Technology Transfer Activities and Productivity of NIDILRR Grantees

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INTRODUCTION

Assistive technologies (ATs) are needed by an estimated one billion individuals worldwide to participate fully in society and live active, independent lives; without them, individuals are often excluded from society, do not have access to basic opportunities such as education and jobs, and are at a higher risk of being poor and unhealthy. This number is expected to increase to 2 billion by 2030 [1]. It is important for research and development dollars to be spent effectively in order to get AT into the hands of these individuals.

NIDILRR understands this need and has designated the IMPACT center to focus on looking at past performance and inform process improvements. The center has been created to understand the barriers, facilitators, and factors associated with ATs and successful AT technology transfer (ATTT). Specifically, this paper addresses the research that has been done to track the activities regarding the ATTT success rate of NIDILRR-funded projects which will help to raise awareness and increase capacity of NIDILRR grantees to perform successful ATTT.

This paper focuses on the SBIR grant mechanism which focus on product and company development. It has two available tiers: phase I and phase II. Some SBIR awardees receive both phase I and phase II funding.

METHODS

We have collected publicly searchable ATTT outputs for the SBIR grant mechanism and have begun collecting this data about the other grant types including RERC, DRRP, FIP, and technology related grants. We aimed to find all publicly searchable papers, patents and website or e-commerce activities from the year 1983 until 2019. Grants that produced any of these were considered as having successful tech transfer. The searching was conducted in a systematic manner as outlined below.

Papers

Papers were found utilizing Python scripting. The Entrez tool from the Biopython tool kit was used to pull relevant papers from the PubMed database. Two methods were used from this toolkit. The first was “esearch”. This method took an input of the grant numbers and outputted the unique identifiers for each of the papers related to the grants. The unique identifiers were then used as inputs to the “esummary” method. This method returned an XML file with all of the information needed about the papers related to the grants. The data was then organized and uploaded to an online NoSQL database called NIMS.

Patents

Patents were found through the Google patent database. The first searching criteria used was the organization associated with the grant. Results were then narrowed by year and then topic using keywords from the grant title. If the first search criterion did not return results, author or organization were used for the initial search. Patents were then narrowed by year and then topic. If the second set of criteria did not yield results, a general patent search for the title of the grant was done, narrowed by year, and searched through to find any relevant organizations or authors. The information was downloaded as an excel file and then data was then organized and uploaded to NIMS.

Websites and E-Commerce

Websites were searched for evidence of tech transfer. First, we navigated to each website provided by the various grantees and reported on NARIC (https://www.naric.com/). Once on the site, we would decide what type of product was being offered through the website. These products could be hardware, software or informational. Informational websites included outcomes such as standards or various curriculum. In some cases, the website was no longer available and this was noted. Grants awarded prior to 2000 were not expected to have a website available and further searching will need to be performed to find if they have outputs that can be accessed by the public.

Analysis

Summary statistics were then generated for each output across all grants and categories that were developed. The categories chosen were computer access, physical environment, recreation, vision, travel and transportation, cognitive, hearing and communication, and mobility and manipulation.

RESULTS

We have found data for approximately 35% of the grants thus far.

Papers and Patents

A total of 490 SBIR grants from NIDILRR were identified and used for the search. A total of 372 peer-reviewed manuscripts and 142 patents were identified as outputs. To date, 13% of SBIR grants produced patents. From the 62 grants total that did, 139 individual patents have been identified. When broken down by phase, 19.2% of SBIR phase II patents produced patents and 10.9% of SBIR phase I grants produced patents.

SBIR II Conversion

Of the 365 phase I SBIRs received, 125 received phase II (34.24%). This percent is broken down by category in figure 1 below.

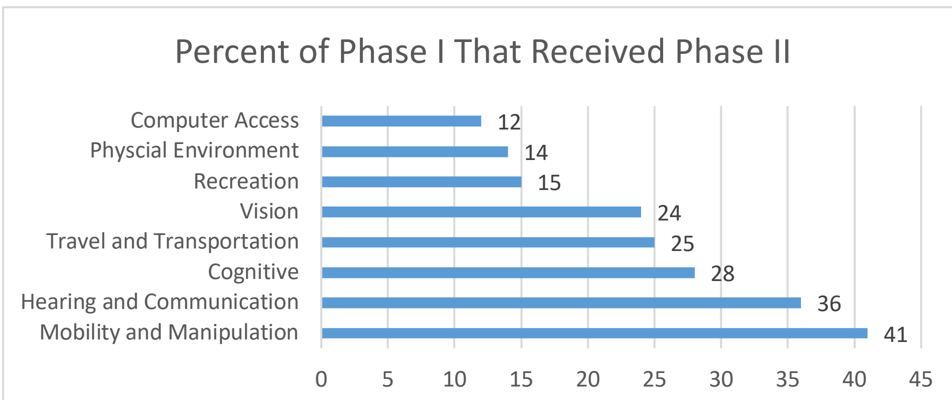

Figure 1: Breakdown of phase II grant recipients by technology type

Websites and E-Commerce

The most likely outcome for an SBIR grant online was software available for purchase. This was followed by informational websites and then hardware products for purchase as shown below in figure 2.

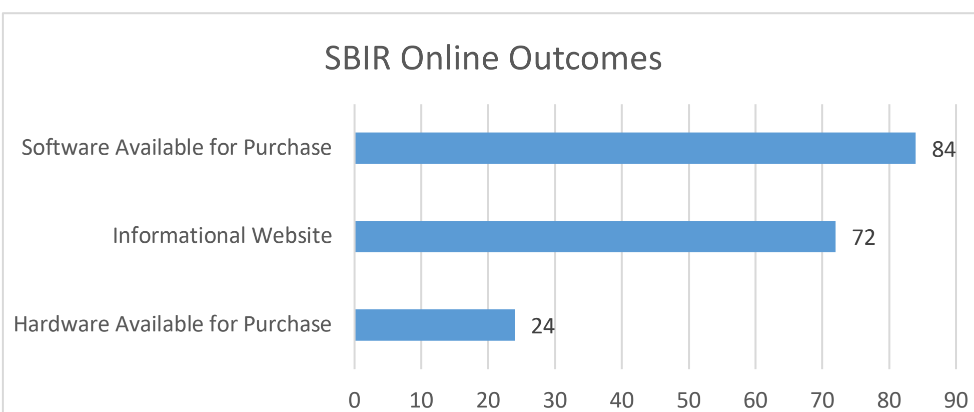

Figure 2: Breakdown of website outputs for SBIR grants

Total Outcomes

Figure 3 summarizes all outcomes for each category of product. Figure 4 compares the number of patents to the total dollars spent. Over the period from 1983 to 2019, mobility and manipulation, hearing and communication and cognitive projects received the most grants.

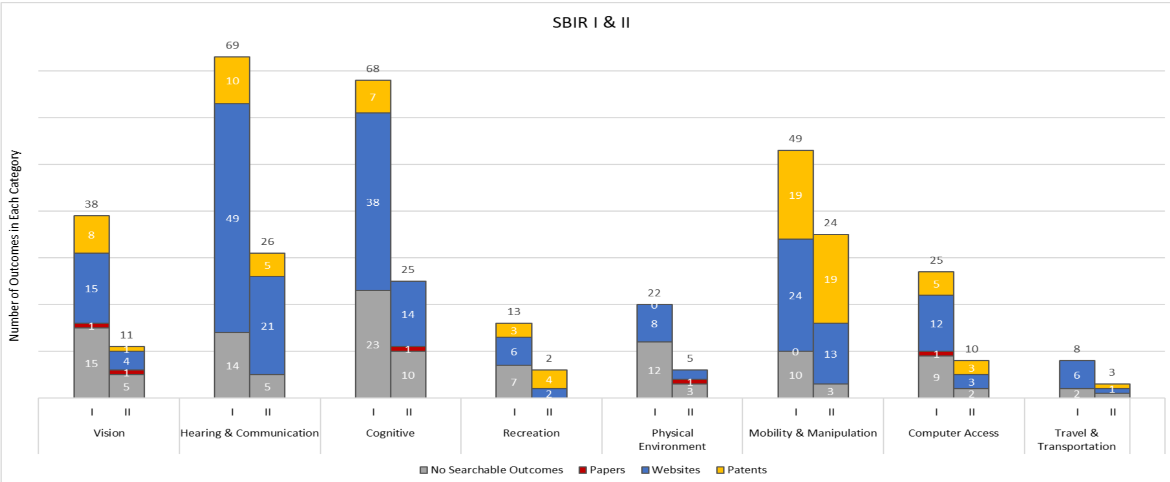

Figure 3: Summary of all outcomes from publicly searchable grant information

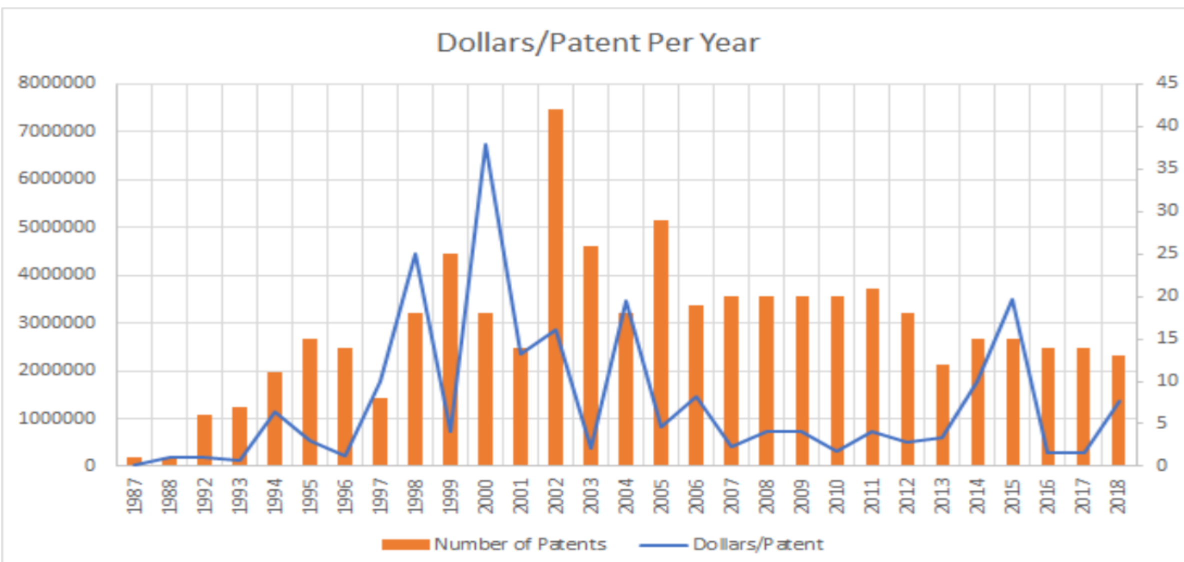

Figure 4: Number of patents produced compared to number of dollars spent

DISCUSSION

Our results highlight the funding and output trends associated with the NIDILRR SBIR portfolio. As seen in figure 1, computer access grants were the least likely and mobility and manipulation grants were the most likely to receive a phase II. Phase I was very likely to produce software outputs, however, which indicates that software development is unique in that it can sometimes result in available products with only a phase I as compared to hardware which often requires an additional iterations and costs associated with prototyping. SBIR phase II grants were much more likely to produce patents.

Products that are less likely to be covered by insurance were also less likely to receive grant funding. These categories include recreation and travel and transportation. Because there are less grants in these categories, it is harder to analyze the likelihood of various outcomes. As seen in figure 4, the mobility and manipulation category is the most consistent producer of outcomes followed by hearing and communication and, finally, cognitive. These grants are also the most likely to receive an SBIR phase II and they have the most grants overall. This leads to the conclusion that having examples to work from, a network of experts to observe and communicate with, and time and money are important facilitators to ATTT.

Figure 5 indicates annual NIDILRR funding for SBIRs versus related patents, which provides an estimate of the cost per patent. Between the years of 1987 and 2018, the costs-per patents were 1,237,831 (SD=913,754.6) with a few notable outliers, including around the year 2000. This correlates with the "internet boom" of the early 2000s and indicates that NIDILRR may have put much more money into software products those years and then eventually began funding a better ration of product types moving forward.

The results seen were similar to results seen analyzing another group of SBIR patents from the National Institutes of Health (NIH) [2]. What we have seen so far, however, is much more conservative than when looking at the NIH's self-reported outcomes [3]. NIH's self-reported outcomes show between 200 and 400 inventions and licenses per year, which is more than three times the rates that we found. Though this is a slightly different granting organization, it is valuable to compare results for the same SBIR grant mechanism. In NIH's report, the number of outcomes is considerably higher. The grantees are sending in information about their progress to NIH themselves to create this data. This surely increases the numbers in comparison to our current public search methods which highlights a limitation of our data being that non-public outcomes (e.g. trade secrets) are not counted. In regards to the paper using public searching methods, the results are similar in all categories. Notably, the dollar per patent ratio for SBIR grants as seen in the analysis of NIH grants (seen in figure 5) follows a similar trend as to what we found in figure 4 but at a higher cost per patent rate (e.g. 3,000,000 per patent NIH and 1,237,831 per patent NIDILRR). This paper, however, also looks at downstream patents and company survival. These could be two interesting new sources of public data to explore moving forward.

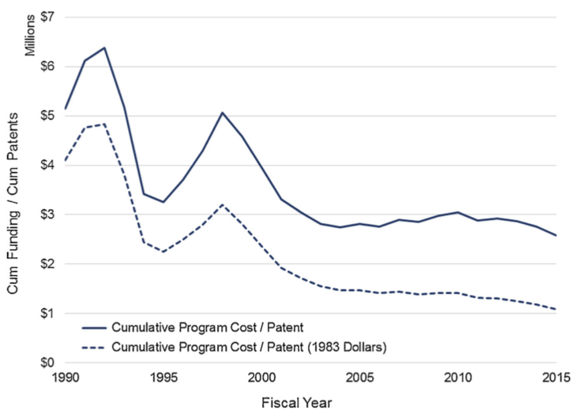

Figure 3: NIH SBIR/STRR funding per patent

As noted previously, a limitation of this work is the reliance on public data sources which will not be comprehensive especially related to outputs protected as trade-secrets or those resulting from grants provided prior to the widespread use of the internet. To increase the accuracy and comprehensiveness of our data we will be reaching out to the past and current NIDILRR grantees with an "IMPACT report". This report will outline the list of outcomes associated with their NIDILRR grants and requests that they fill in gaps where we missed some of the outcomes of their grant activities. All of the data will then be reviewed and added to NIMS to create a complete picture of grant outcome activities. After this data is collected, it will be interesting to once again to compare the results to NIH's self-reported outcomes to see if the numbers are more similar.

Despite having an incomplete dataset, the results so far can still be used to analyze important trends in grant mechanism outcomes. These trends can then be used to develop tools to better assist individuals in successful tech transfer. It can also hopefully allow granting organizations to better allocate their money to individuals.

CONCLUSIONS

As tech transfer outcomes continue to be analyzed, the barriers and facilitators to success will become more obvious. Once those are identified, groups working on NIDILRR grants will be able to implement some of the tactics that produced success previously which will lead to more successful tech transfer for all grantees in the future.

REFERENCES

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