

# DIVERSITY FOR ADDITIVE MANUFACTURING: FIRST QUARTER 2018 REPORT

A quarterly report provided as a resource for understanding the shape and scope of diversity in the 3D printing industry

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**Supported by and Produced for Women in 3D Printing**

# INTRODUCTION

The industry surrounding additive manufacturing is, as is often noted, in its infancy. The technology traces its first research back to the 1960s, patents back to the 1980s, and commercialization back to 1987. Following technological speed bumps and an ultimately unhelpful several years of popular hype circa 2012-2015, the various forms of 3D printing now comprise a technology, and an industry, to be reckoned with, and one becoming firmly entrenched in the global manufacturing industry.

Manufacturing, for its part, is a gargantuan \$12 trillion global industry -- and is a primary target for disruption via advanced technologies including additive manufacturing. As Industry 4.0 takes hold across the world and digitization becomes a mainstay, agile manufacturing is seeing exponential gains in both development and real-world adoption.

The ultimate impetus behind any growth in 3D printing, however, is as non-technological as it gets: the human workforce.

A wealth of industry resources are devoted to discussing the 3D printing industry, examining the seven ASTM-defined technologies under that umbrella, market share, and projected CAGR. Employment figures often provide a brief point of interest, or a footnote in the discussion of companies' growth. Further, while public companies do provide some breakdown of their workforce, these are rarely a focal point. In this new quarterly report, we seek to study more closely the shape of diversity in the 3D printing industry.

This young industry requires different ways of thinking, as often exemplified through the concept of Design for Additive Manufacturing (DfAM) -- we look now into another way of thinking about the industry, with DfAM as Diversity for Additive Manufacturing.

Rethinking and reframing the diverse makeup, or lack thereof, will hopefully provide another lens through which to view the growth and shape of this dynamic field.

## *Resources and References*

Through Women in 3D Printing, we have a growing resource of first-hand reports from female participants in this industry, with more than 100 women profiled so far in in-depth interviews to share their perspectives.

Additional resources contributing to this report include personal experience from on-the-ground reporting at global industry events from author Sarah Goehrke, including several dozen events

annually; public figures disclosed by companies regarding their employment figures and breakdowns; and data collected from reports from:

- Alexander Daniels Global
- Sculpteo
- LinkedIn
- Wohlers Associates

All references are linked to original sources for full attribution and further reading.

### *Thanks*

Our thanks go to the community, who have been overwhelmingly supportive of the launch of this new industry resource. We hope to create a valuable report each quarter, and look forward to adapting the format as additional resources and data become available to us and as we collect more insights. With more data, we will be able to provide a more concrete, objective look at the shape of this industry to complement the wealth of subjective input gathered through primary source interviews and experiences.

### *Contact*

As we look forward to growing this report each quarter with additional information, we appreciate any contributions to add to our understanding and data generation.

We can be contacted with thoughts, suggestions, outreach, and providing additional resources here:

Sarah Goehrke: [Email](#) | [LinkedIn](#) | [Twitter](#) | [Wi3DP Interview](#)

Nora Touré: [Email](#) | [LinkedIn](#) | [Twitter](#)

Women in 3D Printing: [Site](#) | [LinkedIn](#) | [Twitter](#) | [Facebook](#)

### *Disclosures of Affiliations*

Sarah Goehrke is currently the Editor-in-Chief of [3DPrint.com](#); this work was produced outside the scope of that work and is not affiliated with the site.

Nora Touré is currently the General Manager of [Sculpteo](#) USA and the founder of [Women in 3D Printing](#).

# EXECUTIVE SUMMARY

The 3D printing industry is a burgeoning field experiencing ongoing rapid growth in terms of revenues and employment. Diversity in additive manufacturing follows, for the most part, trends in the larger manufacturing and technology sectors; that is, it is heavily and undeniably male-dominated.

Discussion of diversity will focus on two major areas: objective and subjective.

Objectively, the additive manufacturing industry is growing, comprising a more than \$6 billion industry. At one estimate, the workforce is made up of 87% male employees and 13% female employees. Public companies' executive leadership structures can be observed to be made up of a majority male management structure.

Subjectively, women in the 3D printing industry share experiential thoughts, gleaned from author perspective and accumulated interviews from Women in 3D Printing. Focus on shared thoughts includes discussion on the shape of the industry, challenges encountered in women's career paths, and a look into encouraging more women to enter the industry.

The layout of this report encompasses:

- I. Objective Discussion / Data-Driven Examination
  - A. Additive Manufacturing Industry: Shape
  - B. Additive Manufacturing Industry: Employment
    1. Public Employment Figures
- II. Subjective / Experiential Discussion
  - A. Author Perspective
  - B. Accumulated Perspective
  - C. Actionable Perspective

# OBJECTIVE DISCUSSION / DATA-DRIVEN EXAMINATION

*For this first DfAM Quarterly Report, we will be taking a broad-stroke overview approach to the industry. For subsequent quarters, we hope to gain access to additional data to report more specifically on employment figures and trends.*

That women are less represented in manufacturing and technical fields -- no matter the role, from marketing to engineering, entry-level to executive -- is a long-established fact. Manufacturing historically has attracted fewer women for myriad reasons, and while numbers have been rising over the last several decades, it remains an inarguably male-dominated field.

A more diverse workforce produces stronger business results, findings supported through years of [research](#) from a vast variety of avenues. Businesses benefit from a deeper pool of talent bringing together individuals from different backgrounds and experiences with different ways of thinking and problem-solving.

Additive manufacturing as an industry is a unique entity, finding employment overlap with traditional manufacturing as well as advanced technology fields. As 3D printing remains a relatively nascent technology and industry, employees come to the field from a variety of backgrounds, with specialized degrees, certifications, and fields of study emerging only recently.

A [recent study](#) from Northwestern indicates that perceptions are changing among the younger generations, with more youths than ever before -- compared to results gathered from five decades of accumulated research -- depicting female figures when asked to “draw a scientist.”

Broadly, looking into STEM (science, technology, engineering, and mathematics) area employment, a [2016 LinkedIn survey](#) found that 23% of employees in these fields were female. In addition to the base gender disparity in simple numbers, a broad pay gap was found, widening as the talent ladder ascended. LinkedIn metrics, drawn from millions of global users, evidence that women are joining the STEM workforce at an accelerating rate, however, with a [March 2018 snapshot](#) explaining:

*“Encouragingly, we’re seeing significant growth in women joining the STEM (Science, Technology, Engineering, Math) sector. In the last four decades, women are making progress in these roles, as well as the public safety and construction industries, indicating a strong trend of women being better represented amongst traditionally male-dominated roles and industries.”*

The [2017 McKinsey Women in the Workplace](#) study finds a lingering divide in the workplace at large, with women significantly underrepresented in automotive and industrial manufacturing (with women representing 26% of the entry-level force and 13% of C-suite roles) and in technology (hardware and software) (with women representing 26% of entry-level workers and 17% of C-suite positions). This report delves into other measures of diversity as well, finding that, “The workplace is especially challenging for women of color.” This study breaks down a look into why these numbers are the way they are, including views on opportunity, reasons for seeking new employment, and the glass ceiling effect.

## BY THE NUMBERS

### Women’s and men’s very different views

#### WOMEN ARE LESS LIKELY TO THINK THEY HAVE AN OPPORTUNITY TO ADVANCE ...

% OF WOMEN AND MEN WHO THINK ...



#### ... AND THAT THEIR COMPANIES TREAT PEOPLE FAIRLY

% OF WOMEN AND MEN WHO THINK ...



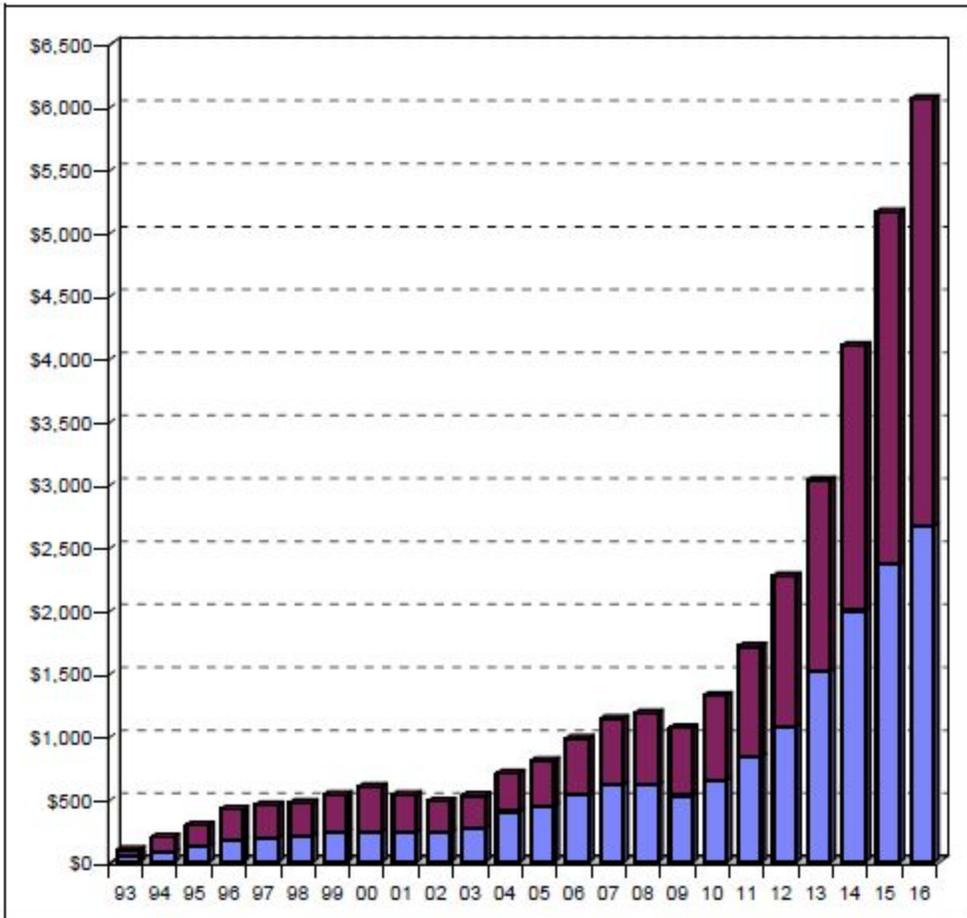
[Graphic: McKinsey&Company]

## Additive Manufacturing Industry: Shape

Turning more directly to additive manufacturing for unique numbers, employment data becomes less readily available. As noted, this field is young; much of the data collection from established authoritative sources focuses on the industry itself and market projections for sales of hardware, consumables, and software, as well as affiliated services. These figures provide a solid understanding of the environment in which the workforce is in play.

The [2017 Wohlers Report](#) found that additive manufacturing represented a \$6.063 billion global industry in 2016, including products and services. While growth projections presented in the Wohlers Report show a slowing of annual gains -- 2016 represented a 17.4% increase over the previous year, compared to previous advances of more than 25% annually -- the numbers in absolute terms continue to grow, evidencing a maturing industry.

The 2017 Wohlers Report showcases industry growth in dollar terms:



Source: Wohlers Associates, Inc.

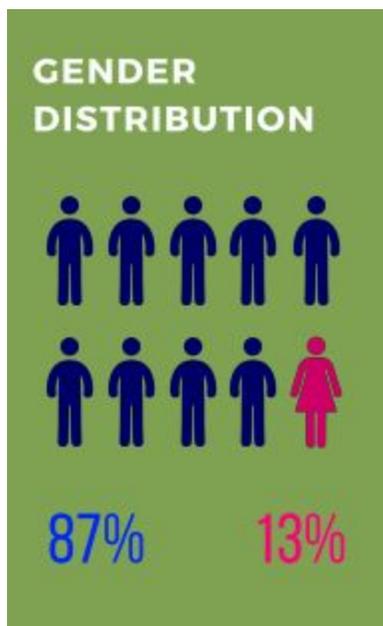
Just released, the [2018 Wohlers Report](#) indicates that the 3D printing industry is continuing to see healthy gains in terms of revenues, hinting at a healthy employment environment overall.

## Additive Manufacturing Industry: Employment

Moving beyond revenues, however, are those behind the salaries.

The workforce supporting the 3D printing market remains somewhat of a blind spot in reported metrics available in major industry reports; these figures are currently outside the scope of such reports due in part to a lack of access. Recruiters and other HR-focused firms are privy to such information though, and do share some results.

According to a recent [salary survey](#) published by Alexander Daniels Global, a UK-headquartered specialist recruitment company working in additive manufacturing, employment in the 3D printing industry skews heavily male. Looking at R&D and engineering, sales, service, applications and consulting, marketing, and software disciplines across the US, EMEA, and Asia Pacific regions, Alexander Daniels Global reports that 87% of current employees in the additive manufacturing industry are male, with a 13% female contingent.



[Graphic: Alexander Daniels Global]

Upon request, the company provided a further breakdown of employment, looking into percentages of women working in 3D printing by discipline:

- R&D -- 8%
- Application & Consulting -- 14%
- Marketing -- 29%
- Sales -- 16%
- Software -- 6%
- Service -- 5%

The highest concentration of women working in this field is, unsurprisingly, in marketing. This discipline also represents the only area of focus with more than one-fifth of employees being female.

The ratio of disparity across the board is telling and requires little additional comment.

## Public Employment Figures

Available employment figures do not include a breakdown along lines of diversity, but we are able to observe some trends in upper management and executive structures from reports.

The two largest businesses in the 3D printing industry, Stratasys and 3D Systems, are both public companies. In 3D Systems' most recent [10K](#) (filed February 28, 2018, with a document date of December 31, 2017) the company notes that as of year-end 2016 it had 2,445 full-time employees (2,492 at the end of 2015). Stratasys, in its [20F](#) for the fiscal year ended December 31, 2017, reports "approximately 2,300 employees."

In terms of executive structure, among eleven reported directors and senior management, Stratasys has two women represented. All five of 3D Systems' reported executive officers are men.

*As we continue on this report in subsequent quarters, we will include additional information gleaned from public filings for a broader look at more leading companies.*

# SUBJECTIVE / EXPERIENTIAL DISCUSSION

Numbers, of course, mean little without context.

Looking into a breakdown by percentage leaves out a deeper understanding of why the industry is shaped as it is, simply presenting that it is such a shape. Through direct industry participation and interaction, an inside look at additive manufacturing allows for an on-the-ground experience of what diversity means in a practical sense and a scope of where the industry has come from and is heading as viewed through this lens.

## Author Perspective

Anecdotal reports are not in and of themselves much more helpful than numbers outside a contextual discussion, but it is my hope that these hard and soft observations together will provide a resource of understanding.

In personal terms, I can honestly say that I have never felt held back in my career due to my gender. I recognize that this feeling is not an uncommon one among successful women in tech today, as education, society, and the workplace genuinely provide a fostering environment for many, without regard to gender, race, or creed. I recognize as well that these statements are limited and come from a perspective of privilege not found in all circumstances, societies, or geographies. This perspective of privilege can often permeate responses to the examination of diversity (and response to broader feminism): “It shouldn’t be about the gender, it should be about the work.” This is correct; it is also indicative of a severely limited view.

With a demonstrated 13% of the active workforce in 3D printing, women are underrepresented. It should be about the work. Until it can be, however, there is work to be done toward equalizing the distribution of employment. Why do tech fields not attract more even parity? This is a loaded question, and a far-reaching societal inquiry larger than the scope of this report. Whatever the myriad factors, striving for diversity remains a significant need.

In the context of this report, anecdotal experiences serve as examples of individuals’ personal experiences in the 3D printing industry; sharing my story, examining the experiences of others, allows for a snapshot of the industry experience. Much like the slow release of a few experiences led to the recent avalanche of outing unacceptable behaviors in Hollywood, starting with a few stories can build a larger lens through which to examine the scope of experiences that may or may not match up to readers’ own. Visibility is important, and speaking up, speaking out, is the first step toward change.

Through my own experiences travelling across the United States this quarter in my role as the Editor-in-Chief of 3DPrint.com, as well as abroad to Canada and Europe throughout the last 30 months of my tenure in this role, I am often faced with the faces of the industry. From industry-leading events such as formnext in Frankfurt where tens of thousands are gathered, and larger tech venues such as the annual CES in Las Vegas, to individual conversations and private on-site facility tours, such first-hand experiences provide a fuller understanding. While I work to share these experiences through published interviews and reports, as well as through professional social media platforms, this DfAM report provides an avenue for an overarching focus on these experiences through the lens of diversity.

In 2016, I [attended a dozen](#) 3D printing events in Europe and the US; in the first half of 2017, that number rose to [18 events and sites](#), while in the second half of the year I went to [22 locations](#). In the first quarter of 2018, I have already been to seven events and sites. With events and on-the-ground reporting only picking up in frequency and quantity, I feel uniquely positioned in gathering a bird's eye view, speaking personally with representatives of a broad variety of companies including industry OEMs and end-use customers alike. One-on-one site visits and facility tours provide an inside look at day-to-day operations, including at least a glance at the personnel makeup of each organization, while conferences and media events also provide the opportunity to compare notes with other journalists and analysts.

A common experience arising from so much travel is eating alone -- at airports, at hotels, a quick bite between conference sessions. Second to that is an additional isolating experience in dining; I am frequently the only woman seated at my table during event meals. At media-heavy events, this is less frequently the case, as many journalists in this space are female, representing what seems to be a relatively even split among dedicated publications. (For our part at 3DPrint.com, our entire full-time content staff is female, and we work with regular freelance and guest writers split fairly evenly between both genders.)

At CES 2018, shortly after the dawn of this new year, thousands gathered in the desert for the neon spectacle that is the massive consumer electronics show. This year was my second time attending, and it seemed to me, primarily focused in as I was on the 3D Printing Zone, that more women were present in 2018 than I had seen in 2017. I took great heart from this -- and then noticed an anomaly. Any woman can tell you that in a packed public space, be it an opera house or a baseball stadium, there are always lines for the bathroom. Queuing here is often a built-in part of any experience, and is less a surprising aspect of these events than an exasperating one. At CES, the line out the men's room door wrapped around a corner in one crowded hallway between event halls; I walked straight into the ladies' room, no queuing required. Realizing this had me look again at the makeup of attendees; while through efforts such as Women in 3D Printing it becomes clear that there are a significant number of women working in tech today -- much of the visibility is clear to those inclined to look. Because I was looking for women in the crowd, I saw them. In absolute numbers, though, women still comprised a significant minority of the total attendance. During a breakfast event for 3D printing

at CES, I discovered I was the only woman in attendance not employed by the host company, among perhaps two dozen guests.

Visibility is critical for encouraging change, both among companies taking notice of the makeup of their teams and for the next generations of the workforce looking to their future careers. By taking the initiative to pay attention, today's workforce can influence the shape of tomorrow's. Just as companies are frequently looking to research the best partners to collaborate with on developing their most important projects, there should be an examination internally as well. Internal collaboration brings together an in-house think tank for R&D; having the right team is critical. Often, a homogeneous mix of like-minded individuals from similar backgrounds will approach problem solving from a similar perspective; an individual coming from a different educational background or having different life experiences will frequently bring a fresh perspective to the table. A diverse team will bring diverse experience, which is increasingly necessary in today's agile environment where so much in the way of business and manufacturing is being rethought.

Design for additive manufacturing is gaining traction because the same designs used for traditional production are not relevant when using different manufacturing technologies. Additive manufacturing enables different topologies not achievable with subtractive techniques, and these considerations require a full rethinking of the entire design, even for the same part.

Diversity for additive manufacturing is relevant in bringing more minds to the table to rethink the shape of production -- and producers.

## Accumulated Perspective

Through Women in 3D Printing, more than 100 interviews have been carried out with women across a variety of areas of focus in 3D printing: artists, CEOs, technologists, technicians, engineers, designers, scientists, makers.

Here, we examine a few of the standout statements made in accumulated interviews, primarily focusing on these questions:

- What do you think of the 3D printing industry today? And how would you like to see it evolve?
- Have you run into any challenges being a woman in the STEM fields?
- In your opinion, how could we encourage more women to become involved with 3D Printing?

The interviews quoted are from Q4 2017 and some Q1 2018; we will look at more recent interviews each quarter. All interviews can be found [here](#) at Wi3DP.

What do you think of the 3D printing industry today? And how would you like to see it evolve?

[Chelsea Cummings](#), Additive Manufacturing Engineer, Arconic:

“Additive manufacturing has matured substantially since its days of prototyping, and I would like to see the rest of the industry recognize AM as a legitimate form of certified aerospace production. There is tremendous growth potential for additive manufacturing in aerospace, and we are on the cusp of it. I would like to see the process evolve and mature so it is truly leveraging all of AM’s benefits, such as design freedom and material efficiency. Much of my daily work pursues this goal.”

[Amy Karle](#), Artist:

“The 3D printing industry is still in its infancy. How I think it will evolve is that even though it will be an industry in itself, it will be spread and integrated across almost every industry, as we use computers now.”

[Monica Sokolowski](#), Head of Imaging, Finance and Logistics at Canaray

“It is still in its infancy. It’s still relatively inaccessible due to price point for a good 3D printer and the technical knowledge required to produce 3D models of sufficient quality within the constraints of what 3D printers will allow in terms of material and esthetic properties. This limits the number of creative people and non-technical entrepreneurs who can try new application for 3D printer. Once these barriers to entry are reduced we will see some really interesting things coming out of 3D printing.

I like that right now it is limited to people who are really invested, so the biggest investment is time and second is money. You have to be able to sit down and figure it out without getting so frustrated that you quit.”

*And how would you like to see it evolve?*

“Lower barriers to entry – financial and technical. Creative people will find exciting and imaginative applications for 3D printing. Need to make it easier for them...”

[Dr. Tracy L. Albers](#), President and CTO of Rapid Prototype and Manufacturing LLC, (rp+m)

“Like any young industry, the world of 3D printing is still determining what it wants to be when it grows up. For a while, the community adopted the prototyping and quick product development opportunity as the ‘end game.’ Then the market demanded more. Additive manufacturing OEM’s are starting to make adjustments to enable real production manufacturing, but that will take time. In my opinion, that’s the only way for the industry to stabilize and grow sustainably.”

Have you run into any challenges being a woman in the STEM fields?

**Chelsea Cummings**

“As a woman engineer, I think inclusion has been the biggest challenge. Company culture is a large factor, and at Arconic I’ve found diversity and inclusion are priorities. Early in my career, I noticed that in order to participate in projects I was most interested in, it was up to me to assert myself in relevant conversations and activities. This required me to adjust my communication style.”

**Amy Karle**

“Interestingly it wasn’t until I was named one of the [‘most influential women in 3D printing’](#) that I noticed an inequality. A colleague congratulated me and then quickly pointed to the top men in 3D printing. He said, ‘how many millionaires do you think are on the list’? The men’s list was almost all millionaires and only a small portion of the women’s list. This lit a fierce fire of ambition under me!

Overall, the challenge – or shall I say opportunity – is in the business aspect. This is true whatever your field but especially true in this rapidly growing and relatively young field. The legislation is not yet established – the thinking in many ways is not even yet established. We are still in our infancy of this technology and the ways in which it could be used. There are opportunities for women, minorities, and all types of minds to be leaders in this field. It’s about being dynamic, innovative, flexible and smart... traits that are not about sex or skin tone.”

**Monica Sokolowski**

“Daily interactions with people who normally expect to interact with a man and inherently (and subconsciously) assume that I are less knowledgeable and competent. This can range from service techs to bookkeepers. It’s something I know to expect, but nevertheless, still takes me by surprise when it happens. I will sometimes compare responses sent from my “female” email to the ones sent from a “male” email account, and it can be quite astounding – particularly in how timely the response is, but I still feel like there’s a lean to the boys club. I’m lucky to be involved with a company that believes in diversity and equal rights. In the past I have experienced chauvinist perspectives at other jobs and I still do from people that are outside our company, such as being assumed to be a secretary or an assistant to some as-yet-unintroduced boss.”

**Dr. Tracy L. Albers**

“In my opinion, a leader is a leader. A problem solver is a problem solver. The challenges I face as an individual are just that – things to overcome. I’m a good scientist – I have reasonably developed problem solving skills and I communicate fairly well. I believe I’m successful for those reasons – not because (or despite that) I also happen to be female.”

[Lizz Hill Wiker](#), Senior Manager, (3D) Product Visualization Team, Technical Development and Prototyping, Hardware and Jewelry, Coach

“I consider myself an extremely fortunate and rare example of a woman in a technology based field which has almost never felt at odds in a stereotypically male-gendered role/career. I believe that this has to do, in large part with the fact that I work in fashion which still tends to be a female-dominated industry. Since college, I’ve been down a fashion-focused path even though I’ve veered into more of a technology-focused career which I believe has kept me insulated from some of the gender-equality struggles of many of my peers. It is only during 3D industry conferences, trade shows and meetings with vendors that I’ve noticed the abrupt lack of women in this field, though that is something in which I’ve also seen a shift in, over the past 5 years as more women are entering the workforce in technology based roles.”

[Naomi Wu](#), Maker, “SexyCyborg”

“In the past 50 years, female representation in the STEM in China has been some of the best in the world. But, due to demographic issues (a shortage of women), we’re increasingly being discouraged from pursuing careers that might delay marriage. Our media is not openly against women in tech yet, but that’s certainly the direction things are headed. Sexism here in China is more cultural and institutional than individual. The men I know in tech are, for the most part, polite and respectful. There is no achievement gap between boys and girls here, so no one ever questions my capability. They just think it’s odd I do technical things because women who look like me usually pursue any number of easier, more profitable paths.

That being said working in a company with hundreds of people, there would be outliers and we have no real laws against sexual harassment, stalking etc. So I work from home as a coder and increasingly as a vlogger instead.”

[Tatiana Reinhard](#), Project Manager and Fabmanager, le FabShop in France

“At the first professional shows we did, I was a bit pissed off to see people asking technical questions to my male colleagues. One time, a man discovering 3D printing for the first time couldn’t believe my explanations about FDM : “Young lady, I think you’re wrong”. I had to learn to have twice more self-confidence and attitude to be more considered, not to be assimilated as a hostess.

But the more awkward story might be this one: For a job, I was impressed to have 6 interviews with 7 peoples. I got the job but after that, an embarrassed male colleague explained to me that the company never ask as many appointments: they were not enthusiastic and confident to have a woman for this work so I was put to the test. (But I was the best !)”

In your opinion, how could we encourage more women to become involved with 3D Printing?

For this question, many of the responses carry a very common throughline: role models.

Role models provide visibility and a figure to emulate. Mentorship is a closer approach of this, allowing for a relationship to develop individually as knowledge and experience can be shared and leveraged for growth. Both are invaluable -- and come up frequently through responses to this inquiry.

### **Monica Sokolowski**

“As with any technology based industry – focus on getting more women in tech and acquiring technical knowledge and knowhow. Just because women are underrepresented in university engineering and science programs doesn’t mean they can’t acquire that knowledge further into their career. Making sure women have this technical knowledge is essential to get them involved with 3D printing.”

### **Dr. Tracy L. Albers**

“Be present. Lead by example. Tell your story. Show young students – male or female – that careers in manufacturing are real and can offer an exceptional career experience.”

### **Lizz Hill Wiker**

“I’ve had the opportunity to speak with various educators and some leaders of women + technology based organizations recently and the consensus seems to be that it’s extremely important to engage with girls when they are very young, prior to high-school even. Girls tend to be very social people so we should give them opportunities to engage in STEM based groups, especially ones that are targeted specifically to them which focus on group collaborations in social environments. I think it’s really important too for women who have paved the way in previously male-dominated industries to speak out and share their success stories as broadly and frequently as they can. And of course, casting women in leading roles in movies and TV series is something we must continue to push for. I think we all can agree that role-models take ALL forms; real or fictional!”

### **Monica Smith, Application Development Consultant, EOS**

“One of the biggest ways, which I think Women in 3D Printing is doing a great job in tackling, is giving young women role models in 3D printing. I was very fortunate in my previous job to have an incredible supervisor and mentor, who I continue to look up to and seek advice from (see [Caitlin Oswald](#), also here on WI3DP). Caitlin believed in me and she encouraged me to take on challenging project which instilled confidence in me.

Another is in changing the conversation about engineering and showing young women that engineering is a creative field that makes a huge impact on the world. At the University of Connecticut I was a part of the Engineering Ambassadors outreach organization. Our mission was to inspire k-12 students to pursue engineering as a career through engaging presentations on engineering applications.

Lastly, put a 3D printer in front of them! For our Engineering Ambassadors presentations on 3D printing we would bring a desktop plastic FDM printer with us and let them run all day. The students were mesmerized by them. This always renewed my passion for what I do, by watching kids get so excited about the possibilities of the technology.”

### **Tatiana Reinhard**

“Girls, you’ll work among lots of male makers, go ahead! Haha.

I don’t think women have to be shy: I’m well placed to know that society and people -women included !- associate some professional field with gender... But at the end at le FabShop we were more women than men. Do not perpetuate the a priori, they are only a priori.”

**Nicole Wake**, PhD candidate in biomedical imaging at the Sackler Institute of Graduate Biomedical Sciences at NYU School of Medicine

“3D printing is an incredible opportunity. We need to encourage women that anyone can learn 3D printing and provide women with mentorship and resources.”

## **Actionable Perspective**

For 3D printing to continue to grow sustainably as an industry, focus needs to be placed on the workforce behind the technological and business developments.

This is absolutely not to say that companies should willfully hire more women because they are women; “diversity hires” are rarely a good HR initiative, and “affirmative action” is its own loaded subject. All hires should be made with the intent of suiting the best candidate with the best fit position, ideally regardless of that candidate’s personal traits.

Much of the action required is deep-rooted and, again, outside the scope of any industry report. Widespread social change is needed to actually shatter the glass ceiling -- which is very much still a present and real concept -- to see more even distribution in employment. This is at every level, beginning with early education to encourage and foster interest in and understanding of STEM subject areas for all students.

Educational initiatives are picking up worldwide, and many are designed to draw more girls and women into STEM programs; these should be encouraged and, hopefully, will continue to spread across all levels of education and training, from elementary, middle, and high school to university to graduate-level to apprenticeships to workforce training.

In taking cues from many of the interviews from Women in 3D Printing, mentorships, role models, and visibility are critical considerations to foster diversity. Representation matters, and bringing more women to visible prominence in industry is a major step forward in shattering stereotypes; invite women to keynote, to speak on panels, to present research. Look at the makeup of presenters at any event and work as possible to ensure better representation. There are women and minorities working in this industry today, offering a wider pool of potential speakers than may be commonly thought.

Women in 3D Printing offers [access](#) to myriad women willing to act as mentors, providing a strong starting point for those looking to get into, or further, careers in additive manufacturing.

Similar opportunities may be found across larger employers, and through 3D printing groups on LinkedIn or even Facebook.

# CONCLUSION

3D printing is more than a technology; it is a burgeoning industry. As additive manufacturing continues to see healthy gains in terms of revenues, more individuals will continue to be attracted to employment in various aspects of this industry. To date, a noticeable minority of employment is comprised of women. This disparity highlights larger trends across the larger manufacturing and technology sectors.

Actionable steps toward evening the field of employment include establishing relationships with mentors, visibility of role models, and encouraging educational and training initiatives. Through sharing the stories of industry participants, visibility of experience is rising, positioning the next generations of the workforce to enter a more level field and creating a more complex, rich industry built upon wider-reaching creative problem solving, inventive approaches, and breadth of resources.