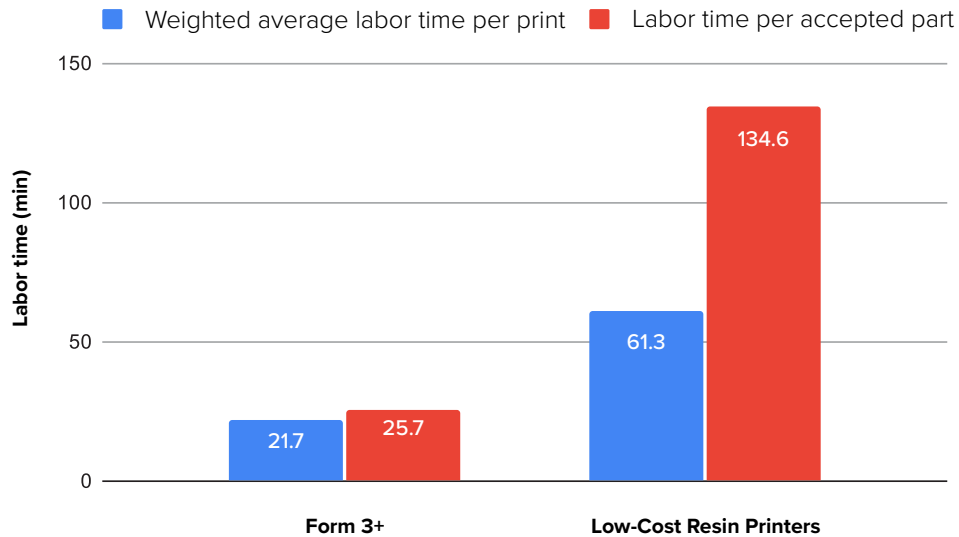
Labor time per completed print	22	59.5
Labor time per failed print	17	64.5
Weighted average labor time per print	21.7	61.3
Labor time (min) per accepted part*	25.7	134.6
Labor time (h) per accepted part*	0.43	2.24

*Labor time per accepted part = (weighted average labor time per print) / (overall yield)

Labor Time



Labor Time Considering Print Completion and Part Acceptance Rates



To print one accepted part, the Form 3+ saves the user about 109 min (1.8 hours) of labor time compared to a low-cost resin printer. Assuming an hourly labor cost of \$48 per hour for a mechanical engineer ([according to the U.S. Bureau of Labor Statistics](#)), this represents \$87 of labor cost reduction per part.

Material cost calculation. While popular low-cost resins cost about \$44 per liter, Formlabs standard resins cost \$149 per liter, which should be reflected in the cost analysis. For 100 mL of resin per print, including the resin wasted through print and part failures, Formlabs resins cost about \$8 more per part compared to low-cost resins.

Consumables cost calculation. Resin tanks are consumables for all resin 3D printers. The Form 3+ resin tank costs \$149 and should be changed every 6 months, while tanks from a popular low-cost resin printer cost \$17 and should be changed every 3 months. Considering print and part failure again, Formlabs resin tanks cost about \$3 more per part compared to low-cost resin tanks.

Cost-benefit analysis. Low-cost resin printers cost about \$848, with wash and cure kit. The analysis is based on the cost of the Form 3+ complete package, \$4,249, which includes post-processing equipment, accessories, and a Professional Service Plan. Businesses save about \$3,401 upfront capital expense when purchasing a low-cost resin printer.

As shown above, 3D printing with the Form 3+ allows to save \$76 per printing job compared to low-cost resin printers, considering labor, consumables, and material costs. This significant difference in operating costs quickly compensates the difference in upfront capital expense.

The Form 3+ upfront cost is paid back after 53 prints or 9 months of use printing 6 jobs per month. After that threshold, the Form 3+ becomes more cost-effective than a low-cost resin printer.

Business Cost of Unreliable 3D Printers

The previous section demonstrates how using a low-cost resin printer dramatically increases labor costs because of a complex workflow, long learning curve, printer unreliability, and poor part performance. **But the cost of hardware unreliability extends far beyond labor and maintenance; it alters productivity, revenue opportunities, customer satisfaction, and brand reputation.**

Wasted time is not only wasted labor. When using a low-cost resin printer, the chances of experiencing print failure or part failure are high. Because low-cost resins have only basic material properties, even if the print is completed, it is difficult to predict if the part will perform in use. If prints or parts fail during time-sensitive projects, the risks of missing development deadlines or customer orders are higher and the consequences are expensive.

When a fabrication deadline is missed unexpectedly or a part fails during usage, it can have cascading impacts on a business. For instance, for a consumer electronics company that launches products on a tight annual schedule, a missed deadline or failed part can hinder a prototyping phase, pre-production build, or validation testing. This potentially slows down product development and launches. For a product design firm delivering 3D printed parts to their clients, a missed deadline or failed part leads to order delays, unsatisfied customers, and revenue loss.

For an innovative business that needs to adapt rapidly to customer demand, flexibility is key. Being able to 3D print parts on demand quickly and consistently boosts productivity, encourages innovation, and opens new markets. But using reliable equipment is crucial for consistency. While low-cost resin printers are affordable up-front, they are not reliable enough to participate in the growth and success of a business.

This is even more important for businesses selling 3D printed parts, where revenue is directly tied to yield. To illustrate the cost of reliability let's assume \$100 revenue per part. The Form 3+ yields 100 customer-accepted parts and \$1,000 in revenue for 43 hours of labor. At similar labor time, a low-cost printer only yields 19 customer-accepted parts and \$190 in revenue. The Form 3+ generates 5.2 times more value than a low-cost resin printer.

“For engineering applications, when you need to test things and only have one shot [...] you just can't get that type of information with open-source printers nearly as easy.”

William Titus, R&D Manager at Haygor Instrument and Company, Inc.



Conclusion

This report evaluated the hidden costs associated with the use of the Formlabs Form 3+ printer and popular low-cost resin printers, defined as systems ranging between \$600 and \$900. These hidden costs are identified as extra time, labor, and lost opportunities. They are driven by the learning curve, workflow complexity, printer reliability, and part quality and performance of low-cost resin printers. Formlabs invests heavily in R&D to improve reliability and ease of use, which is reflected in the purchase price, while low-cost resin printers come with a complicated, labor-intensive, and unreliable workflow.

The cost analysis from this report **shows that a business producing 6 parts per month should expect to spend an extra 130 hours (or \$6,240) per year operating a low-cost resin printer. The Form 3+ will become more cost-effective than a low-cost resin printer in about 53 prints or 9 months of operation while delivering better part performance.** The Form 3+ not only drastically reduces labor costs by streamlining the resin 3D printing workflow, but also produces high-performance parts on time, every time.

Selecting the right equipment can be one of the most difficult parts of making things. If you are a hobbyist with time for experimentation, low-cost resin printers are a good solution for you. But if you are a professional who is 3D printing regularly at work, choose the Form 3+. The Formlabs printing ecosystem is designed to deliver high-quality, functional parts every time you need them. The Form 3+ won't waste your time, energy, or money – allowing you to focus on what matters most – bringing your ideas to life.