Remarks of Dr. Ashley J. Stevens

I’m going to use the bulk of my time on the title of this series of meetings – Return on Investment. Along the way I’ll identify the biggest issue I see facing technology transfer and make a recommendation.

I’ve been working on economic impact of technology transfer since 1992, so summarizing my thoughts in 3 minutes is going to be very difficult. But I’ll try.

First, what is the government’s investment in technology transfer?

Well, you could look at the AUTM Survey, see $39.9 billion in federal research funding in 2016, $4.9 billion in industrial funding and $23 billion in all other funding and say “Universities spent $66.9 billion on research in 2016.”

However, the overwhelming majority of these investments, and especially the Federal piece, were not made with the objective of creating new technologies. They were to increase the nation’s scientific base and to train the next generation of scientists, the grad students and postdocs who actually do most of the work. Very few federal grant programs include even commercial prospects as a review criterion. CTSA grants do, as do SBIR’s and STTR’s, but that’s about it, and the latter two are primarily targeted at companies. I consider the lack of a reliable source of significant federal funding of translational research to be the biggest systemic issue for technology transfer in the US and I recently submitted a proposal to Director Copan for a $100 million annual program that I called Alexander Graham Bell grants to fund translational research at universities specifically intended to lead to commercialization.

In fact, you could make the argument that the actual investment in technology transfer is the $407 million that universities – universities, mind you, not the Government – spend on converting scientific results into intellectual property that can be licensed and developed by companies. And we get $180 million of that reimbursed by licensees.

And what is the return on that investment? You can certainly look at license income. In 2016 it was $2.6 billion after you eliminate double counting. That’s just a 3.8% return on the $66.9 billion and an accountant would say: “Miserable. Shut it down. Put the money in Savings Bonds.”

On the other hand that $2.5 billion is 1,130% of the net investment of $266 million in getting patents – rather better I think you’d agree.

Most academic licenses are not big money makers. Out of 43,000 active licenses in 2016, 20,000 were generating some sort of income and almost 11,000 of those were generating running royalties on a marketed product. Of these, just 217 generated over $1 million. That’s why 52% of all US TTO’s in 2006 lost money – they spent more than they generated – and only 16% kept enough of their income after distributions to inventors and grants for research to cover their operating costs.

But just like the government is looking for a scientific return, not a financial return, on the bulk of its investment in science, I believe that we should be looking beyond the financial return on research to a social return. This is how the UK now looks at all of its investments in academic research, and Australia is moving to this approach too.

Look at the Internet, probably the greatest contribution of academia to society since Alexander Graham Bell, a Professor of Vocal Physiology and Elocution at Boston University, invented the telephone. After a massive investment by ARPA and then NSF on the infrastructure of the Internet — the tubes and pipes – it was public sector researchers that made the internet useful for the common man. CERN in Geneva invented the World Wide Web and gave it away free, while the University of Illinois Urbana-Champaign invented the two tools that billions of people use every day – the first web browser, Mosaic, which became Microsoft’s Internet Explorer, and Eudora, the first email program that could attach documents. UIUC made a total of $8 or 10 million from these inventions, arguably a major financial failure, but what a contribution to society.

And yes, Stanford made a respectable $355 million + from Google, but in just 20 years Google has become the second most valuable company in the US, and has created over 80,000 jobs with a median salary of over $197,000. The social return of Google vastly outweighs Stanford’s financial return.

The time limit doesn’t allow me to talk about the return of academic research in healthcare, in the discovery of new drugs and new medical devices but again these sectors depend very heavily on academic research.

The last point I want to make is that the major return from the transfer of academic technologies comes not to the universities – if we’re lucky we’ll get a 2% or 3% royalty on product sales or own maybe 1 or 2% of a start-up company when it goes public or gets acquired – meaning that 97-99% of the economic return is in the private sector. And that’s where it belongs, because it takes massive amounts of private investment to turn embryonic, untested, unproven academic technologies into marketable products that people will buy. As Edison once said: “Genius is 1% inspiration and 99% perspiration” – in other words 1% research, which universities do, and 99% development, which they don’t.

That said, the government will get its return on its research investment via taxation on the increased wealth that those private companies and entrepreneurs generate.

Thank you for your time.

Ashley J. Stevens, D.Phil (Oxon)  
 President



70 Yale Street

Winchester, MA 01890

Phone: (781) 721-2670

Cell: (617) 251-6088

email: astevens@fipgllc.com

TO: Dr. Walter G. Copan

FROM: Ashley J. Stevens

SUBJECT: Proposal to Create the Alexander Graham Bell Grants – a Program of Translational Research Funding for U.S. Universities

DATE: April 23, 2018

Summary

This recommends a program to fill a gap in the U.S. government’s funding of research at universities, teaching hospitals and non-profit research institutes. The core mechanism for awarding grants for basic research to these institutions results in a dearth of funds to enable these institutions to perform translational research to de-risk the inventions they make in the course of basic, curiosity-driven research and make them more attractive to commercialization partners. The major programs that currently exist to support translational research – the SBIR and STTR programs – require that the technology be sufficiently mature to have already attracted a corporate partner.

I propose building on the results of philanthropically-funded pilot programs that have been both highly successful and cost-effective in preparing technologies for transfer. The sums of money involved are relatively modest, but equally as critical to success as the new funding are program management principles developed by these philanthropies that are very different from the management principles appropriate for basic research programs.

I propose a translational research grant program that would award $1 million annually to 100 institutions meeting specified research volume and co-funding criteria. The program would result, each year, in around 450 inventions being developed, over 140 start-up companies being formed and over $650 million in private capital being invested in these companies for further development of the technologies after their federal funding ceases.

I have proposed calling the program the “Alexander Graham Bell Grants”. Bell was a Professor of Elocution and Vocal Physiology[[1]](#footnote-1) at Boston University when he conceived of the telephone and struggled to obtain the resources to reduce his idea to practice. He requested, and received, a leave of absence to perfect his invention and asked his Dean at BU to pay his next year’s salary in advance, which Monroe did.[[2]](#footnote-2) He and Thomas Watson then had to give up a half interest in the Bell Telephone Company to the fathers of two of the deaf students Bell taught to speak, his patent attorney (and future father-in-law) Gardiner Hubbard and Thomas Sanders, George’s father and a wealthy entrepreneur in the leather industry, in what was a classic friends and family (in Bell’s case, a soon-to-be-family) seed round funding to start the company.[[3]](#footnote-3)

# Background:

U.S. universities, teaching hospitals and non-profit research institutes (collectively and, for convenience only, referred to herein as “universities”) spent $66.9 billion on research in 2016.[[4]](#footnote-4) Of this, $38.9 billion was provided by the Federal government, $4.9 billion came from industry and $23.1 billion from other sources (state, philanthropic, institutional, etc.)

The Federal funding is supplied under a number of funding mechanisms, predominantly the R01 mechanism, and, generally speaking, is awarded based on peer review groups’ assessment of the scientific merits and novelty of the project. These grants are intended to increase the scientific knowledge base of the nation and the world and to train the next generation of researchers, the graduate students and post-doctoral fellows who perform the bulk of the scientific research. Peer review is a mechanism for funding basic research, not for funding development, and grant proposals seeking funding to reduce earlier discoveries to practice – manufacturing process development and scale up, testing in higher animal models, toxicological testing, clinical testing, etc., will not be deemed scientifically innovative and will not be funded.

A small amount of Federal funding to universities is provided to develop new products and services based on the results of earlier research. Those funding sources are:

* The university share of STTR grants, of which between 30% and 60% of the work must be carried out by a university;
* Any subcontracts entered into by small businesses receiving SBIR awards, which may, but are not required to, subcontract up to 50% of the work to a university;
* NIH Clinical and Translational Research Centers (CTSA);
* NIH Centers for Accelerated Innovations; and
* NIH Research Evaluation and Commercialization Hubs.

The problem with the first two of these is that the technology must already have been transferred to a company – i.e., it must be sufficiently well developed to be able to attract a corporate partner. This frequently results in a “chicken-and-an-egg” situation in which the technology is insufficiently de-risked to be able to attract a corporate partner, so it is unable to secure the funding to de-risk it. The problem with the other three is that they are limited to life sciences inventions and are not available to the enormous range of non-life sciences research and innovations at universities.

Accordingly, there are no dedicated sources of federal funds available to universities to start to reduce the high technical risk and high market risk in embryonic academic inventions. This gives rise to what is variously termed the “Valley of Death” or more simply the “Gap”.

In the absence of federal funding, some states have established translational research programs:

* The New York Centers of Excellence Program;
* The Edison Program in Ohio;
* The Ben Franklin Program in Pennsylvania.

The Department of Commerce’s U.S. Economic Development Agency provides funds to universities to offer their technical capabilities to local companies through the University Center Economic Development Program, demonstrating that the government understands and accepts that universities are capable and have the facilities needed to participate in product development as well as basic research.[[5]](#footnote-5)

# Federal Labs Development of Their Inventions Compared with Universities

Federal laboratories receive line item appropriations, rather than having to apply for grant funding on a project-by-project basis the way universities do. This gives federal laboratories flexibility in the projects they fund and allows them to carry their successful projects further down the road towards commercialization than universities can do. In other words, the “Gap” can be smaller for federal laboratories than for universities.

This was illustrated in a paper analyzing the winners of the *R&D Magazine* annual R&D 100 awards over a near fifty year period.[[6]](#footnote-6) In the early 1970’s, the winners were overwhelmingly large corporations. Over the next thirty years, the number of winners transitioned progressively to the non-profit sector. However, by 2006, federal laboratories and their collaborators won five times more awards than universities. Even when university spin-offs were combined with universities, federal labs still won more than twice as many awards.

# Government Support of Technology Transfer Outside the U.S.

The 1980 Bayh-Dole Act allowed universities to own inventions which were made with federal funding – previously, the federal government owned them and the National Technical Information Service normally had the responsibility for licensing them. Bayh-Dole provided no financial support for technology transfer, and universities have had to fund those activities themselves. By the broadest measure of profitability, just over half of them lose money on their technology transfer efforts, while by the narrowest measure of profitability, nearly 84% lose money.[[7]](#footnote-7) Universities generally pursue technology transfer for reasons other than financial returns, but nonetheless there is a limit to the amount of money they are prepared to lose.[[8]](#footnote-8)

Very few universities outside the U.S. have the financial resources of U.S. universities, and some foreign governments have provided financial support to their universities for technology transfer:

* The Danish, Japanese and Norwegian governments provided financial support for technology transfer for 10 years after Bayh-Dole-like reforms were instituted in their countries;
* The UK government provided financial support for technology transfer from 2001 as part of its broader program to support knowledge-based interactions between universities and the wider world which result in economic and social benefit because it realized that universities were not prioritizing and investing sufficiently in technology transfer.  Today, the UK government provides some £230 million annually through the Higher Education Innovation Fund (HEIF) program to support knowledge exchange (commercialization and broader engagements) at English universities, with a further £13.5 million p.a. million provided through the University Innovation Fund to Scottish Universities. The UK government, through its Funding Councils, requires universities to assess the impact of their research on society;[[9]](#footnote-9)
* In 2012, the French Government initiated a 10-year, €1 billion (i.e., €100 million per year) program to create 14 regional SATT’s (Société d’Accélération du Transfert de Technologies).[[10]](#footnote-10) The primary use of the funds is for translational research.
* Science recently reported on a current European Research Council program that had started adding Proof of Concept funding of €150,000, (about 7-10% of typical basic research grants of €1.5–2.5 million), to basic scientific research grants to promote commercialization.[[11]](#footnote-11) The ERC found that forty-two percent of the PoC recipients reported filing at least one patent application, compared with only seventeen percent of a control group who had unsuccessfully applied for PoC funding. Twenty percent of respondents said their project led to the creation of a company, compared with six percent in a control group. For example, a PoC grantee raised €1 million in private seed funding and created a company that develops supermirror coatings for ultraprecise laser measurements. In all, the ERC has provided about 800 PoC grants, totaling 1% of its budget.

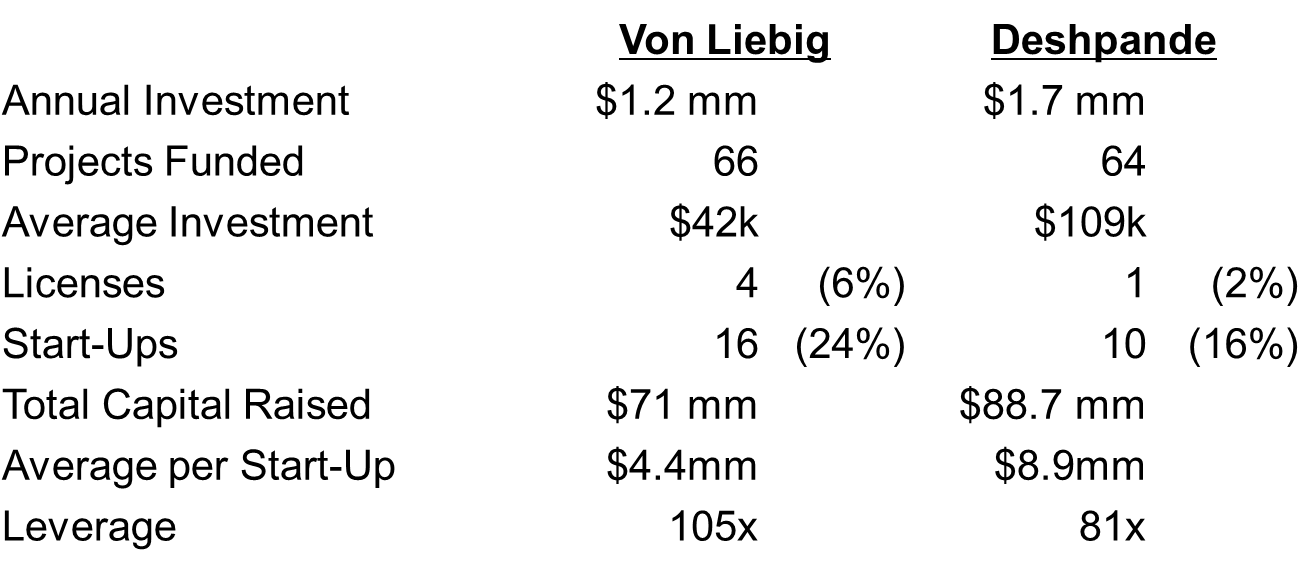
# Philanthropic Funding Sources

In the absence of broad-based federal funding of translational research, some institutions have been able to secure translational research funding from philanthropic sources. Some individual institutional programs include:

* The Deshpande Center at MIT;
* The von Liebig Center at the University of California San Diego; and
* The Stevens Center at the University of Southern California.

The Kauffman Foundation analyzed the effectiveness of the Deshpande and von Liebig programs and found that (a) they were efficient generators of new start-ups, and (b) the start-ups subsequently raised multiples of the funding provided by the Centers from private sources [[12]](#footnote-12)

Table 1: Results of von Liebig and Deshpande Centers

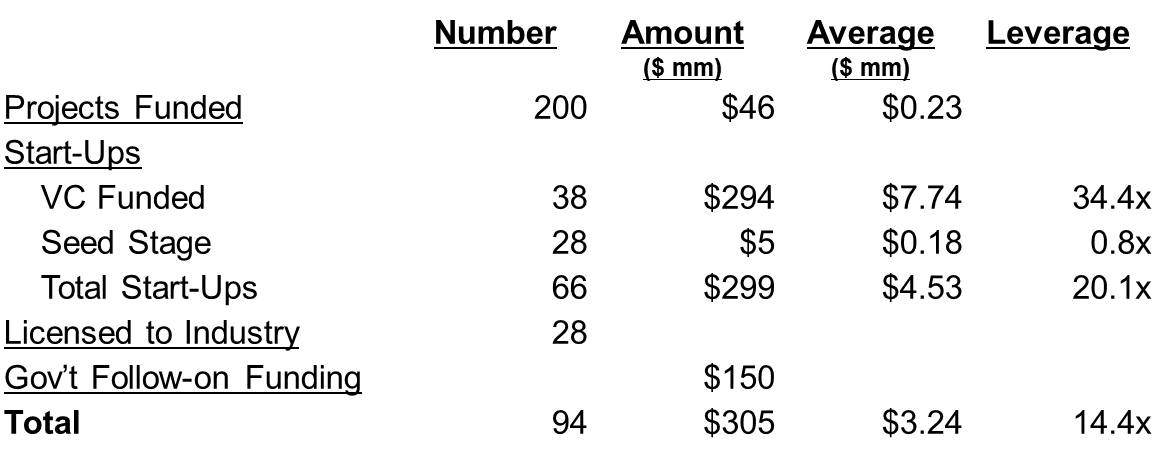


The Wallace H. Coulter Foundation launched its Coulter Translational Research Partnership Award in Biomedical Engineering in 2005 after a national competition of all 85 U.S. universities with biomedical engineering programs. The initial cohort of 10 awardees received $1,000,000 per year for 5 years. The initial awardees were:

* Boston University
* Case Western Reserve University
* Drexel University
* Duke University
* Georgia Institute of Technology / Emory University[[13]](#footnote-13)
* Stanford University
* University of Michigan
* University of Virginia
* University of Washington
* University of Wisconsin

The results of the program[[14]](#footnote-14) were similar to those of the Deshpande and von Liebig Centers in terms of funding leverage from the private sector and in generating start-ups. However, whereas the licensing success rate[[15]](#footnote-15) (“LSR”) of the Deshpande and von Liebig Centers was not substantially higher than the 25-30% rate of university technology transfer programs overall,[[16]](#footnote-16) the Coulter program achieved an LSR of 47%.

Table 2: Results of Coulter Foundation Translational Research Partnership Awards First Cohort



Coulter launched a second cohort in 2012 which has 6 awardees:

* Columbia University
* Johns Hopkins University
* University of Louisville
* University of Missouri
* University of Pittsburgh
* University of Southern California

The conclusions from the analyses of these three programs are that translational research funding programs are;

1. Relatively low cost, with funding amounts of from $40,000 to $200,000 per project, with the larger amounts being staged, with follow-on amounts being awarded following initial technical success;
2. Tend to result in new start-up companies to develop the technology to the next stage.
3. Leverage the translational funding amount by subsequently generating substantial amounts of private investment;

# Critical Success Factors of the Coulter Program

Boston University was in the first cohort of Coulter grants, and I was part of the management team of the program. The elements I observed that made the program successful were:

## Management Committee

Each program was run by a Management Committee. The Committee had members from the university – typically the Dean of Engineering, the Chair of Biomedical Engineering, the Director of Technology Transfer and the Director of Entrepreneurship – but it was a requirement that they be outnumbered by people from the local innovation ecosystem – venture capitalists, angel investors, device industry technology scouts, patent lawyers, corporate lawyers, entrepreneurs, etc. The Coulter Foundation had one representative on the Committee.

The external members of the Management Committee were not compensated and provided their time and expertise as a contribution to the local innovation ecosystem.

The Management Committee:

* Reviews project proposals and selects those that will be funded;
* Reviews progress quarterly;
* Advises on commercialization;
* Decides whether to continue or curtail funding; and
* Decides on follow-on funding.

In other words, the university gives up control of awarding the funding to a committee drawn from the local innovation ecosystem.

## Co-PI’s

Each project must have co-PI’s:

* A basic scientist or engineer; and
* A clinician from the specialty that will use the proposed device.

Either PI could initiate the project. If the clinician identifies the need, the scientist or engineer identifies the technical solution. If the scientist or engineer identifies the proposed device, the clinician ensures that the need is real and that the proposed solution will be compatible with current clinical practice.

The Coulter program was specific to biomedical devices, and the co-PI was a physician at an Academic Medical Center. In areas outside of life sciences, where there may not be suitable academic scientists who work in the field of application of the technology, a corporate scientist could fill this role. Indeed, having a corporate collaborator committed should probably be considered a positive in the project evaluation process.

## Strong Administrative Support

Translational research programs need strong administrative support. Each program was required to have a Program Director (who could be part time) but who had medical device industry experience. There was also a full time Program Manager who received and distributed proposals for review, coordinated meetings, managed budgets, ensured reports were timely filed, distributed and reviewed, etc.

## Existing IP

The proposed technology had to be the subject of an invention disclosure and, preferably, an existing patent filing. BU’s experience was that about 2/3rd of the project proposals submitted were already well known to the TTO, while 1/3rd of proposals were new and an invention disclosure was submitted to meet the prerequisite.

## Project Evaluation

A review of the invention disclosure had to have been carried out by the TTO. The protocol of the First Look Technology Assessment which provides an ideal format for such an assessment, is attached.

## All Necessary Inventions and Discoveries Have Already Been Made

The grants are strictly for translational research. All basic research, discoveries and inventions must already have been completed. Any proposals that requested funding for any basic discoveries were rejected and told to reapply when the remaining basic science had been completed.

## Active Project Management

Typical academic grants for basic, curiosity-driven research are awarded for 3 or more years with only an annual progress review being required. Translational research projects, by contrast, need active project management, including Gant charts identifying monthly and quarterly milestones, with progress against achievement of those milestones being reported on and monitored quarterly by the Management Committee. Projects whose timing slipped would receive a warning and would be terminated if they continued to fall behind schedule (or if the science didn’t work out, of course).

## Follow-On Funding

Coulter funding could only be the first step in the development pathway for any given technology, and a key criterion in the evaluation of projects was the PI’s plans for securing follow-on funding and the viability / credibility of those plans. Funding sources could be SBIR / STTR, venture funding, institutional funding, state funding, corporate funding etc. Whatever source of funding was proposed would need to have evidence that it was credible – e.g., a conditional expression of interest from a potential corporate partner or investor (“If you are able to demonstrate XXX level of performance, we will provide $YYY for the next stage of development in return for an option to license the technology.”)

# The Alexander Graham Bell Grant Program

All of the features of the Coulter program identified above will be included in the Alexander Graham Bell Grant program.

1. Each award will be for an initial term of 5 years and will provide $1,000,000 million per year to the awardee, inclusive of IDC. An individual project could receive no more than $100,000 per year and could be funded for no more than two years.
2. Institutions which wish to apply must agree to fund, out of institutional resources:

* A 50% FTE program director, and
* A 100% FTE program manager.

1. Applicants must have research programs which spend $400 million or more on research annually (inclusive of IDC). Large state and private universities with multiple campuses which each spend over $400 million on research (e.g., the University of California, University of Illinois, Johns Hopkins University, etc.) would be permitted to submit an application for each campus.
2. Institutions which conduct less than $400 million of research annually may form an alliance with one or more other institutions such that the alliance members in total perform $400 million or more of research annually and submit a joint proposal. In this case, the alliance will create its own management committee to manage the program, and the members of the alliance collectively will occupy fewer than half the seats on the management committee. An alliance management agreement must be signed by all the partners which identifies the 1.5 FTE individuals who will carry out the administrative functions required under the program and how their funding will be supplied.
3. The membership of the Management Committee would be included in the grant proposal, and the quality of its membership would be a factor in the evaluation of proposals.
4. Recipients of awards under the program must agree to track the outcomes of all projects funded under the program for 10 years after the end of funding, and report to NIST:

* If and when the technology is licensed;
* If it is licensed, whether the licensee is a:
  + Large company (>500 employees at the time the license is issued);
  + Small company (<500 employees at the time the license is issued); or
  + Start-up company (a newly established company formed specifically to develop the licensed technology);
* If the licensee is a large or small company, the estimated annual investment it makes in developing the technology;
* If the licensee is a start-up company, the investment capital it raises each year;
* When a product is launched which results from the project and is royalty bearing under the license;
* Annual sales of the royalty bearing products.

1. License agreements must include the obligations of the licensee to report the information identified above, which are somewhat broader than normal academic license reporting requirements.

# Implementation

The program I am recommending would invest $100 million annually via 100 grants of $1 million each. This would enable translational research investments in the inventions flowing from more than $40 billion of basic research (100 x $400+ million per program), or roughly 60% of all the research carried out at U.S. universities, teaching hospitals and research institutes.

I recommend that this program be implemented via a new program funded by the Department of Commerce and administered by NIST.

This structure is appropriate because this is a program designed for commercialization, not to increase basic scientific knowledge and it builds on the Bayh-Dole Act, of which NIST is the overseer.

This structure would have two important consequences:

1. The grants could be applied to fund projects based on any and all technologies. If the program were funded by traditional granting agencies, it is hard to see how this could be achieved. Would DoE make a grant to a university without specifying it be spent on energy related projects?
2. It would bring new money into the system. If the program were funded through traditional granting agencies, the mechanism would most likely be through a set-aside, which would likely result in opposition from constituencies that saw the funding available to them decreasing.

The precedent for substantial NIST funding of technology commercialization exists with the Advanced Technology Program. This program awarded more than $100 million annually between 1995 and 2007. The ATP program was controversial in part because it involved government funding large companies and in “picking winners”. The Alexander Graham Bell Grants would avoid these issues by being more in line with traditional federal research funding mechanisms, with the funding going to universities and leading to the creation of small companies.

# Potential Return on Federal Investment

Assuming the programs achieve comparable results to those found in the Coulter program, this would result in, annually:

* Around 450 inventions being developed;
* Over 140 start-up companies being formed; and
* Over $650 million in private capital being invested to continue development after federal funding of the project ceased.

The $100 million in annual funding would represent an increase of 0.26% in total federal funding to universities

1. What we would today call “Speech Pathology”. Bell’s father and grandfather were both also speech pathologists. [↑](#footnote-ref-1)
2. BU received no reward for having provided this funding – it was close to another hundred years till universities starting claiming ownership of their professors’ inventions. In fairness to Bell, he supplied all the equipment and his only use of BU facilities was carrying out his initial experiments in his BU room. He quickly transferred his work to the lab he built in the basement of the Salem home of the grandmother of one of the deaf children he treated, George Sanders. [↑](#footnote-ref-2)
3. “Bell: Alexander Graham Bell and the Conquest of Solitude”, R.V. Bruce, Cornell University Press, 1973 [↑](#footnote-ref-3)
4. AUTM Annual Licensing Activity Survey, 2016 [↑](#footnote-ref-4)
5. <https://www.eda.gov/news/press-releases/2017/08/29/university-centers.htm>, visited 4/3/18 [↑](#footnote-ref-5)
6. “Where do innovations come from? Transformations in the US economy, “, 1970–2006, F. Block and M.R. Keller, Socio-Economic Review (2009) 1–25 doi:10.1093/ser/mwp013 [↑](#footnote-ref-6)
7. “How US Academic Licensing Offices are Tasked and Motivated – Is it all about the money?”, I. Abrams, G. Leung and A.J. Stevens, Research Management Review, 17.1, Fall/Winter 2009; [↑](#footnote-ref-7)
8. ibid [↑](#footnote-ref-8)
9. <http://www.hefce.ac.uk/> ; the work of HEFCE has been taken over by U.K. Research and Innovation <https://www.ukri.org/> [↑](#footnote-ref-9)
10. <https://www.satt.fr/en/> [↑](#footnote-ref-10)
11. Science 359 Issue 6383 p. 1445, March 30 2018; the item was a small news item and didn’t identify an author. [↑](#footnote-ref-11)
12. “Proof of Concept Centers: Accelerating the Commercialization of University Innovation”, C.A. Gulbranson, D. B. Audretsch, Kauffman Foundation, January 2008, available at <https://www.kauffman.org/what-we-do/research/2008/01/proof-of-concept-centers> [↑](#footnote-ref-12)
13. Emory and Georgia Tech have a joint biomedical engineering program; Emory has a medical school and Georgia Tech is an engineering powerhouse. [↑](#footnote-ref-13)
14. Elias Caro, Coulter Foundation, personal communication [↑](#footnote-ref-14)
15. The percentage of inventions licensed [↑](#footnote-ref-15)
16. “Technology Transfer’s Twenty Five Percent Rule”, Ashley J. Stevens and Kosuke Kato, Journal of the Licensing Executives Society (Les Nouvelles) XLVIII #1, 44-51, March 2013; [↑](#footnote-ref-16)