AUTM 2018 Licensing Activity Survey

A Survey of Technology Licensing and Related Activity for US Academic and Nonprofit Research Institutions

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A Message from AUTM's Chair

Federal Government Must Invest More in R&D

In 1980, the Bayh-Dole Act unlocked inventions and discoveries made in labs and funded through taxpayer dollars. Universities became drivers of the innovation economy — contributing $1.7 trillion to the US gross industrial output and adding more than 5.9 million jobs. Over the past 20 years, more than 60% of all new drugs worldwide have been created in the US — more than in the rest of the world combined.[1]

Despite these impressive returns, the share of federal investment in research is stagnating, down from more than 70% when AUTM first published the licensing survey in 1991 to 57.6% in this year's report. Meanwhile, many other countries are outspending the US in research and development (R&D) as a percentage of gross domestic product.[2] If the US wants to maintain its global innovation leadership, the federal government must invest more in R&D.

Investment is essential for innovation, but it's not the only factor enabling it. We need our legislators and policymakers to continue providing a reliable framework of strong intellectual property laws — an infrastructure that efficiently moves ideas to the marketplace and gives investors the confidence to back entrepreneurs.

Society as a whole benefits from the innovation ecosystem put in motion by Bayh-Dole. The AUTM survey data illustrates how this enduring system encourages the risk taking that's driving a globally competitive economy, creating better jobs, improving quality of life and strengthening national security. Let's not lose our edge.

Richard Chylla, PhD, CLP, RTTP
AUTM Chair

[1] AUTM and the Biotechnology Innovation Organization: *The Economic Contribution of University/Nonprofit Inventions in the United States: 1996-2017*, June 2019.
[2] "How Much Does Your Country Invest in R&D?," UNESCO Institute for Statistics.

Executive Summary

Evolving TTOs Are Doing More with Less

HOW DOES YOUR TTO STACK UP?

This year, AUTM's Licensing Activity Survey drills deeper into the data. We know that survey contributors already use the historical data to see how their institutions stack up. So, this year, using research expenditures to level the playing field, we're taking a closer look at how tech transfer operations tick for different peer groups.

The survey data, collected from 198 institutions, illustrates the evolving role of tech transfer offices (TTOs), which are doing more with less, and the changing risk appetites for licensing intellectual property.

LESS STAFF, MORE LICENSES

While the number of licensing full-time staff equivalents (FTEs) decreased 1.6% from 2017 — suggesting fewer people are available to perform core tech transfer tasks — data shows a 10.2% increase in the number of licenses and options executed per licensing FTE. Office staffs managed 1.6 more active agreements per FTE, and the volume of work is not likely to slow as TTOs reported a record 26,217 invention disclosures, up 4.9% from last year.

BROADENING REACH WITH NON-EXCLUSIVES

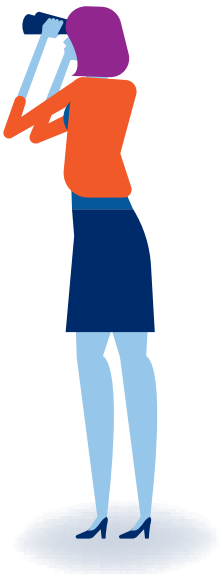
The number of non-exclusive licenses and options topped 5,400 in 2018, up 29% from the previous year. That's three times more non-exclusive licenses than two decades ago. Why? TTOs are getting more creative, branching into areas like data and software. This trend bears watching in light of legal changes that may weaken patents.

BUILDING ENTREPRENEURIAL ECOSYSTEMS

For the second year in a row, tech transfer institutions formed 1,080 start-ups based on university intellectual property. While the record level of start-up formation underscores a continued focus on local entrepreneurial ecosystems, the year-over-year plateauing after a decade of steady growth may point to both investors and TTOs becoming more selective.

In the pages of the report, you can read more about the impact of recent rulings, trends in start-ups and the drivers of non-exclusive licensing. We've also included just a few of the hundreds of stories available in the Better World Project that illustrate the impact technology transfer has made on lives like yours. If you'd like to go beyond the data provided in the survey, consider AUTM's STATT Database.

Ragan Robertson
Chair,
AUTM Metrics and Surveys Portfolio



Tech in Your Life

Using the Sun to Make Drinking Water: Arizona State University Taps Renewable Resources

With more than 2 billion people around the world struggling to find clean drinking water, Cody Friesen, an Arizona State University (ASU) alumnus and associate engineering professor, made it his mission to change that.

Inaccessible drinking water is one of the world's greatest issues.

Through ASU's technology transfer arm, Skysong Innovations, Friesen founded the Scottsdale, Arizona-based Zero Mass Water, which launched Skysong's proprietary SOURCE hydropanel. The device makes clean drinking water out of only sunlight and the water vapor in the air.

Today, Zero Mass Water's SOURCE arrays can be found in more than 30 countries on six continents. Recently, Zero Mass Water partnered with Patty Mills of the San Antonio Spurs to bring renewable water to indigenous communities in Australia and saw the completion of an array at the pediatric ward of the University Hospital of the West Indies in Jamaica.

In even the driest environments, SOURCE is able to use solar power — plus thermodynamics, controls technology and materials science — to generate heat, extract water vapor, sterilize it with ozone and transform it into a liquid that is stored in a 30-liter reservoir. The array then adds magnesium and calcium, not only to provide consumers with more electrolytes, but also to mimic the taste of the world's premium water brands.

"Thankfully,modern technology has allowed us to tap into renewable resources and identify a solution to this crisis," says Friesen, whose company has gone on to raise more than $50 million in outside funding.

2018 TECH TRANSFER BY THE NUMBERS

828 New Products Created

1,080 Start-Ups Formed

$71.7 BILLION Research Expenditures

26,217 Invention Disclosures

7,625 US Patents Issued

6,518 Start-Ups Still Operational

17,087 New US Patent Applications

9,350 Licenses and Options Executed

The Survey

Fresher Ways to Fund Research

Funding the work of researchers and scientists at colleges, universities and other research institutions is the first step in developing technologies that eventually improve our world. Funding comes from the federal government, industrial sponsors and other sources.

Data from 2018 continues the trend of finding more funding, but not in the usual places. The biggest funding change occurred in the Non-Classified research dollars category, which increased 7.6% from 2017 levels. This category can include funding sources such as grants from nonprofit organizations or state and city grants. However, over the past ten years, growth in this category has steadily outpaced relatively flat federal and industrial funding. This trend indicates that institutions are successfully pursuing more non-traditional funding sources and partnerships.

KEY FINDINGS

- Total research expenditures grew to $71.7 billion, an increase of 5.1% over 2017.
- Over the past five years, total research funding has risen 13.8%.
- Research funding is trending away from federal sources. Over the past five years, the share of funding from federal sources has declined from 60.3% in 2014 to 57.6%.
- That same downward trend is also occurring within industrial sources, whose share of research funding has declined from 7.3% to 7.0% over the past five years.
- Those declines are balanced by increased funding from non-classified sources such as nonprofit organizations and state and local governments. Non-classified funding grew to $25.4 billion in 2018, an increase of 7.6% over the prior year and an uptick of 24.7% over the past five years.

Research Expenditures ($ Billions)

	2014	2015	2016	2017	2018
Federal	$37.96	$39.21	$38.94	$39.77	$41.24
Industrial	$4.62	$4.87	$4.93	$4.83	$5.01
Non-Classified	$20.38	$22.49	$23.02	$23.61	$25.41
Total	$62.96	$66.57	$66.89	$68.20	$71.66

	2014	2015	2016	2017	2018
% Federal	60.3%	58.9%	58.2%	57.6%	57.6%
% Industrial	7.3%	7.3%	7.4%	7.0%	7.0%
% Non-Classified	32.4%	33.8%	34.4%	34.6%	35.5%

KEY FINDINGS

- Overall disclosures grew to 26,217, an increase of 4.9% from 2017.
- Over the past five years, disclosures have risen 8.7%.
- The average number of disclosures received was 134 for the 196 institutions that responded to this question. Over the past three years, the average disclosures per respondent have remained fairly flat. Compared with five years ago, the average number of disclosures per institution has increased by only seven.
- Licensing staff declined 1.6% from the prior year, and overall staffing decreased 0.4%.

The Survey

Disclosures Keep Rising, But...

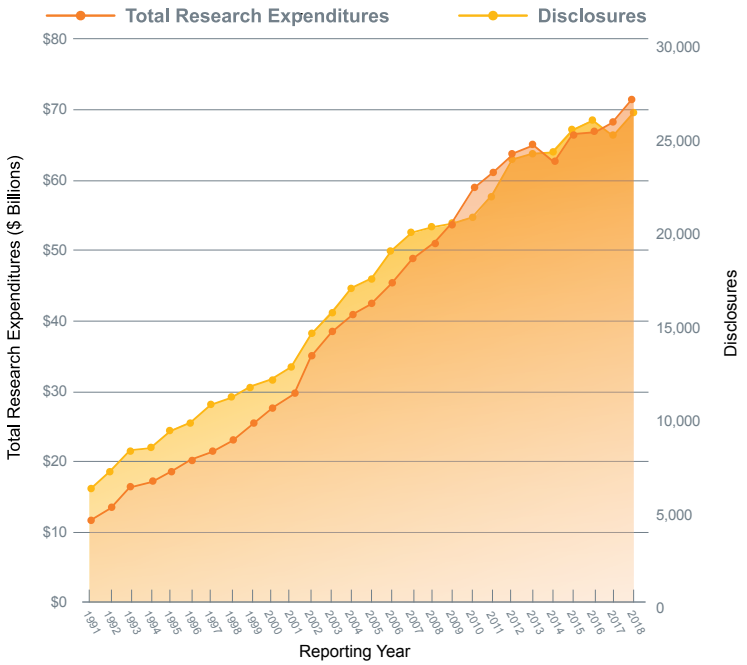
The disclosure is the launching pad for evaluating new inventions, analyzing market potential and developing strategies for protecting the intellectual property.

The total number of disclosures increased year over year, but the number of disclosures reported per institution has remained relatively flat for the past few years. This may be an indicator of the headwinds that technology transfer offices (TTOs) are feeling regarding institutional research and TTO funding, inventor outreach and commercialization.

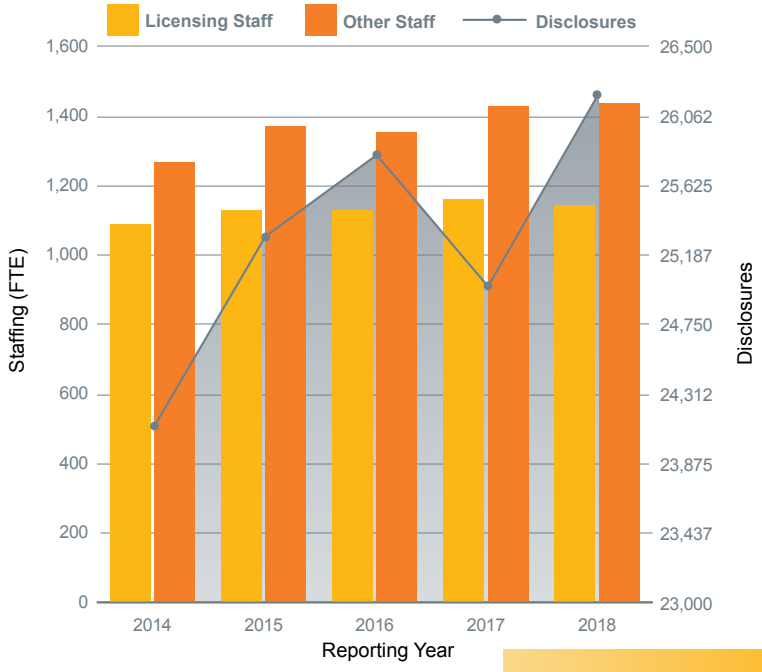
Invention Disclosures

	2014	2015	2016	2017	2018
Invention Disclosures Received	24,117	25,313	25,825	24,998	26,217
Number of Responses to Survey Questions	190	200	194	187	196
Average Disclosures per Respondent	127	127	133	134	134
Total Research Expenditures ($ Billions)	$63.0	$66.6	$66.9	$68.2	$71.7
Disclosures per $10M Research Expenditures	3.8	3.8	3.9	3.7	3.7

Research Expenditures vs. Disclosures



More Disclosures, Same Staff



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project

Tech in Your Life

Shielding Calves from Deadly Virus: Vaccine Springs from Ohio State, Baylor Technology

After more than 20 years of basic research on the structure and biology of rotavirus, researchers at Baylor College of Medicine and The Ohio State University have contributed to the development of a vaccine that protects newborn calves from the life-threatening illness.

Rotaviruses, together with other pathogens such as coronaviruses and E. coli bacteria, are the most common causes of neonatal diarrhea in calves.

This condition can be fatal from the loss of nutrients and dehydration. Surviving calves suffer the consequences of their neonatal condition throughout life by being more susceptible to disease, having trouble gaining weight and producing less milk.

Scientists at ImmuCell Corp., an animal health company that develops, manufactures and markets products to improve health and productivity in the dairy and beef industries, used the university-based viruslike particle technology to develop and field-test a vaccine in cows.

The cows responded to the vaccine by producing anti-rotavirus antibodies in the colostrum, which was tested for its ability to protect newborn cows from the virus. Successful field trials led to First Defense Tri-Shield, a product approved by the US Food and Drug Administration in 2017, which combines the anti-E. coli and anti-coronavirus antibodies in ImmuCell's product First Defense with anti-rotavirus antibodies.

Rotaviruses are the main cause of gastroenteritis in children around the world; they cause more than 200,000 deaths annually.

The scientists hope that after the success in the cattle industry, health care officials will be encouraged to think about rotavirus vaccines based on viruslike particles for children.

The Survey

Patents: Safeguarding Ideas

A key step in the transfer of technology is the protection of new inventions. Patent protection provides both economic opportunities for sponsoring research institutions and an incentive for entrepreneurs and companies to invest in new technologies.

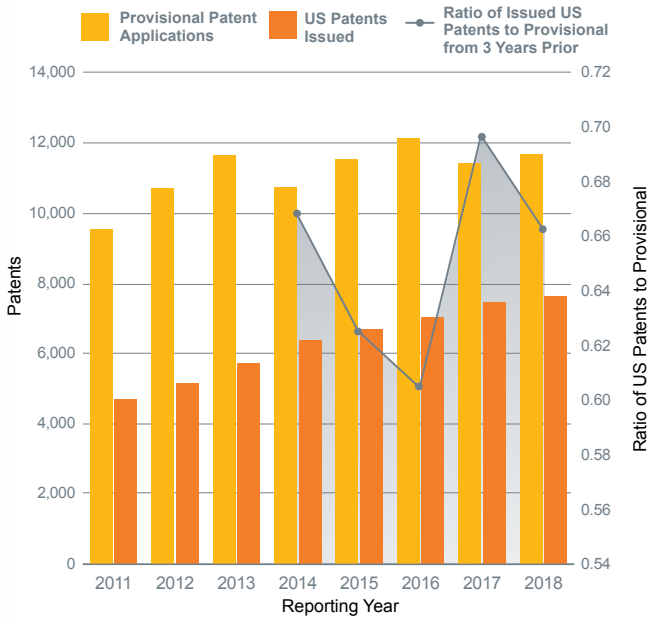
Overall disclosure and patent activity — disclosures and provisional patent applications and issued patents — have steadily increased, but offices continue to demonstrate the same efficacy.

KEY FINDINGS

- While provisional patent applications, issued patents, gross patent expenses and net patent expenses continue to rise, their rates of increase remain consistent. This implies that TTOs have implemented the same general patent strategy over the past five years.
- United States Patent and Trademark Office data indicates a lead time of approximately three years from provisional patent application to issued patent. Applying this timeline to the AUTM data indicates that TTOs have been fairly consistent over the past five years in how provisional patent applications are prosecuted to issued patents. Looking back from 2018's issued patents to the provisional patent applications from three years prior, we estimate the ratio of issued patents to provisional patent applications to be about 2-to-3. This implies a high level of patentability of inventions coming out of research institutions.
- The US continues to be the primary market in which research institutions focus, with US patent applications accounting for 66.5% of total filings.

Research Institutions Opt for US Patents

A High Level of Patentable Research



Patents

Great Expectations: Rulings Force Universities to Up Their Game

Have decisions invalidating patents stifled technology innovation and curbed investment, as some had predicted?

In *Mayo v. Prometheus* (2012) and *AMP v. Myriad* (2013), the Supreme Court helped establish a framework for handling applications touching on judicial exception. In *Alice v. CLS Bank* (2014), this framework was extended to software as the court held that claims directed to abstract ideas must have additional elements capable of rendering them significantly more than the abstract ideas themselves. Critics wondered if *Alice* would kill the market for software patents.

Overall, disclosures and patent applications by US institutions continued a slight upward trend in 2018, making it difficult to assess the ramifications of the court rulings.

"We'll need another two years to see if there's been a negative impact from these decisions. Things have kind of leveled off in the last five years," said John Miner, assistant director in the Office of Technology Transfer at the University of Central Florida.

"*Alice* had a chilling effect on software patents. It scared a lot of people," said Doug Hockstad, assistant vice president at Tech Launch Arizona, the tech transfer office for the University of Arizona. "But it didn't affect the number of invention disclosures or patent filings. What it did do was create a need to define the way you file for patents differently."

Calling the past few years "critically important to the future of our business," Jon Soderstrom, who heads Yale University's Office of Cooperative Research, said the courts have raised the standards for claiming that an invention will have value. "Now you need evidence and to be able to withstand a challenge, so it's become increasingly difficult to substantiate a claim," he said. "The patents that get issued nowadays are stronger" but harder for universities to obtain, "which is challenging our ability to compete in the marketplace."

"Patents are the lifeblood of technology transfer. There's a disproportionate effect if there's any additional risk on universities for commercializing their inventions."

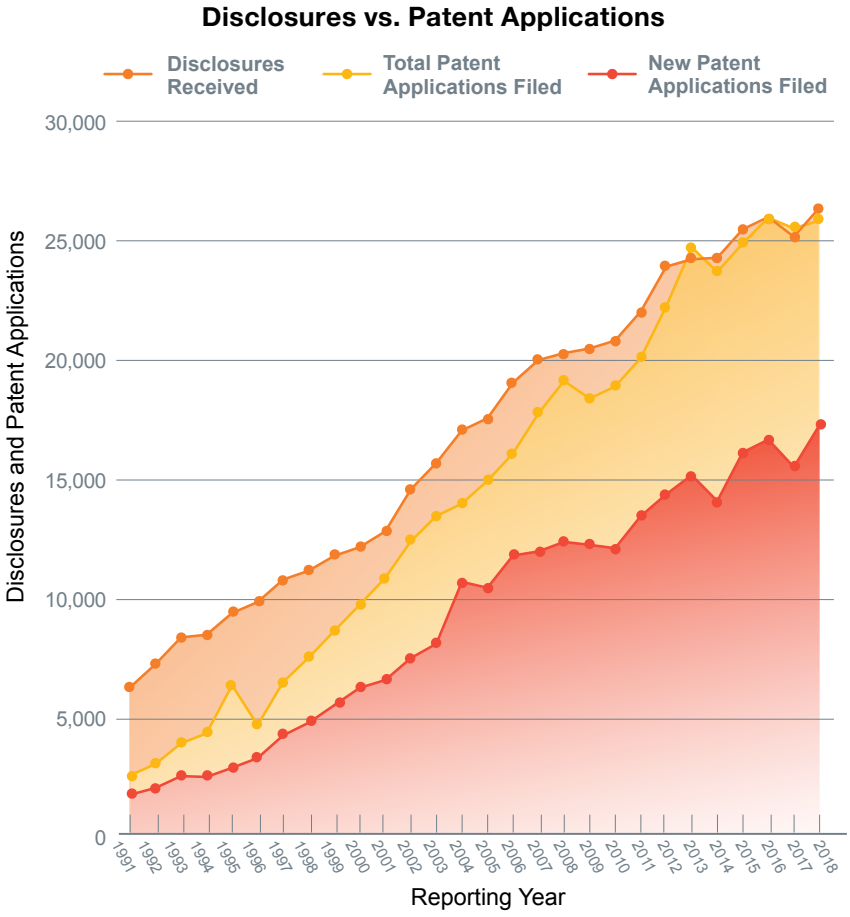
– Stephen J. Susalka, AUTM CEO

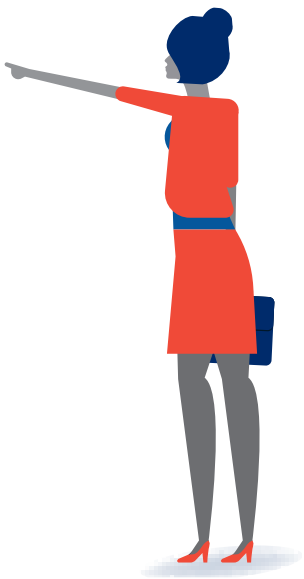
With companies growing more risk-averse and wanting data to prove the value of an invention before investing time and money in it, Soderstrom says universities will need to figure out new partnerships to collect that data. "Success will come from different risk/reward relationships," he said, rather than universities going it alone.

"Given the cost of securing, not to mention litigating patents, there may be more reluctance to seek them for software and diagnostic tools," said Miner, who doesn't foresee a big downward trend. "I think new areas will step in as technology evolves," he said, adding that it depends on research expenditures. "If they fall, you'll see a decline."

US Patent Applications Filed and Issued to US Institutions

	2014	2015	2016	2017	2018
Number of Survey Respondents	191	202	198	193	195
New Patent Applications	13,907	15,953	16,487	15,335	17,087
Total US Patent Applications	23,536	24,723	25,797	25,351	25,678
New US Provisional Patent Applications	10,715	11,516	12,114	11,418	11,670
New US Utility Applications	1,504	1,672	1,391	1,381	1,991
New US Plant Patent Applications	85	102	61	72	117
New Non-US Patent Applications	1,107	1,876	2,507	2,546	3,221
US Patents Issued	6,363	6,680	7,021	7,459	7,625





Patents

Software Scare

Patent Filings Rebound after Rough Patch

In the five years following the *Alice v. CLS Bank* decision, federal courts invalidated 781 unique patents, in whole or in part, under Section 101 of Title 35 of the U.S. Code. That was a 914% increase over the five preceding years, according to a study by attorney Robert Sachs. The number of court decisions finding ineligible claims also ballooned, from 45 pre-*Alice* to 521 after. Software and biotechnology were among the fields most affected. The findings were reported Aug. 29, 2019, on IPWatchdog.com.[3]

Reports of the death of software innovation and patents because of *Alice* may have been premature. Yes, many broad software patents were invalidated (or were never applied for), but funding for software and related R&D rose 27% in the year after *Alice* and continues to grow, according to a June 2018 report by the Electronic Frontier Foundation. And some analysts think revised guidelines the US Patent and Trademark Office (USPTO) issued in 2019 will make it easier to patent software.

After years of parallel growth that ended in 2013, the number of patents granted by the USPTO continues to rise, while the number of patent cases filed in federal district courts has been steadily declining, according to PricewaterhouseCoopers' 2018 Patent Litigation Study.[4]

The Survey

Licensing Staffs Do More with Less

The next step in the commercialization process for protected intellectual property is licensing. The number of exclusive licenses executed is a leading indicator of licensing revenue and the commercial development of new products and services five to ten years later.

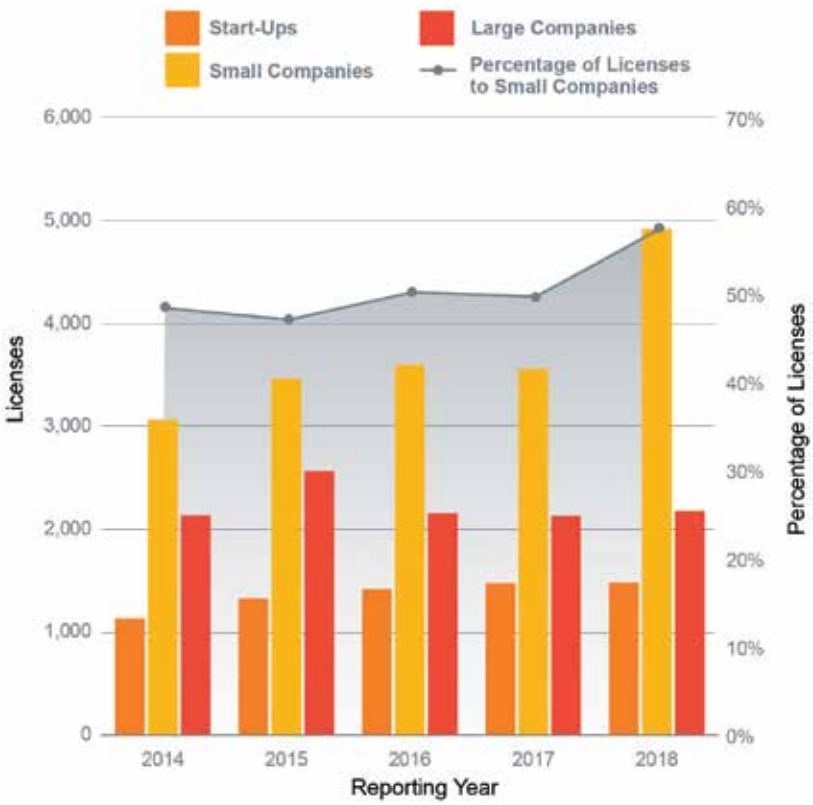
TTOs are doing more with less. The number of licensing full-time staff equivalents (FTEs) decreased 1.6% from 2017 — suggesting fewer people are available to perform core tech transfer tasks.

KEY FINDINGS

- While the number of licensing FTEs decreased 1.6% from 2017, the data shows a 10.2% increase in the number of licenses and options executed per licensing FTE.
- Office staffs managed 1.6 more active agreements per FTE in 2018 than in the prior year.
- Licensing to small companies outpaced large companies and start-ups. The share of licensing from small companies grew from 44.4% in 2014 to 57.4% in 2018.

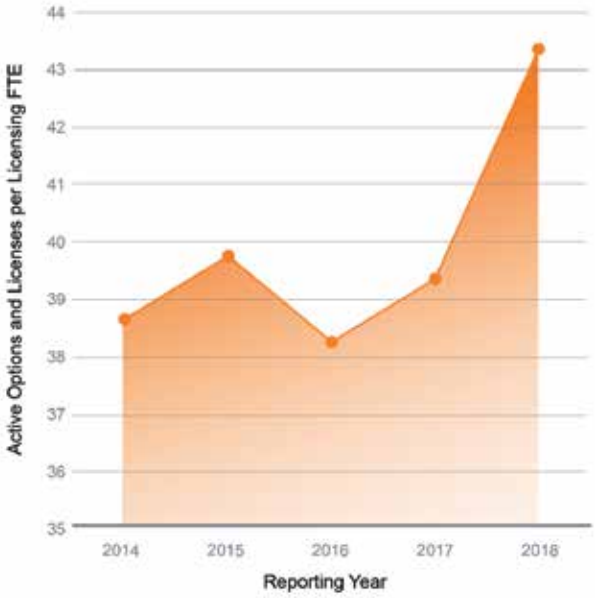
[3] Robert Sachs, "Alice: Benevolent Despot or Tyrant? Analyzing Five Years of Case Law Since Alice v. CLS Bank: Part I," IPWatchdog.com, August 29, 2019.
[4] Doug Branch et al., 2018 Patent Litigation Study, PwC US, October 1, 2019, https://www.pwc.com/us/en/services/forensics/library/patent-litigation-study.html

Licensing More to Small Companies



Increasing Productivity: Licenses and Options per Staff FTE

Doing More with Less: Licenses and Options per Licensing FTE



Licenses

The Exclusivity Gap: TTOs Broaden Their Reach with Non-Exclusive Licenses

The number of non-exclusive licenses and options topped 5,400 in 2018, up 29% from the previous year and a whopping 59% higher than four years ago. Over that same four-year period, the number of exclusives reported to AUTM went up by seven — not 7%, but seven licenses.

Explaining the widening gap, Doug Hockstad, of Tech Launch Arizona at the University of Arizona, said: "When TTOs started, they were almost completely focused on patents," which often lead to exclusive licenses. "It's taken a long time to modify that focus."

Ian McClure, executive director of the University of Kentucky Office of Technology Commercialization, said non-exclusives are growing because TTOs have broadened their reach in areas such as big data, software and educational content.

"Exclusivity is very expensive," added John Miner of the University of Central Florida (UCF). At UCF, "the underpinning of most of our technology is in the physical sciences. Companies that want to do business with us prefer a non-exclusive license. It's cheaper for them, and the university gets multiple revenue streams."

The 1980 Bayh-Dole Act, which allows universities to own and commercialize their federally funded inventions, encourages non-exclusive licensing.

While companies operating in high-risk environments often seek exclusive licenses to protect the time and capital they're committing, other companies prefer non-exclusives because they "just want the freedom to operate and not have to worry about being sued by other companies," Miner said.

A popular example is the iPhone. Its many components — some with very short technology life spans — are made by different companies, so non-exclusive licenses are almost essential.

"Universities are moving toward copyrights and non-exclusive licenses," Miner said, noting that half the licenses his office handled last year were for copyrighted software.

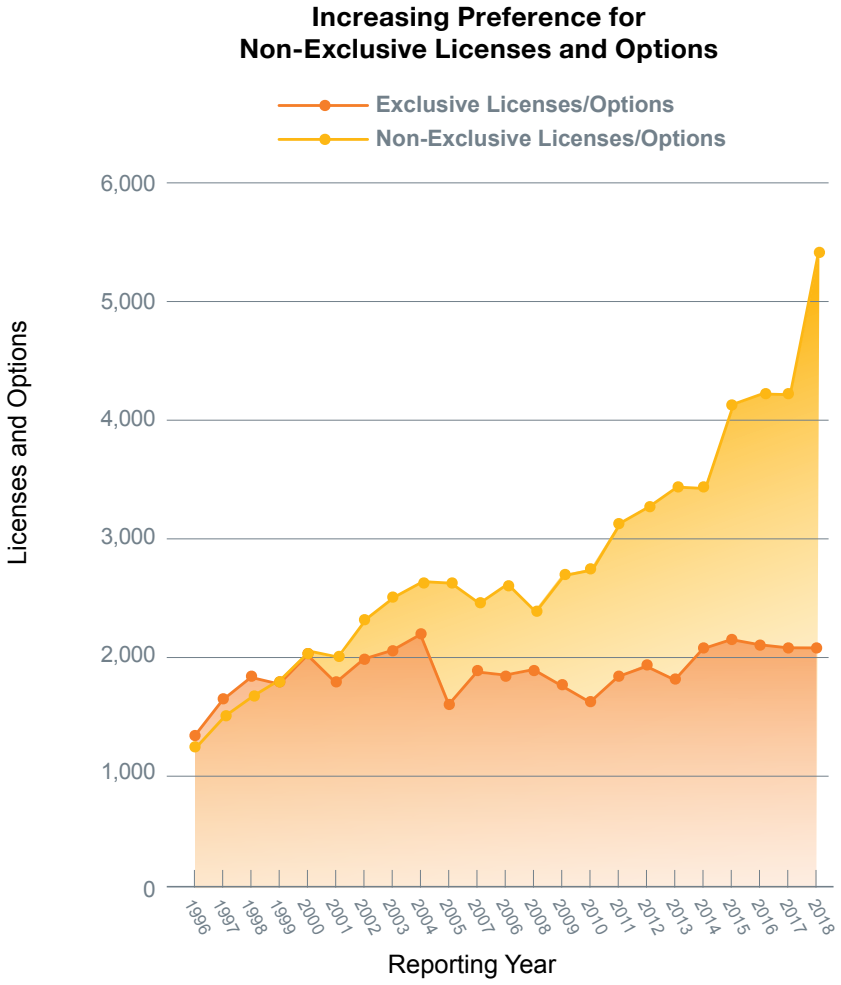
"Creativity knows no bounds. We've done deals with almost every department at Yale. Faculty are being challenged to be more innovative."

— Jon Soderstrom, managing director, Office of Cooperative Research, Yale University

Kentucky's McClure singled out a copyrighted program that helps hospitals manage their nursing staffs. His Office of Technology Commercialization has been licensing the program for about two years, he said, and 15 hospitals are using it.

On everyone's mind, it seems, is the long list of federal court decisions invalidating certain types of patents. The perception of diminished patent strength may be driving down the value of patents and factoring into the growing preference for non-exclusive licenses.

If the result of the court cases is that patents are less valuable — that they're harder to get and easier to challenge — "it wouldn't surprise me that exclusive licenses are not growing," said Stephen J. Susalka, AUTM's Chief Executive Officer. Companies may be thinking that "investing for an exclusive is not worth the risk."



Defining Moment

Historic Dictionary Going Digital

It took Samuel Johnson nine years to produce his Dictionary of the English Language. Beth Rapp Young of the University of Central Florida hopes to have her team's digital version of the famous 1755 lexicon — two volumes with more than 2,000 pages and 42,000 words — online three years from now.

"I'm so excited. We're creating a fully searchable, online scholarly edition" of Johnson's first and fourth editions (the last one published in his lifetime), Young said of the groundbreaking project.

John Miner of UCF's technology transfer office is helping advance it. "Universities are moving toward copyrights and non-exclusive licenses," he said.

Miner is the go-between for Young's team and the University of Birmingham, which has a copyrighted version of Johnson's text on CD-ROM. Once Young's project, funded with $350,000 from the National Endowment for the Humanities, is ready, Miner will help register it for a US copyright. It will be available free online.

"It's kind of shocking there is no scholarly edition" of Johnson's dictionary online, given its importance to historical, legal and literary researchers, Young said.

As an example of TTOs expanding beyond the traditional sphere of science and technology, Miner said, "This is a very cool thing, *and* it's the English Department!"

The Survey

New Products: Where It All Comes Together

The arrival of new products in the marketplace is the culmination of successful tech transfer, from idea, research and development to intellectual property protection and licensing — a strategic, collaborative and often complicated process led by tech transfer professionals.

KEY FINDINGS

- The number of new products per TTO remained relatively flat at six new products per institution responding to this question. Overall, there is a downward trend from a high point in 2014 when respondents averaged 7.5 new products.
- The number of new products increased to 828, up 9.7% from the 755 products created in 2017.
- The number of products is down 14.2% from the historic high in 2014 of 965.

New Products

	2014	2015	2016	2017	2018
New Products	965	879	800	755	828
Number of Responses to Survey Questions	128	129	133	125	139
Average New Products per Respondent	7.5	6.8	6.0	6.0	6.0
Total Research Expenditures ($ Billions)	$63.0	$66.6	$66.9	$68.2	$71.7
New Products per $10M Research Expenditures	0.15	0.13	0.12	0.11	0.12

Tech in Your Life

Ratted Out: University of Arizona Finds a Safe, Non-Lethal Way to Control Rodents

Two mating rats can produce 15,000 descendants in just one year. They spread disease, eat and destroy food in the field and storage, and wreck human infrastructure. While lethal poison is often employed, it is dangerous to people, other animals and the environment.

The technology allows for the management of animal populations by targeting their ability to produce offspring as opposed to killing them outright.

Researchers at the University of Arizona (UA) approached the problem from a different angle, developing a chemical that offers a non-lethal pest control strategy by targeting the root of the problem: reproduction. The technology allows for the management of animal populations by targeting their ability to produce offspring as opposed to killing them outright.

Studies show that the formulation, delivered through a liquid bait, chemically accelerates the depletion of ovaries and induces egg loss in female rats. It also causes testicular disruption in males. If the rats do not continuously consume the liquid, just as with human birth control, they will be able to reproduce again. This treatment causes no systemic toxicity or adverse side effects. As an added benefit, it is environmentally neutral, does not affect the food chain and has no reported toxic effects on humans.

Patricia Hoyer of the College of Medicine – Tucson, along with postdoctoral fellows Loretta Mayer and Northern Arizona University Research Professor Cheryl Dyer, launched a start-up — SenesTech Inc. — to bring the UA technology to the market. They continue to collaborate with the UA through Tech Launch Arizona, the university's commercialization office.

Today the publicly traded company (SNES:Nasdaq) is working to expand its impact to adjacent areas and other global needs.

The Survey

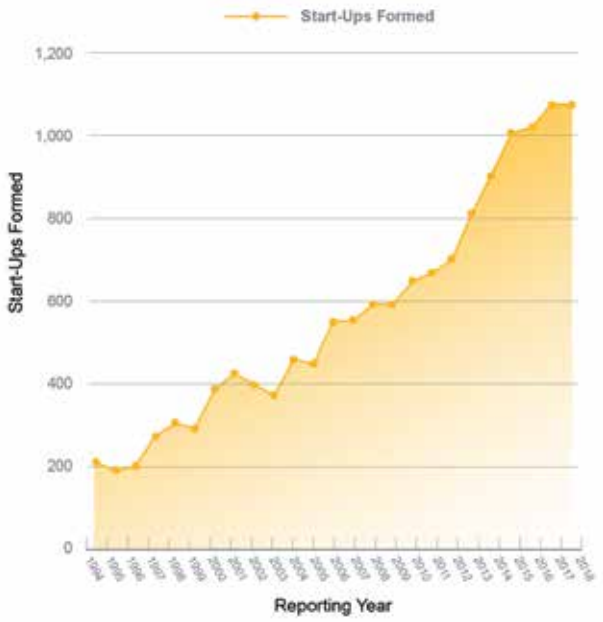
Start-Ups: Taking a Breath

Start-ups continue to be a core focus of university technology transfer offices, but after a decade of steady growth, there are signs that investors and TTOs may be becoming more selective. However, less research-intensive institutions are experiencing an increase in the mean of the start-ups formed.

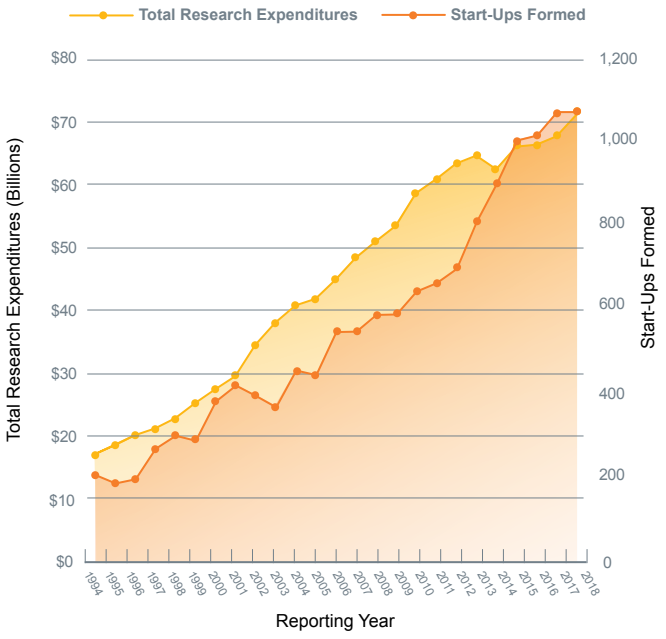
KEY FINDINGS

- In 2018, 1,080 start-ups based upon foundational university intellectual property were formed, an increase of 18.8% over the past five years.
- At the end of the year, 6,518 start-ups were still operational, an uptick of 7.7% over the prior year and an increase of 39% since 2014.
- Of these start-ups, 69.4% were incorporated within the institution's home state.
- The average number of start-ups formed over the past five years has increased 15.1%, from 4.9 in 2014 to 5.6 per survey respondent in 2018.
- Smaller TTOs may be increasing focus on forming start-ups as there is a substantial increase year-over-year in their average start-ups formed.

Rapid Growth in Start-Ups Slowing



Research Funding vs. Start-Ups



Forming Start-Ups

	2014	2015	2016	2017	2018
Start-Ups Formed	909	1,012	1,024	1,080	1,080
Start-Ups Still Operational at End of Year	4,688	5,057	5,237	6,050	6,518
Number of Responses to Survey Questions	187	189	192	188	193
Average Start-Ups Formed per Respondent	4.9	5.4	5.3	5.7	5.6
Total Research Expenditures ($ Billions)	$63.0	$66.6	$66.9	$68.2	$71.7
Start-Ups Formed per $10M Research Expenditures	0.14	0.15	0.15	0.16	0.15

Start-Ups

Quality over Quantity: Start-Ups Hit Pause as Universities Become More Selective

For more than a decade, the number of start-ups reported to AUTM climbed steadily. Then came 2018, when it froze. Is that one-year plateau a hiccup or something more?

"Whether we go up or down from here depends largely on things we can't control" such as venture capital, the economy and other factors, said Orin Herskowitz, head of Columbia Tech Ventures at Columbia University.

Venture capital fundraising hit a new high in 2018, but only 7% of the money went to smaller funds, the lowest percentage since 2009. The shrinkage has forced some universities to be more selective about what they push forward.

"For years it was exciting and sexy to have lots of start-ups," said Ian McClure, who heads the Office of Technology Commercialization at the University of Kentucky. Now "we're better at identifying the ones with potential. It's not just a volume-based thing, it's a quality-based thing."

Funding is not as big an issue in larger urban areas, where entrepreneurs tend to cluster. "We've seen growing investor and entrepreneur interest," said Columbia University's Herskowitz. "Good ideas are getting funded," echoed Jon Soderstrom, head of Yale University's Office of Cooperative Research.

But rural areas struggle for their piece of the pie. Their share of start-ups went from 20% in the 1980s to 12% now, according to the Kauffman Foundation.

"Early-stage venture money has been tight for quite a while, but it doesn't tamp down the desire of people to create start-ups," said Doug Hockstad of the University of Arizona's Tech Launch Arizona. "While universities focus on quality and strength in new ventures, growth in incubators and accelerators will be important to the success of start-ups" in his region.

The University of Michigan, which has operated an incubator for years, had a record number of start-ups in fiscal 2018, with 21. Arizona will soon have its own incubator. Some universities have set up "new ventures teams" to focus on start-ups. At the University of Kentucky, the result has been fewer start-ups, with more support for those that do get created. "Universities are focused on quality and process,

"The rise in start-ups was not surprising. Every region wants to be the next Silicon Valley, many scientists the next unicorn founder."

— Orin Herskowitz, senior VP of intellectual property and tech transfer, Columbia University

ensuring that start-ups have strong cohesive business teams, a viable go-to-market plan and access to an asset [university intellectual property] that is appropriately positioned," said Joann MacMaster, senior director of venture development at Tech Launch Arizona. "This means the number of new start-ups stemming from university research is beginning to level out, but as a result we'll also see better social and economic impact from these start-ups."

Noting that a one-year freeze in start-up numbers "is not a trend," Yale's Soderstrom said: "I'm an optimist. There could be some diminution in funding for start-ups, but I'm not seeing it yet. We're in a really opportunity-rich environment right now."

Cold Cash

A Chilly Student Apartment Inspires Start-Up Success

Jacob Kring's hot tech idea came from the fact that he was freezing in his undergrad apartment. Three bedrooms, one thermostat and electric bills that exceeded the rent led to his senior project at the University of Pittsburgh and a start-up called Hibersense. Kring co-founded the company in 2015 with engineering classmate Brendan Quay and Daniel Mosse, former chair of computer science at the university.

Hibersense provides room-by-room climate control using multiple sensors, information about user habits and preferences, and predictive analytics to tailor the environment in each space for maximum comfort.

"The system is infinitely configurable," said Bob Fields, the company's chief revenue officer, noting that one commercial customer reported energy savings of 36%.

With about a third of the nation's energy consumption directed at heating and cooling our homes, even more modest savings would be impactful, in both efficiency and economics. An early test of the system in an aging downtown office building estimated energy savings of 20%.

Launched with $55,000 raised by family and friends, Hibersense is closing in on $1 million in research funding, Fields said. Included in that pot is its $10,000 first prize from 2019's Pitch and Play – AUTM Venture Challenge.

For Good Measure

How Does Your Institution Stack Up?

We know that survey contributors already use the historical data to see how their institutions stack up. So, this year, using research expenditures to level the playing field, we're taking a closer look at how tech transfer operations tick for different peer groups.

WHAT TO MEASURE

For this initial benchmarking report, we selected five of the most common measurements that broadly capture the overall performance of tech transfer offices. A sixth key measurement, research expenditures, was used to organize the data into peer groups.

- Invention Disclosures
- New Patent Applications
- Licenses and Options
- Gross Licensing Income
- Start-Ups Formed

SELECTING PEER GROUPS

Another important consideration in cross-institution benchmarking is identifying appropriate peers.

We used the HERD report to divide the population into categories based on research funding. Each year the National Science Foundation (NSF) conducts the comprehensive Higher Education Research and Development (HERD) Survey.[5] This annual census collects information on R&D expenditures from more than 900 degree-granting institutions that spent at least $150,000 in R&D during the fiscal year. These institutions accounted for more than 99% of the total R&D expenditures reported.

Peer Group Comparison

Peer Groups			Invention Disclosures		New Patent Applications		Licenses and Options		Gross Licensing Income		Start-Ups Formed	
HERD Rank	Total Research Expenditures	Group Size	Average	Median	Average	Median	Average	Median	Average	Median	Average	Median
1	More than $469,682,000	48	329.4	264.0	187.9	136.0	104.1	78.0	$30,816,984	$11,546,862	14.2	10.5
2	$212,823,000 to $469,682,000	35	124.1	119.0	70.6	51.0	41.8	28.0	$3,756,354	$2,341,093	5.0	4.0
3	$102,823,000 to $212,823,000	27	55.9	50.0	39.5	35.0	20.6	9.0	$3,162,714	$1,389,943	2.9	2.0
4	$46,253,000 to $102,823,000	24	33.9	36.0	17.3	15.5	54.4	7.0	$1,159,482	$335,790	1.5	1.0
5	$24,194,000 to $46,253,000	16	25.1	19.0	25.1	12.0	8.2	3.5	$455,765	$128,931	1.9	1.0
6	$8,011,000 to $24,194,000	10	12.8	5.5	7.5	3.5	1.7	1.0	$30,075	$863	0.8	1.0
7	Less than $8,011,000	3	11.0	8.0	5.0	4.0	17.3	4.0	$36,415	$24,865	1.0	0.0
H	Medical Research Institutions	24	117.8	75.5	147.9	39.0	32.0	19.5	$49,552,912	$12,403,581	2.3	2.0
Overall		187	138.3	73.0	91.0	43.0	49.7	19.0	$15,619,682	$1,872,146	5.7	3.0

[5] Higher Education Research and Development Survey (HERD), National Science Foundation, October 1, 2019, www.nsf.gov/statistics/srvyherd

About the Survey

AUTM invited 312 US institutions — universities and colleges, hospitals and research institutions, national laboratories and third-party technology investment firms — to participate in the AUTM 2018 US Licensing Activity Survey. AUTM received 198 completed surveys, for a response rate of 63.5%. Respondents for 2018 comprised 170 universities, 27 hospitals and research institutes, and one technology management firm. The numbers from these institutions reflect the significant role played by technology transfer in today's innovation economy.

Most of the data collected in this survey is also available in AUTM's Statistics Access for Technology Transfer (STATT) Database. To access this searchable database of more than 28 years of academic licensing data, visit **www.autm.net/statt**.

Suggested Citation

AUTM report titled AUTM US Licensing Activity Survey: 2018, A Survey Report of Technology Licensing (and Related) Activity for US Academic and Nonprofit Institutions and Technology Investment Firms can also be referenced by its abbreviated title, AUTM US Licensing Activity Survey: 2018, editors Grant Allard, John Miner and Ragan Robertson.

About AUTM

AUTM is the nonprofit leader in efforts to educate, promote and inspire professionals to support the development of academic research that changes the world and drives innovation forward. Our community comprises more than 3,000 members who work in more than 800 universities, research centers, hospitals, businesses and government organizations around the globe.

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