

Delivering beneficial impacts in Assistive Technology: Improving government's approach to innovation.

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Abstract. Society typically relies on the industrial sector to supply product and service innovations through the free market system. In some areas of free market failure deemed important to society – such as Assistive Technology -- governments intervene by applying alternative innovation systems. This paper contends that governments consistently and inappropriately support an exploratory grant approach led by academia which generates knowledge in conceptual and prototype states, and instead should shift to a procurement contract approach led by industry which designs, tests and deploys commercial products and services.

Keywords. Assistive Technology, science, technology, innovation, invention, government, industry, academia, market failure, procurement contract, exploratory grant, policy, practice.

1. The Business of Innovation is Business

The term 'innovation' has infiltrated common language to mean everything from a new to the world nano-material such as graphene, to a handy new smart phone application for completing a routine task. The government and academic sectors had already embraced the term to represent all outputs from scientific research in the form of conceptual discoveries, as well as all outputs from engineering development in the form of prototype inventions. The term's appeal stems from its ability to attract investment capital based on the promise that innovations return a profit on that investment.

A large gap exists between the outputs from science or engineering projects, and the profitable commercial outcomes from industrial production. This gap is called the 'valley of death' because so few R&D outputs manage to cross it. Those working in the public and non-profit sector who are not conversant in business practices, don't

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realize that most outputs fail because they don't meet the requirements of industry or don't address an important socio-economic issue.

Instead, government agencies and academic universities persist in identifying innovation as the key solution to all critical problems, and position themselves as the source of such innovations. All they ask is a continued investment of public funding with no established metrics of accountability. This approach has not demonstrated evidence of success, particularly in niche markets where it is easy to identify and trace the origins of innovations introduced into the marketplace.

The field of Assistive Technology is one such niche market, where most beneficial device and service innovations can be traced back to the internal efforts of AT corporations. There is little evidence that government-sponsored programs in the United States or the European Union, have generated technology-based or clinical-based outputs that have successfully transitioned into products or services in the AT marketplace. But those circumstances may soon change for the better.

After decades of refinement, the European Union settled on a definition for the term 'innovation' [1], and the United States eventually adopted the same definition [2]. This shared definition is an important refinement because it restricts use of the term innovation to the context of products and related activities within the industrial sector:

“An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices . . .”

Based on this business-oriented definition, any government-sponsored programs that exist for the explicit purpose of generating beneficial socio-economic outcomes through innovation should be restructuring their programs to solicit R&D proposals from industry rather than from academia. But that is unlikely to happen because the historical evidence shows a government bias towards funding scholarship rather than practical outcomes.

Public government agencies and non-profit universities depend on a continuous flow of funding from revenues collected through taxation, while for-profit corporations depend on revenues from the sales of products and services. Government agencies and universities fear that by allocating some of the available public funding towards the private sector, there will be less funding available to them.

This fear is exaggerated because the industrial sector does not operate in isolation. It draws inspiration and support from government and academic sectors. Corporate demands for efficiency necessitate external expertise in methodologies (i.e., scientific research; engineering development), secure financial investment, and verify the presence of market conditions necessary to sustain a competitive business model [3]. Corporations are more than willing to pay the cost of accessing the knowledge held by university faculty and graduate students that is relevant to on-going R&D projects.

The historical precedents for industry-based innovation typically represent business opportunities arising under the free market system, where companies can foresee a return on their investment. However, there are also instances of “market failures” where the private sector cannot make a compelling business case due to insufficient capacity to address the scale of the enterprise (e.g., military weapons; space exploration), or insufficient financial return on the required investment (e.g., fundamental scientific research; orphan drug development).

When governments view instances of market failure as critical to national interests they can choose to intervene through one of two alternative innovation systems:

- 1) Contractual Procurement System – A government agency sponsors the necessary R&D and specifies both the outputs to be generated and the performance parameters to be achieved. The contracting organization – typically an industrial corporation -- is chiefly concerned with delivering a product or service that meets the government’s specified performance criteria within the corporation’s time and cost parameters. The Contract Procurement system supports relevant engineering development and industrial production activity, to achieve a pre-determined advance in the state of the practice to serve a national need. The sponsoring government agency

often serves as both the R&D sponsor at the front-end (input) while serving as the primary customer for the project's deliverables (output).

2) Exploratory Grant System - A government agency sponsors the necessary R&D but the funding recipient – typically a university faculty member – determines the output to be generated by proposing a scope of work. A peer-review process involving other scholars determines the general merit of the area of conceptual knowledge to be advanced, while the government agency focuses on the quality and rigor of the activity conducted. The Exploratory Grant system typically scientific research intended to advance the state of global knowledge. The sponsoring agency provides the front-end resources (input), but the academic community is viewed as the customer for the project's deliverables (outputs), which are typically embodied in scholarly publications.

These two alternative innovation systems can deliver the intended impacts for society when they are properly aligned to the intended mission. That is to say, problems requiring the delivery of products and services should implement the Procurement Contract system, while problems requiring the delivery of new conceptual discoveries should implement the Exploratory Grant system. This paper argues that governments consistently and mistakenly apply the exploratory grant system when intending to address the needs of people with disabilities and the elderly through Assistive Technology devices and services.

2. Innovation in Assistive Technology Devices and Services

The field of Assistive Technology (AT) is a clear case in point for four reasons: (1) As a small market it is easy to identify the organizations, actors, actions and resources that influence the state of technological innovation; (2) As a relatively new technology field one can see the relative contributions or constraints arising from the various economic sectors involved; (3) Lacking the private market forces of scale and profit, the AT field is a free market failure; (4) Most importantly, decades of government investment in the Exploratory Grant system have failed to produce much evidence of outcomes with the promised beneficial socio-economic impacts.

The United States' National Institute on Disability and Rehabilitative Research has expended between \$25 million and \$50 million per year since 1974 on technology-oriented programs intending to improve AT devices and services. Similarly, the European Union's Framework Programmes have allocated several million dollars per year since 1984. Both the U.S. and the E.U. have consistently devoted the majority of resources to Exploratory Grant systems led by academic faculty within universities.

All told, multiple nations have channeled hundreds of millions of dollars into university coffers for the expressed purpose of generating new or improved AT products and services to improve the quality of life for persons with disabilities and older persons. A retrospective study of the most prestigious university-based R&D programs in the United States showed that many of their funded projects could not even demonstrate evidence of reaching the prototype stage, let alone resulting in transfers to the commercial marketplace [4]. Similar projects funded through multi-national consortia in the European Union (e.g., TIDE, CORE, CARDIAC) for the purpose of addressing technology transfer issues, do not typically include representation from AT manufacturers and suppliers, and tend to produce reports containing agendas for further research. These examples are in addition to the hundreds of university-based R&D projects that leave no evidence of eventual transfer and commercialization.

During the same timeframe of thirty to forty years, the predominantly small private companies comprising the AT industry struggle to fund their internal R&D activity from the slim profit margins available through the third-party AT reimbursement system. Most of the commercial successes have involved some cross-over between the niche AT and mainstream commercial markets (e.g., Kurzweil Reading System, Carbone-fiber Wheelchairs and ICT Interfaces).

Most of these AT companies cannot afford to pay for scientific research beyond that required to meet health and safety requirements, and their engineering development is focused on lowering the costs of manufacturing and supplying their AT devices and services so they can afford to remain in business. If the public funding delivered to academia had instead been allocated directly to companies in the AT industry, they

could have implemented improvements to their existing product lines as a return on the government investment.

This situation is true across all sizes of AT companies, across all levels of technological maturity, across all fields of application, and for all potential beneficiary target audiences. Small companies are likely to fail but at some of them survive. The larger companies depend on continuous product innovation to maintain their market share, and often grow through the acquisition of smaller companies who have managed to succeed through the introduction of new or improved products and services. Companies typically focus on internal R&D activities so they can maintain control over the costs, and maintain confidentiality in their competitive environment. However, as noted previously, companies are willing to pay external experts as consultants in order to obtain state-of-the-art knowledge.

Under the Procurement Contract system in other fields, corporate leaders often create a hybrid system where they fund exploratory grant activity that is oriented to their internal product development requirements. This approach ensures that the outputs from academic R&D projects will only satisfy the scholar's professional incentives, but will be immediately applied by the sponsoring company. This immediately solves the existing and persist challenge for academics to demonstrate evidence of uptake, application and benefit in areas deemed important to society. But the current innovation system for AT continues to fund Exploratory Grants initiated independent of corporate requirements or societal needs.

The future for AT looks equally grim elsewhere. Government-sponsored initiatives to address AT in other countries (i.e., Australia's National Disability Insurance System, and Brazil's National Research on Assistive Technology initiative), appear to be emulating the same mistaken approach. That is, both Australia and Brazil are identifying 'technological innovation' as a high priority for public funding, although there is no documentation that innovation ranks anywhere near the more immediate concerns of consumer awareness, product deployment, clinician credentialing or device reimbursement. The immediate concerns of industry and clinicians are business-based and market driven, so they could be readily addressed by changing government policies,

and channeling resources for R&D to the professionals who know how best to apply them. The Contractual Procurement system is the proven path to success.

However, it should be no surprise that the same two economic sectors -- government and academia that most benefit from the flow of public revenues -- continue to promote the Exploratory Grant system. Unfortunately it is easy for anyone who has followed the AT field to predict that the results in Brazil and Australia will follow the pattern observed in the northern hemisphere. The new funding will expand the bureaucracies in the government agencies assigned to administer them, while the sponsored university faculty and graduate students will generate volumes of new publications leading to their academic promotion and tenure. The AT companies and clinicians will be left to make ends meet, and the intended beneficiaries will gain little direct benefit from all the money and time expended.

3. Recommendations for Government Support of Assistive Technology

It is past time for policymakers and political representatives to insist on substituting a Contract Procurement system led by industry for the essentially failed Exploratory Grant system led by academia. Under a Procurement Contract system in direct partnership with the industrial sector, the government would set the performance specifications for all types of AT, companies would bid to fulfill those performance requirements. Once designed and tested by AT corporations, government would contract with those same AT corporations to manufacture, deploy and support the resulting AT devices and services. One can only imagine AT products with the performance capabilities of military hardware, the reliability of commercial airplanes and the functional efficacy of medical implant products.

At the backend of the innovation process, government agencies would purchase and distribute these AT devices and related services within the domestic market. The government would also fund the Certified AT professionals to ensure that AT recipients receive the right devices, learn to use them and have a source of follow-along support. Access to free AT products and services would eliminate costs for entire third-party review and payment system, along with the associated medical and legal fees

determining eligibility, all of which is funding that could be reallocated to the direct delivery and support of AT products and services.

The Procurement Contract approach would support technological innovation by channeling public money toward the market-oriented efforts of the AT industry – supported by expertise from academia and resources from government -- to define and design the optimal AT products and services. This recommended course of action could be readily tested through a three to five year pilot project within any specific AT topic area. It seems that entrenched interests in the current Exploratory Grant system could be overcome by a united effort from AT consumers, family members, clinicians, suppliers and manufacturers, but these stakeholders must first decide to act.

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