October 14, 2021

Submitted through the Federal eRulemaking Portal

The Honorable Andrew Hirshfeld
Commissioner for Patents
United States Patent and Trademark Office
600 Dulany Street
Alexandria, VA. 22314

AUTM's Comments on USPTO's Patent Eligibility Jurisprudence Study (Docket Number: PTO-P-2021-0032)

Dear Commissioner Hirshfeld:

Here are the comments provided by AUTM to the Request for Information as published in PTO-P-2021-0032.

1. **Please explain how the current state of patent eligibility jurisprudence affects the conduct of business in your technology area(s). Please identify the technology area(s) in your response.**
2. **Please explain what impacts, if any, you have experienced as a result of the current state of patent eligibility jurisprudence in the United States.**

AUTM represents a non-profit community comprising more than 3,000 members who work in more than 800 universities, research centers, hospitals, businesses, and government organizations around the globe. AUTM members lead efforts to educate, promote and inspire professionals to support the development of academic research that changes the world and drives innovation forward. AUTM members use a variety of contractual and business approaches to accomplishing this mission, including defining, protecting, and licensing patentable subject matter. AUTM members are responsible for hundreds of U.S. patent filings each year. Since the passage of the Bayh-Dole Act in 1980, university-based technology transfer has yielded over a trillion dollars of positive economic impact on our nation.

AUTM members are tasked with moving discoveries from the lab to the marketplace with an often finite set of resources. As such, tech transfer offices are forced to make difficult decisions as to which technologies they can afford to protect with patents. Unfortunately, the current jurisprudence surrounding Section 101 makes those difficult decisions even more difficult.

Our members' partners in commercializing these discoveries -- be they existing companies or start-ups that our members help create -- have a daunting challenge to secure investment funding to further develop the concepts from research labs and make them viable products and services. The lack of clarity about patent eligibility can often snuff out these discoveries before they ever leave the lab. Without enforceable patents as a source of sustainable competitive advantage, few companies, particularly in the life sciences, will make the necessary multi-million dollar investments

into the development and testing of new products, particularly medical treatments. In other words, no patents mean no licenses, which means no startups, which means no further development, and little or no benefit to the economy or the public. It's as simple as that.

Patent eligibility concerns have not only discouraged the filing of patent applications by AUTM members, they have also discouraged faculty from disclosing new discoveries to their technology transfer offices once they learn that there is little chance that disclosures in certain technical areas can be patented.

The fact is that the jurisprudence of the past decade – where the Supreme Court has muddied the waters about what is patent eligible through such decisions as *Alice* and *Mayo* – has complicated things to an extent never seen. Indeed, when she and other judges were considering the *American Axle* case last year, Federal Circuit Judge Kimberly Moore was quoted as saying that judges are "at a loss" as to how to apply Section 101. Other judges -- notably Federal Circuit Judge Todd Hughes -- have begged the Supreme Court and Congress to provide more clarity, pointing out that "uncertainty" is a major problem. Uncertainty is a jobs and innovation killer.

American patent law must ensure that inventors and companies are incentivized to bring their inventions and discoveries to the marketplace. At the current time, AUTM believes that many great ideas and new technologies are being left behind because of the inability of the courts and the PTO to clearly establish what is and what is not patent eligible. This must be fixed by Congress.

3. Please explain how the current state of patent eligibility jurisprudence in the United States impacts particular technological fields, including investment and innovation in any of the following technological areas:

a. Quantum computing;
b. artificial intelligence;
c. precision medicine;
d. diagnostic methods;
e. pharmaceutical treatments; and
f. other computer-related inventions (*e.g.*, software, business methods, computer security, databases and data structures, computer networking, and graphical user interfaces).

Unfortunately, there are numerous examples of technologies and discoveries that have been abandoned for not being considered patent eligible. Here are just a few of those examples. (The specific names of the universities involved and the companies they worked with are omitted for confidentiality reasons.)

- One major nonprofit research institution attempted to patent a genome browser. It abandoned the effort due to a persistent patent eligibility rejection by the PTO. That same institution also developed a diagnostic test to detect metabolites associated with thiopurines, which are a class of drugs used to treat a variety of conditions. Due to concerns that they would be unable to secure a patent in view of current patent eligibility jurisprudence, the results were merely published, with no commercial champion or development partner expected to take an interest given the lack of patent protection.

- At another institution, an Electrical Engineering and AI Professor invested in acquiring training and validation sets to develop non-contact (e.g., optical) multivariate assays. Since such assays are not statutorily patentable subject matter in the U.S, as at one time they were, the faculty member, students, and postdocs feel trapped between entrepreneurial interests and academic ones, since counsel continues to advise that the assays are "not realistically patentable," and journals require posting of their methods and tools, such as the code and training sets, eliminating a path to commercialization by way of trade secrets. The institution is exploring the feasibility of "academic

use only" licenses to their tools, and how enforceable they will be. Previous attempts by this group to license tools for "academic use only'" while retaining the ability to enter into commercial licenses separately were unsuccessful.

Additional problems caused by the current 101 jurisprudence include: inability to enforce; inability to acquire US claims allowed with the side effect of abandoning a granted ex-US patent; and deterrence of faculty disclosures. Here are some examples:

- A major research university owns a patent directed to a method of diagnosing exposure to a cancer-causing virus, and companion patents covering antibody therapeutics for patients who have been exposed. The inventor had reason to believe that another institution had created an infringing test. When contacted, the other institution threatened litigation, stating that the university's claims were invalid for being directed to ineligible subject matter. The inventor's university consulted outside patent counsel who opined similarly. Thus, said university chose not to enforce the method patent due to the time and expense required, the likelihood that the claims would be invalidated, and the potential that the companion therapeutic patents could get pulled into the fray putting them at risk as well.

- That same university was prosecuting a patent application directed to a biomarker for acute coronary syndrome. It was jointly owned with a company. During prosecution, in order to obtain exclusive rights to the invention, the company entered into a license agreement for the university's rights in it. However, the university could not overcome the 101 rejections and ultimately decided together with the company not to respond to a final rejection thereby allowing the application to go abandoned. The licensee terminated the license and the university ended up also abandoning a granted Japanese patent as a result of losing the partner. Without US patent rights, the company simply could not make the business case for continuing to commercialize the biomarker. Despite the subject matter being patent-eligible in Japan, the differences in eligibility between the US and Japan meant that all the time and money spent on acquiring the Japanese patent were for naught.

- Meanwhile, another faculty member's entire career has been focused on developing biomarkers for diagnosing cancers. From 2003 – 2016, she submitted 18 invention disclosures directed to various cancer biomarkers and detection methods. Since then, she has only submitted one (on June 28, 2021). Upon review and discussion, her university discovered that the researcher had become very discouraged by the inability to obtain patents for her discoveries and that she only submitted this most recent disclosure hoping to learn that something had changed at the patent office.

- At another major university, scientists invented a new method for detecting graft-versus-host disease (GVHD) involving measurement of biomarkers associated with GVHD for diagnosing, monitoring, and predicting outcome in patients with acute GVHD. GVHD, a leading cause of non-relapse mortality, is a common complication of allogeneic bone marrow transplantation. A company licensed the invention and worked with university scientists for over 18 months, spending significant time and resources, in developing and marketing a test to measure biomarkers associated with acute GVHD. The university and the company filed a patent application on the invention; however, the USPTO is maintaining a rejection based on Section 101. As a result, the university and company will likely abandon the patent application, and the company will no longer have the prospect of enforceable patent rights therefore eliminating widespread distribution of the test.

- At that same university, faculty made discoveries useful for monitoring, diagnosing, and treating age related macular degeneration (AMD), the leading cause of legal blindness in the U.S. The university licensed the related patent rights to a small molecular diagnostic company with a focus on commercializing genetic discoveries in human healthcare, which is offering a reasonably priced personalized genetic test for AMD. Again, the university and the company filed patent applications to cover the discoveries and were able to obtain claims directed to certain methods, but the USPTO

is maintaining a rejection, based on Section 101, of another important application directed to methods of detecting a combination of clinically relevant mutations that can be used in an algorithm to select the correct medical interventions for macular degeneration patients. Once again, the university and company will likely abandon the patent application, and the company will no longer have the prospect of enforceable patent rights therefore eliminating widespread distribution of the test.

Particularly in the area of diagnostics, far too many discoveries are being dismissed by the USPTO out of hand as unpatentable, denying the American taxpayer the full benefits of the research as well as the economic benefit created for companies and their employees prepared to develop these discoveries and technologies.

4. Please explain how your experiences with the application of subject matter eligibility requirements in other jurisdictions, including China, Japan, Korea, and Europe, differ from your experiences in the United States.
5. Please identify instances where you have been denied patent protection for an invention in the United States solely on the basis of patent subject matter ineligibility, but obtained protection for the same invention in a foreign jurisdiction, or vice versa. Please provide specific examples, such as the technology(ies) and jurisdiction(s) involved, and the reason the invention was held ineligible in the United States or other jurisdiction.

The impact of current US patent eligibility jurisprudence as compared to the other leading patent regimes is most stark in the area of computer-implemented inventions, which are often determined to be ineligible abstract ideas in the US. The difference also impacts claims involving methods of diagnosing as they are often determined to be ineligible natural phenomena.

In the last decade, the legal frameworks of the major patent offices (EPO, USPTO, CNIPA, JPO, and KIPO) with respect to computer-implemented inventions have gradually become more aligned. While certain differences in the assessment of computer-implemented inventions between the patent offices still persist, it can be generally said that claims providing a technical solution to a technical problem are patentable throughout the world – if claimed properly and provided that the requirements for patentability (i.e., novelty and nonobviousness/inventive step) are fulfilled.

This closer alignment is particularly true with respect to the US with the advent of the 2019 Revised Patent Subject Matter Eligibility Guidance (PEG) focusing on determining whether a claim is actually "directed to" a judicial exception (an abstract idea, a law of nature, a natural phenomenon) as opposed to just "reciting" a judicial exception. Per step 2A of the *Alice/Mayo* test, a claim determined to be "directed to" and a judicial exception is, for all intents and purposes, doomed.

The PEG sets forth that, if the claim (as a whole) integrates the judicial exception into a practical application, it is not directed to said judicial exception. This change highlights the importance of drafting a background section and detailed description to highlight the applicant's improvement to the underlying technology. Courts often look at these sections for deciphering such improvements, and indeed the PEG itself indicates that the specification should be evaluated for such purposes while also commenting that the improvement should not be set forth in mere conclusory fashion. The PEG also states that if the specification sets forth an improvement in technology, the claim must be evaluated to ensure that the claim itself actually reflects the disclosed improvement.

Further, the PEG affirms that the USPTO is no longer taking the case-comparison approach to determining whether a claim recites a judicial exception and instead uses enumerated groupings of abstract ideas. This change is based on the realization that Article III cases on patent eligibility have become both inconsistent and too numerous to be manageable, and that "the enumerated groupings [of abstract ideas] are firmly rooted in Supreme Court precedent as well as Federal Circuit decisions interpreting that precedent."

As a result of these changes, the PEG offers more simplicity in determining subject matter eligibility and separates that assessment from obviousness or claim breadth considerations. This development is a positive one in and of itself but has the added benefit of moving the US toward the other major patent regimes and, in particular, toward the EPO's approach to eligibility assessment which, once the technical character has been identified, moves to the assessment of inventive step.

The problem we run into in the US, as compared to the other major offices, however, is that the courts here flat out ignore or are downright hostile to the PEG. The Court of Appeals for the Federal Circuit (CAFC), for example, has written on several occasions that the PEG is not the law of eligibility, that it does not carry the force of law, and that the CAFC must follow Supreme Court precedence on eligibility, particularly when the PEG does not align, because Supreme Court precedence has established the law.

Thus, we have a disconnect between the USPTO and the courts. This disconnect contributes to unpredictability in the US caused by the current eligibility jurisprudence. Unfortunately, the unpredictability manifests itself both within the US and without. The impact of the unpredictability when considered in light of the differences between the US and the other leading patent regimes is particularly acute because of the high costs of prosecuting ex-US patent applications.

Consider again the example of a Japanese patent granted in March of 2017 described above. The invention implicates both a computer-implemented invention and a natural phenomenon. Specifically, it involves biomarker signatures and associated methods for identifying patients (i.e., diagnosing) who are not likely to manifest significant coronary artery disease. Based in part on a clinical trial, a set of biomarkers was identified as exhibiting different levels of expression in subjects who did, or did not, require invasive intervention. In addition, an algorithm was developed which, using serum levels of these biomarkers, assigned a score to a given patient that was indicative of whether that patient required invasive intervention.

The application that led to that Japanese patent claimed priority to two US provisional patent applications, one filed in July 2011 and the other filed in December 2012. The corresponding US non-provisional applications were abandoned after insurmountable section 101 rejections. Due to the inability to obtain the US patent rights, the licensee terminated its license, and, due to the lack of a commercialization partner, the Japanese patent was also allowed to go abandoned. So, due to the difference between the US and Japan in what constitutes patent-eligible subject matter, all the time and treasure spent prosecuting the Japanese patent and negotiating the license were for naught, and the product was never further developed and never came to market.

7. Please explain whether the state of patent eligibility jurisprudence in the United States has caused you to change business strategies for protecting your intellectual property (*e.g.*, shifting from patents to trade secrets, or vice versa). If so, please identify the changes and their associated impacts.

The 101 issue presents various challenges to universities and nonprofit institutions in reviewing and assessing invention disclosures and in structuring licensing agreements. It forces technology transfer professionals to dig into the invention disclosure to proactively capture non-patentable components, such as copyrightable works of authorship, know-how, proprietary or confidential data, and research tools.

The non-patentable component approach comes with some challenges in designing licensing transactions. For example, one institution had a situation where the licensee, because of the 101 concerns, chose to license only the non-patentable component, i.e., proprietary data, not the pending U.S. patent rights on a biomarker discovered through analyzing the proprietary data sets. The value of such a license is significantly lower for both the institution and the licensee. Without the exclusivity provided by patent rights, the licensee often ultimately determines that a higher return on its investment dollars is available elsewhere. Thus, the considerable uncertainty created by the current 101 jurisprudence is resulting in lost partnership and development opportunities.

8. Please explain whether you have changed your behavior with regard to filing, purchasing, licensing, selling, or maintaining patent applications and patents in the United States as a result of the current state of patent eligibility jurisprudence in the United States. If so, please describe how you changed your behavior.

Many universities have been very reluctant to file patent applications on biomarker-related technology, because of the uncertainty as to whether it would be subject-matter eligible under the current 101 interpretations. One such school migrated from filing applications on the underlying core technologies to trying to identify additional elements in order to potentially get around the 101 issues; for example, any enrichment or depletion processes (beyond the amplification and detection steps), any treatment component, or any combination of biomarkers with equipment such as a cassette or chip to perform the diagnostics. Unfortunately, the 101 issue often results in a decision not to allocate the limited resources toward patenting and commercialization support.

Similarly, many universities have been very reluctant to file patent applications on computer-implemented inventions. Instead, universities settle for protecting the code that implements the invention by copyright. This approach provides incomplete protection and results in fewer disclosures of computer-implemented inventions and less development in must-win technology areas for the U.S. such as artificial intelligence, quantum computing and disease-prediction algorithms.

10. Please identify how the current state of patent eligibility jurisprudence in the United States impacts the global strength of U.S. intellectual property.

According to a recent Global Innovation Policy Center U.S. Chamber International IP Index[i], the current patent eligibility jurisprudence has weakened the U.S. patent system such that U.S. intellectual property overall is weaker when compared to the rest of the world. A weak IP regime as a result of the uncertainty of patent rights reduces the appeal for private-sector parties to fund the further development of early-stage research. Consequently, weak IP damages partnerships in general, and public-private partnerships in particular. Thus, in a weak IP regime, governments, and other non-industry funders, such as universities, and ultimately, taxpayers, end up paying for a larger fraction of the research, and for later stage research.

A weak IP regime places the U.S. at a disadvantage with respect to recruiting and retaining human capital, and with respect to nurturing the next generation of domestic start-ups.
Weak IP reduces the appeal of the U.S. as a place to invest, and of U.S. intellectual property as an asset worthy of investment. As noted by David Taylor in his survey on patent eligibility and investment, “The survey results reveal investors’ overwhelming belief that patent eligibility is an important consideration in investment decision making, and that reduced patent eligibility makes it less likely their firms will invest in companies developing technology.” [ii]

11. Please identify how the current state of patent eligibility jurisprudence in the United States impacts the U.S. economy as a whole.

Weak IP is an inefficiency machine. Patent uncertainties damage AUTM members’ ability to work with the private sector. It greatly reduces their clout at the bargaining table, including their ability to advocate for their inventors, the technology they develop, and the local start-ups they want to found or join.

Weak IP effectively turns industry-sponsored research into an academic exercise. Frequently, the industry-sponsored research terms provide the sponsor a royalty free non-exclusive license, with no further contractual obligations to develop the new technology. If the new technology is not patentable, publications are typically the only result. On the other hand, industry-sponsored research terms also include the right to negotiate for a royalty-bearing exclusive license to the technology. If the technology is patentable, the exclusivity incentivizes the further development, availability, and distribution of the technology. Thus, when

the meaningful exclusivity provided by patent rights is not available, a collaborative public-private partnership opportunity to develop a new technology is often lost.

BIO and AUTM publish an estimate of the economic impact of AUTM member technology transfer activity. According to the most recent report, released in 2019[iii], over a 22-year period from 1996-2017, public-private partnerships, and the intellectual property and patent licenses associated with such partnerships, contributed, in 2012 dollars, up to $1.7 trillion to US Gross Industrial Output, up to $865 billion to GDP, and supported up to 5.9 million person-years of employment.

AUTM data suggest that our community (academic Technology Transfer and our inventors and our licensees) contributed disproportionately to US GDP growth as a whole over a 21-year period from 1997-2017. U.S. GDP grew, on average, a little over 2% annually between 1997 and 2017. Research intensive industries [iv, v] grew, on average, a little over 4% over the same time period. The sales of new products reported under the AUTM Survey, and captured in the BIO and AUTM report released in 2019, grew on a par with the research-intensive industries.

The fact that the growth *rate*[vi] of the AUTM licensees' modeled contribution to GDP closely tracks (and for selected sectors and time periods may exceed) the growth rate of research-intensive industries' contribution to GDP underscores the importance of new products to GDP.

New product sales add to, replace, and/or prevent a loss of existing revenue streams. Thus, new product development also supports preservation of current productivity, manufacturing and jobs, and as such has a role to play in enhancing U.S. competitiveness.

Unclear patent law places an undue burden on these high growth industries and the public-private partnerships that support and benefit from them.

Entrepreneurially-inclined academics consider technology transfer and entrepreneurship environments when they are choosing a home institution. Some well-known U.S. academics have changed institutions, in part due to the perception that certain environments are more conducive to entrepreneurial activity, or to ensuring the distribution and thus impact of their work. This trend could continue, leading to more international moves in addition to moves with in the U.S., thus depriving the U.S. of talent.

Unclear patent law places an undue burden on talented innovators, who will go where the rules make sense, and investors will meet with them earlier in the inventive and developmental process.

12. Please identify how the current state of subject matter eligibility jurisprudence in the United States impacts the global strength of U.S. intellectual property and the U.S. economy in any of the following areas:

a. Quantum computing;
b. artificial intelligence;
c. precision medicine;
d. diagnostic methods;
e. pharmaceutical treatments; and
f. other computer-related inventions (*e.g.*, software, business methods, computer security, databases and data structures, computer networking, and graphical user interfaces).

These comments are to some degree informed by the remarks[vii] of Laurie Self, Senior Vice President, Qualcomm, to Senators Tillis and Hirono, including the discussion of 101 and 112. In general, uncertainty reduces value, encourages workarounds, and reduces a potential U.S. competitive advantage. Impacts across fields are more pronounced at academic institutions and at smaller and newer companies for the reasons discussed above.

AUTM will not attempt to calculate losses, past, present, and future, due to the particular problems introduced by unclear patent law in the technological areas identified in questions 3 and 12 of the RFI. Instead we discuss the impact on particular groups of technological areas:

b. artificial intelligence and
f. other computer-related inventions

AI inventions risk being found not patent eligible, or later invalidated, under the "abstract idea" exception, even when practical results are obtained, and the process for obtaining the results has been disclosed. On the surface, AI and computer innovators could elect to use other forms of IP protection, such as copyrighted software, or copyrightable elements within data sets.

However, it is relatively easy to design around or rewrite code entirely, particularly for entities with significant resources. Copyright protection may provide a head start, but rarely a sustainable competitive advantage. Know-how can generally be licensed only non-exclusively, consistent with the academic mission of broad dissemination of knowledge. Know-how alone is also unlikely to be a compelling nugget around which a company can be formed or a new product developed.

For-profit entities can opt to use trade secrets, an alternative not available to academic inventors. See AUTM's response to the USPTO request for comments on AI and Innovation[viii]. Innovators in the biological sciences can sometimes use tangible biological materials as technology transfer tools. This option is not available to AI and software innovators.

That said, AI inventors, frustrated by the challenge of interpreting the "abstract" idea exception, are turning to development of proprietary training sets, including seeking corporate funding to develop such training sets. Others leave academia altogether, creating, ironically, a shortage of AI faculty[ix]. One of the suggestions to address this academic brain drain is to encourage faculty and students to launch start-ups. Forming a start-up, however, is made more challenging of by the lack of an identifiable and predictable scope of intellectual property protection.

At present, AI and other computer-implemented inventions play a significant role in virtually every aspect of the U.S. economy. Such inventions impact drug discovery, manufacturing, financial services, materials and sensor engineering, agriculture, and self-driving vehicles, to name a few. The foregoing, and others, are must win-areas in order for the U.S. to maintain its current technological superiority and the commensurate competitive advantage that fuels continued economic growth and a rising standard of living. Finally, given AI's incorporation into military technology and the spectrum of AI-related threats the U.S. is facing, it is also an essential component of U.S. national security.[x]

13. Please identify how the current state of patent eligibility jurisprudence in the United States affects the public. For example, does the jurisprudence affect, either positively or negatively, the availability, effectiveness, or cost of personalized medicine, diagnostics, pharmaceutical treatments, software, or computer-implemented inventions?

When patent eligibility issues become unmanageable, the American economy suffers. When ideas are left behind, we all end up having fewer new or improved products and services coming to the marketplace. There are economic harms (reduced economic growth, fewer high-paying jobs, reduced standard of living, tax money squandered, etc.), length and quality of life is harmed, and national security can be diminished as well. At a time when we are fighting China and numerous other nations for economic wealth and opportunities, we simply cannot afford to have Section 101 issues impede our economic engine.

In just the last few years, the CAFC has held that patents claiming electric vehicle charging stations, cell phone cameras, medical diagnostic technologies, and methods of manufacturing drive shafts are

unpatentable abstract ideas or laws of nature. These are all important discoveries that could have significant positive economic, health and other impacts on Americans.

Although patents only issue after difficult scientific or engineering work, they are not principally a reward for that work. By definition, patents are granted only for products or inventions that have no current market: products or inventions whose value is largely speculative. That is not much of a reward. Only after they have obtained patent rights do the thousands of start-up companies incubated by America's universities face the task—and the risks—of building a market for their technology. They will incur those risks only if they can do so profitably.

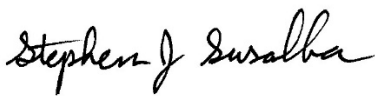
Rather than being a reward for hard work, therefore, patents make it more likely that the future work of building a marketable product around a patented invention will be rewarded. Only such improved odds can attract the capital investment from others necessary to turn academic research into new products and services with tangible benefits for the public whose tax dollars have supported the early-stage research that laid the foundation for them.

Many of those opposed to patent eligibility reform oppose it because they believe that USPTO issues too many patents that should not have issued for other reasons, such as obviousness. Section 101, on this view, provides an additional tool for eliminating such patents. Certainly, some patents found to be patent ineligible are also invalid on other grounds. But the reverse is also true. New and useful inventions are often held patent ineligible. The indiscriminate way in which patent eligibility law is currently applied lumps the good with the bad and casts a pall of uncertainty over whatever remains. Here again, uncertainty deprives the American people of amazing new technologies that could improve our economy and our health care as well.

Finally, it is worth considering one of the most important inventions ever to come from an American university. The invention is described and claimed in U.S. Patent No. 6,285,999. The patent issued to a Stanford University graduate student in 2001, well before the current patent eligibility jurisprudence took hold. Today, however, its claims to a revolutionary search algorithm would almost certainly be ruled an unpatentable abstract idea. Needless to say, Google, the company largely built on that patent, grew and thrived in a much different environment than university inventors do today. Google changed the world.

We urge USPTO and Congress to reform Section 101 so that today's inventors can do the same.

Sincerely,



Stephen Susalka
Chief Executive Officer, AUTM

About AUTM
AUTM is the non-profit 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 is comprised of about 3,000 members who work in more than 800 universities, research centers, hospitals, businesses and government organizations around the globe.

ENDNOTES

[i] https://www.theglobalipcenter.com/wp-content/uploads/2018/02/GIPC_IP_Index_2018.pdf

[ii]Taylor, David O., Patent Eligibility and Investment (February 24, 2019). 41 Cardozo Law Review 2019 (2020), SMU Dedman School of Law Legal Studies Research Paper No. 414, Available at SSRN: https://ssrn.com/abstract=3340937 or http://dx.doi.org/10.2139/ssrn.3340937

[iii] Pressman, Lori and Planting, Mark A. and Bond, Jennifer and Yuskavage, Robert and Moylan, Carol E., The Economic Contribution of University/Nonprofit Inventions in the United States: 1996 – 2017 (June 2, 2019). https://autm.net/AUTM/media/About-Tech-Transfer/Documents/Economic_Contribution_Report_BIO_AUTM_JUN2019_web.pdf

[iv] Carol A. Robbins and Carol E. Moylan, 2007, "Research and Development Satellite Account Update: Estimates for 1959–2004, New Estimates for Industry, Regional, and International Accounts," Survey of Current Business 87 (October): 49–92. https://apps.bea.gov/scb/pdf/2007/10%20October/1007_rd_text.pdf

[v] Wendy C. Y. Li and Bronwyn Hall, 2018, "Depreciation of Business R&D Capital," *Review of Income and Wealth*, DOI: 10.1111/roiw.12380, https://onlinelibrary.wiley.com/doi/10.1111/roiw.12380.

[vi] The absolute contribution of products reported under the AUTM survey to U.S. GDP as a whole is of course small, on the order of a few tenths of a percent. For context, the modeled contribution of such products to GDP in 2017 was $43.5 billion in 2012 dollars, while U.S. GDP as a whole in 2017 was $18.1 trillion in 2012 dollars. For context, the seven research intensive industries used in the 2019 BIO/AUTM report, alone, contributed about 13% to U.S. GDP as a whole in 2017. See especially figure 4 of the 2019 report (ft 3 above), and table S-7.

[vii] https://www.judiciary.senate.gov/imo/media/doc/Self%20Testimony.pdf and https://www.judiciary.senate.gov/imo/media/doc/Self%20Responses%20to%20Questions%20for%20the%20Record.pdf

[viii] AUTM's Comments on Intellectual Property Protections for Artificial Intelligence Innovation (Docket No. PTO-C-2019-0038) https://autm.net/AUTM/media/About-Tech-Transfer/Documents/AUTM-Comments-on-Intellectual-Property-Protections-for-Artificial-Intelligence-Innovations_1-10-20.pdf

[ix] https://www.insidehighered.com/views/2019/11/20/how-stop-brain-drain-artificial-intelligence-experts-out-academia-opinion

[x] https://www.nscai.gov/wp-content/uploads/2021/03/Full-Report-Digital-1.pdf