THE SENTINEL BOX: IMPROVING BIKE SAFETY IN PITTSBURGH

A Non-Market Strategy for TransitSource

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THE SENTINEL BOX: IMPROVING BIKE SAFETY IN PITTSBURGH

TRANSITOURCE - "DATA LOVES COMPANY"

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EXPLANATORY NOTE:

This Report is part of a student project, and thus is not meant to be quoted, cited or referenced as it has not been subject to rigorous level of critical review. The following report, completed for a local company [TransitSource] based in Pittsburgh, Pennsylvania, is a twelve-week assignment for the course, New Technology Commercialization: Public Policy Strategies, administered within the Department of Engineering and Public Policy at Carnegie Mellon University.

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INTRODUCTION

In recent years, the theory of business has evolved. Businesses no longer should solely focus on their position in the market. Instead they should refocus their efforts in strategic position in the "non-market" environment. Due to the increased spread of information and the increased government role in business, conducting a non-market analysis helps businesses improve their successful prospects. By evaluating, from an objective perspective, businesses gain leverage in the new set of opportunities already available.

In the case of TransitSource, a local data sharing company in Pittsburgh that advocates for bike safety, the purpose of this analysis is to provide non-market strategies to the co-founders, Allison and Ethan Plummer, in order to help them navigate the public sector opportunities. As the company further develops the Sentinel Box, it can seek partnership opportunities with City Government. To solidify a public-private partnership with the Pittsburgh Police Department, our team proposes drafting a Memorandum of Understanding (MOU) to formalize this partnership. As Pittsburgh becomes technologically advanced, and inclusive, it will rely on MOUs to foster relationships with local companies. The result of the MOU will provide the next step for TransitSource to commercialize the Sentinel Box.

The purpose of this report is to provide policy options and recommendations for TransitSource to utilize public resources in order to commercialize the Sentinel Box.

EXECUTIVE SUMMARY

STATE OF AFFAIRS:

TransitSource is developing a prototype device to identify chronic problem areas within the City of Pittsburgh and help riders make the safest routing decisions. In the long-term, the device will be developed for a pilot to be adopted by the City and local nonprofits to make data-driven decisions where the infrastructure should be improved. The company aims to take advantage of non-market strategies in the public sector to bring to market the Sentinel Box to improve the biking experience in the City and better enforce Pennsylvania's Safe Passing Law.

NON-MARKET CONTEXT:

In evaluating the non-market landscape, the project team has focused on the following considerations:

Issues: Safety for cyclists and drivers, privacy concerns for data sharing, adoption of a functioning prototype.

Interests: Cyclists, taxpayers, drivers, law enforcement agencies, bike advocacy groups, bus operators (City Transit).

Institutions: The City of Pittsburgh: the Police Department, City Planning, and Transportation, Envision Downtown, the Idea Foundry, AAA, the United States Federal Government.

Information: Bike Safety reports, Healthy Ride (Bike Pittsburgh) reports, Innovation Partnership PowerPoint presentations, City Government Reports on bike infrastructure, trends, and initiatives, and online news articles.

POLICY RECOMMENDATIOSNS:

In order to execute prototype development, this report proposes the following non-market recommendations to complement TransitSource's short-term and long-term market strategies:

Short-Term:

- Write a Memorandum of Understanding (MOU) for the Police Department to establish proper communication channels with the City of Pittsburgh in order for the Police Department to investigate pilot adoption.[1]

Long-Term:

- Contact Program Officer for SBIR/SBTT Grant eligibility, and use acquired information to assess whether or not to apply (a 9-15 month period from submitting application to receiving the grant and executing funds for prototyping).[2]

[1] The idea of the MOU resulted from an April conversation with Rick Stafford.
[2] Extracted from phone conversation with Kelly S. Wyam at the Innovation Partnership.

TECHNOLOGY OVERVIEW

TransitSource is a Pittsburgh startup (LLC) aimed on improving bike safety in inner-city commuter environments using their device, the Sentinel Box.

FIG. 1: THE SENTINEL BOX PROTOTYPE

The Sentinel Box is a small 3D printed box (3/4 lbs.) that sits on a bike's crossbeam and houses a microcontroller and an array of sensors. The device is able to record the GPS location and an image when a car unsafely passes a biker. By collecting a series of data points, TransitSource aims to develop an understanding of hazardous locations for bikers in cities such as Pittsburgh. This data can be used for city planning, path-finding applications such as Google maps, etc. The detection method is relatively simple: use two ultrasound sensors and perform cross-correlation to determine whether the bike has passed an object that is not stationary. If the bike is passed by a moving object that is closer to the bike than three feet, this counts as an unsafe pass and triggers the devices recording process.

The Sentinel Box remains in active development, and as such is not yet ready to face the market. Currently, the company's co-founders are working to develop a functioning device using what seed funding they have, but have not been able to reach this goal.

The Sentinel Box is not patented. TransitSource is currently developing a Business Plan. Idea Foundry, a local accelerator that conducted market research for TransitSource provided national and international opportunities for TransitSource, subjective to the functionality of the device. The market research highlighted local resources, Rothschild Doyno Collaborative and Maya Studios, as key opportunities for TransitSource to utilize for design and prototype improvements.

Currently, TransitSource is using remainder of funding from Idea Foundry to continue prototype development on the Sentinel Box. Other accelerators including AlphalabGear have not granted funding for prototyping as the market opportunity of the Sentinel Box is too small to provide a multi-million dollar return on investment.

TIMELINE: THE BIRTH OF THE SENTINEL BOX

NOVEMBER 2013

Allison Plummer, an enthusiastic cyclist with a degree in Environmental and Urban Studies and interests in Geographic Information Systems (GIS) partners with her brother, Ethan Plummer, a computer and robotics engineer, to display the first Sentinel Box prototype at the Carnegie Library of Pittsburgh. Carnegie Library of Pittsburgh assists creative entrepreneurs in the start-ups space. The Library launches the "Show Your Work" to help idea-makers with various stages of product and business development, providing console, work-in-progress feedback and design tools made available at the library.

SPRING 2014

The Plummers submit their application to a local startup incubator AlphaLab Gear, which provides a space for tech entrepreneurs to grow and build their company. Their application for seed funding is denied, prohibiting the Plummers from further developing their hardware.

SUMMER 2014

The Plummers seek investors and approach Idea Foundry to develop a market strategy and business plan.

FALL 2014

Idea Foundry incorporates TransitSource (parent company) as a Limited Liability Company (LLC) and conducts a market analysis to be used in their business plan. Idea Foundry provides first-stage seed funding to new companies whether or not a business plan is in place. Foundry mainly allocates funding to LLCs and B-Corps. They grant the Plummers $10,000 for first-stage development of the Sentinel Box—sponsoring the development of two devices to be mounted to bicycles.

The challenge for the Plummers remains: "*Are we selling information or hardware?*"[3]

SEPTEMBER 2015

The Plummers, along with the Foundry's support, approach Envision Downtown for additional funding. Envision Downtown, is a public-private partnership created by City of Pittsburgh Mayor Bill Peduto and The Pittsburgh Downtown Partnership to provide 21st century solutions for the City of Pittsburgh. $30 million is been injected into this partnership. The Plummers then submit a proposal. They receive a verbal, non-formal agreement to collaborate on the Sentinel Box project to include funding allocation in the amount of $30,000.

MARCH 2016

Idea Foundry's Director of Social Enterprise Initiatives follows up with Envision Downtown. The Downtown partnership prefers to fund "stationary" devices or devices mounted on stationary objects. Idea Foundry seed funding runs out. The 2016 cycle for the InterSector program opens and the Plummers submit an application. The InterSector is a fellowship program that requires a formal agreement from a sponsor to help companies develop the next stage of prototyping to commercial product, in order to create jobs and grow the local economy. The allocation amount is $15,000.

APRIL 2016

The Plummers are using the remaining funds the initial Foundry grant of $10,000 to improve their prototype.

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[3] Reported from a phone conversation with Allison Plummer, on April 16th. The chronological description is taken from that same conversation.

CHALLENGES AND OPPORTUNITIES

Because TransitSource is a small company and their technology is not past prototype stage, their non-market situation does not reflect the situations commonly found in case studies, i.e. the set of challenges and opportunities the company faces are effectively unique. The company requires a slightly different approach to non-market analysis.

CHALLENGES:

- **Prototype:** The most fundamental challenge for TransitSource is their lack of a functioning and well tested prototype. Due to the fact that the company is small and not the main focus of either of the two co-founders, the investment of time and energy on their part required getting to a working device is a major commitment. As such, this presents a *non-market barrier*, a road block to continued strategy development that must be dealt with, as discussed later.
- **Safety and Privacy Concerns:** The nature of the device raises certain questions about the hazards of use involved. For example, for the standard user biking in a populated area, if the device were to become dislodged from its position on the bike, there is a chance it could become an airborne or ground hazard and cause serious damage to a person or property. In addition, the data stored on the device is a liability in and of itself; if the device were to be stolen and fall into the hands of a skilled hacker or engineer, the routes the user bikes along could be derived, which to some is a major threat to privacy.

OPPORTUNITIES:

- **Small Business STEM Opportunities:** For Small Businesses doing development of STEM products which provide some form of public services, there are countless methods of receiving Federal or Local Government assistance. Among these, one of the best known is the Small Business Innovation Research (SBIR) or Small Business Technology Transfer (SBTT)[4], is a multi-Departmental grant program meant to provide funding to small companies just like TransitSource. These kinds of opportunities are almost exclusively available to small tech startups, making TransitSource an ideal candidate.
- **Public/Private Partnerships:** The City of Pittsburgh has recently focused its efforts on expanding municipal bike infrastructure. This has resulted in several partnerships between the city and private sector groups which are aimed at providing data for city planning and improving accessibility to Downtown Pittsburgh.[5] Back by the Mayor, these efforts present a timely opportunity for TransitSource, since they happen to be requesting a non-market strategy analysis while this is still recent, implying there may be some funding available for the company from the city of Pittsburgh.

[4] Description of grants found on sbir.gov.

[5] Many articles on improving bike safety can be found in the Post-Gazette and The Pittsburgh Downtown Partnership.

POLICY ANALYSIS FRAMEWORK

STATUS QUO:

> ***Definition:*** *In non-market analysis, the Status Quo is the "path of no interference"*[6]*, i.e. the path the company being analyzed is taking or would take through the non-market if they were not advised otherwise.*

Prior to their request for non-market analysis, TransitSource was working towards establishing funding for their next stage of continued prototype development. This was done entirely within the private sector, via standard channels for seed-stage startups. TransitSource was initially funded by Idea Foundry, a Pittsburgh-based startup accelerator, with a $10,000 beginning grant. TransitSource's contract with Idea Foundry expired in March of 2016, and they are now looking towards funding for their second stage of prototype development. In addition, in order to address the issues of safety and privacy, Allison Plummer is looking to use the remaining portion of the initial Idea Foundry seed funds to conduct a pilot study and collect data, which it is believed would be advantageous to the company's funding requests.[7] Below, we discuss how the Status Quo option covers the Challenges and Opportunities listed in the previous section.

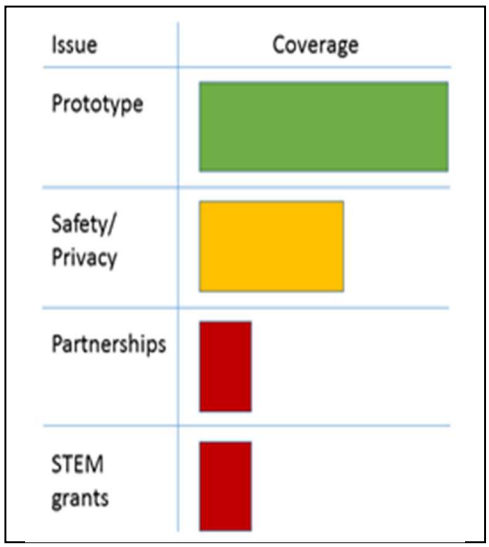

FIG. 2: GRAPHICAL DESCRIPTION OF TRANSITSOURCE'S STATUS QUO COVERAGE OF NON-MARKET ISSUES

- **Challenge – Prototype:** The *TransitSource Status Quo mainly focuses towards this issue*. Since there is a lack of funding to continue development, the Status Quo's main concern is finding a source of funding that will allow the continuation of prototyping.
- **Challenge – Safety/Privacy:** TransitSource's Status Quo does also address this concern on its path to addressing the prototype challenge. However, this is in many ways a side effect. The pilot study is not meant to demonstrate safety so much as it is effectiveness, *suggesting that while this is covered, it is not covered optimally*.
- **Opportunity – Partnership:** TransitSource has considered the public/private partnership opportunity, but are unsure how to pursue it as the Envision Downtown partnership has not been advanced, meaning *this opportunity is not being taken advantage of*.
- **Opportunity – Small business STEM:** TransitSource has not considered STEM grants, and as such the company *is not pursuing this opportunity* at all.

[6] A phrase that Will Hedberg adopted from New Technology Commercialization lecture on the Status Quo.
[7] Transcribed from the April 16th conversations.

This review of the Status Quo option shows that TransitSource is not pursuing an optimal non-market strategy, since they are not taking advantage of opportunities and to some extent are not addressing all of their non-market challenges. This fact motivates the necessity of the non-market analysis in this paper. As such, below, we begin to frame our group's policy analysis path.

> *Note: Non-market Policy Analysis begins with the "4I" framework: Issue, Interests, Institutions, and Information.[8] These form the foundation of the policy analysis that is pursued in the rest of this paper.*

ISSUE:

On the grand scale, understanding and fostering bike safety initiatives has traditionally been difficult to optimize in the City of Pittsburgh. Since the election of Mayor Peduto in December 2012, The City of Pittsburgh has grown into a progressive bike city, with over 60 miles of bike lanes.[9] Peduto says he sees the new lanes as being part of a "comprehensive approach to revitalizing Pittsburgh's dense core,"[10] which also has a compact street grid with both protected and unprotected bike lanes.

In addition to bike safety, sharing and using this data is a concern for Pittsburgh citizens.[11] With bikes becoming more accessible in urban centers across America, city governments are taking a greater stance on protecting both cyclists and drivers, for example, the City of Atlanta nominated a Chief Bicycle Officer[12]. As more cities take on these progressive initiatives, policy discussions around data sharing devices may be more acceptable.

Another concern is the deployment of Bike Shares and their willingness to adopt the Sentinel Box technology. Because the bikes are stationary, parked outside on the streets, the devices are vulnerable in that people may want to tinker with the devices. Furthermore, for Bike Shares to adopt the Sentinel Box may not be the best strategy as in some cities there is growing evidence that bike shares do not increase bike collisions,[13] a finding that contrary to public opinion, and may not support the goals of TransitSource that may want to have a full, comprehensive view of bike-related accidents in and outside of protected and unprotected bike lanes.

On the small scale, the prototype adoption remains a significant issue. Allison Plummer has limited funding and time to work on the prototype, as she has a primary day job that requires significant managerial duties. She is looking for low-cost, pro-bono developers to develop a functioning prototype in addition to securing a corporate sponsor. A sponsor of any sort is unlikely to fund a company that has no business plan in addition to a functioning prototype. If the Plummers succeed in finding a corporate partner that is willing to help based on good will, then they can secure the next stage of seed funding, Idea Foundry's InterSector grant.[14]

Enforcement of the four-foot law has created a disinterested police force in Pittsburgh. After 13 months of the law's passage in 2012, 15 citations for passing too closely were issues in the state of which two were issued in Allegheny County and non in the City of Pittsburgh.[15] Police Cmdr. Scott Schubert cited the lack of citations were due to not only the newness of the law but also to the nature of crime fighting, more serious matters needed to be addressed.

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[8] Further reading of the 4I's adopted from Sloan Review Article "What Every CEO needs to know about Nonmarket Strategy.

[9] Figure extracted from a report produced by Action News 4.

[10] Peduto expresses his views on biking in Pittsburgh in an article produced for NextCity.

[11] A common theme expressed by many constituents that Allison has spoken with and reported after her personal questions addressing the usage of her bike data, collected by the Sentinel Box.

[12] Becky Katz is the new Chief Bike Officer, as reported by the local nonprofit Atlanta Bicycle Coalition.

[13] Based on the NYPD Motor Collision Data Reports, reported in the Bike Share 2013 article.

[14] More information on the program can be found on Heinz Endowment website.

[15] "Review finds Pennsylvania's new bike safety law not closely enforced," Post-Gazette. May 24, 2013

Advocacy groups such as Bike Pittsburgh and others have been challenged with working with city departments to enforce the law. The Police Department has been unsure how to protect this aggregated data and with no policy place, similar initiatives have been put on hold. The proposed Business Plan will help Allison and Ethan evaluate the issue further so that both the Police Department and advocacy groups can adopt the pilot.

INTERESTS:

- Cyclists are interested in this initiative as it increases bike safety. The public is interested in learning about the trouble spots as bike-related accidents are often under reported. [16]

- Drivers benefit from knowing where these areas are so truly could avoid, if needed.

- Tax payers are interested to see the effect of bike safety initiatives on the tax structure.

- Some drivers oppose bike lane expansion as they add additional obstacles on the road. Drivers fear colliding with cyclists especially when cyclists don't adhere to traffic laws. No turn by a motorist may interfere with a bicycle proceeding straight (the right hook).[17]

- Law enforcement agencies such as the Pittsburgh Police Department are interested in bike safety for the police officers that ride the bicycles (17 in total).[18] However issues around safety and enforcement remains.

- Bike advocacy groups such as Bike Pittsburgh is interested in bike safety initiatives.[19] The nonprofit works closely with Envision Downtown and the City of Pittsburgh to ensure safe passage for cyclists.

- Bus operators (City Transit) drivers may complain of cyclists weaving in and out of traffic, especially cutting off buses. Second, cyclists run lights and stop signs, when a bus coming in order to avoid riding behind a bus. Third, cyclists step in front of the bus to mount a bike on the rack before the bus stops.

- Local nonprofit accelerators such as Idea Foundry and AlphaLab Gear sponsor local startups with a technological focus. They provide robust initial seed funding. AlphaLab focuses on advances technologies and scalability potential of projects.[20]

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[16] Allison mentioned only 10% of bike accidents are recorded.
[17] The term is used to describe when the driver violates the cyclist's "right-of-way." Blog Virtuous Bicycle covers more details of this topic.
[18] This city website describes the Pittsburgh Bicycle Unit.
[19] As part of the Bike Pittsburgh's mission statement, the organization pursues "creative and proven solutions that increase biking and walking;"
[20] Transcribed from phone conversation with Project Manager Christopher Millard from the AlphaLab Gear.

INSTITUTIONS:

City Government:

The City of Pittsburgh's Department of City Planning has provided numerous public sources informing citizens the location of bike lanes.

The Pittsburgh Police Department has a Bike Program –17 bikes in total that patrol the streets.

The City of Pittsburgh's Department of Transportation administers city buses.

Click on any image to enlarge.

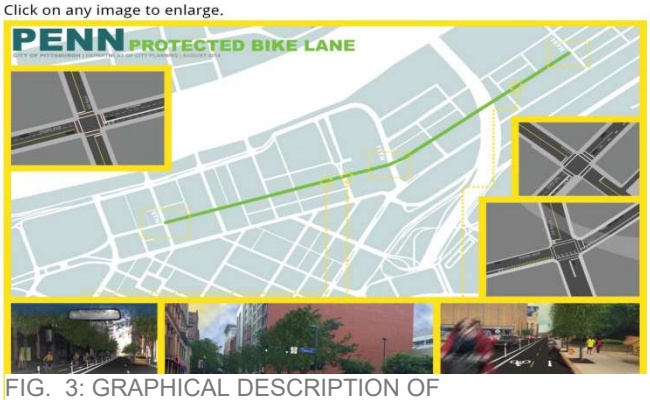

FIG. 3: GRAPHICAL DESCRIPTION OF TRANSITSOURCE'S STATUS QUO COVERAGE OF NON-MARKET ISSUES

Public Private Initiatives:

Envision Downtown works in parallel with Mayor Peduto's downtown urban center developments plans to include bike lanes.[21]

Nonprofits:

Idea Foundry and the AlphaLab Gear sponsor local startup companies with the goal of job creation and economic growth in Pittsburgh.

The AAA Mid-Atlantic ensures drivers and promotes motorist safety. In some cities they opposed protected bike lanes.[22]

Federal Government:

Department of Transportation's SBIR Grant Program

Department of Energy' SBIR Grant Program

National Institute of Health's SBIR Grant Program

INFORMATION:

City of Pittsburgh Bike Plan – A report, sponsored by the City of Pittsburgh, which outlines a strategy for addressing bike conditions and enhancing biking improvements in Pittsburgh. This report outlines with Penn DOT's **Statewide Bicycle and Pedestrian Master Plan** (1996) which identifies usage and safety targets for the Commonwealth's large cities, including Pittsburgh. The City of Pittsburgh evaluates any infrastructure or traffic flow improvement with the prescribed Penn DOT targets:

"Statewide:

- Double the percentage of trips by foot/ bicycle, from a national average of 7.9-15.8% of all trips.
- Reduce the number of injuries and fatalities suffered by bicyclists & pedestrians by 10%.

[21] With a $35 million, Envision Downtown will make for more complete streets, to include bike lane expansion.
[22] For more programs on ensuring driver safety, visit the AAA Mid-Atlantic website. According to our research we couldn't find any opposition from AAA in Pittsburgh.

For Large Cities/Metropolitan Areas in Pennsylvania:

- Target (a) Bicycle use should account for 5-10% of trips within the Central Business District
- Target (b) For trips less than 4.8 km (3 miles), 5% of trips should be made by bicycle.
- Target (c) Double the percentage of persons accessing transit on foot or by."[23]

Statistics on SBIR allocation from the **Innovation Partnership,** located in Harrisburg, PA. [24]

News articles from **Bike Pittsburgh, Post-Gazette and NextCity.**

[23] Figures extracted from the City of Pittsburgh Bike Plan Report. Pages 1 -2.

[24] Innovation Partnership provides consul to small business on SBIR developments. They aggregate statistics on SBIR funding for the Commonwealth and present their finding to businesses and universities in the form of PowerPoint presentations. For most up-to-date information visit their website.

POLICY OPTIONS AND ANALYSIS

GUIDING QUESTION:
Given the state of the non-market environment, we devise the following policy question as our guiding concept for the remainder of the following analysis:

"What actions, if any, can TransitSource take to obtain funding for their next-stage prototype?"

From the policy environment we describe, we can extract *four* policy options that constitute the possible paths forward for TransitSource. These are as follows:

POLICY OPTIONS:

Option 1: Status Quo:

TransitSource can continue to seek private sector funding and conduct its own pilot program. This is not necessarily ineffective, but it does lack the advantage of pursuing the non-market factors outlined.

Option 2: SBIR/SBTT Grant

TransitSource can undergo the application process for an SBIR/SBTT grant, which is complicated and will require extensive interaction with outside contacts—Grant Program Project Managers, independent Consultants or Academics—to maximize chance of receiving. The potential payoff is greater as it provides a raw monetary value.

Option 3: Partner with Envision Downtown

TransitSource can pursue partnership with the recent Pittsburgh city initiative, Envision Downtown, which has a transportation focused budget of $32 million and the resources to perform a large-scale pilot program.[25] However, the program representatives have been extremely difficult to contact, suggesting that partnership may be a lofty goal.

Option 4: Partner with Pittsburgh Police Department

The Pittsburgh City Police Department has a bike program consisting of 17 on-bike officers, and an inability to enforce the Pennsylvania Safe Passing Law.[26] As such, TransitSource can provide enforcement capabilities to the Department in exchange for funding and pilot study opportunities.

[25] This capital expenditure will be used 2015-2020, and is already included in the city budget to upgrade bike lanes. More information can be found in this Post-Gazette article from March, 15, 2015.
[26] Pittsburgh Bureau of Police Specialty Unit. This Unit describes the bike program with the Police Department.

CRITERIA FOR ANALYSIS:

There are *four* criteria for analysis of policy implementation[27] as explained below:

Effectiveness:

In the general case, effectiveness refers to how well a policy can achieve the goal. In the case of TransitSource, effectiveness refers to the likelihood that a policy option will allow the goal of preparing the next-stage prototype to be achieved (i.e. the benefit of "cost/benefit analysis").

Efficiency:

The relative effort required by TransitSource to implement the policy option in question.

Equity:

The "fairness" of a policy option, i.e. a relative measure of the ratio of "winners" to "losers" should a policy option be implemented.

Ease of Political Acceptability:

A measure of the resistance to the policy option in question, assuming it can/will occur if political factors were to be ignored. Determined using Prince Analysis, which weighs the relative power and position of the most influential parties involved in a policy options' implementation.

RANGE OF OUTCOMES:

This range of outcomes, composed of our ratings for Effectiveness and Efficiency, aim to explain the potential for the each of the options to meet the goals outlined in our guiding policy question.

Status Quo:

The status quo path, applying for private sector funding, has low effectiveness using our cost/benefit analysis path. We assert that the average Venture Capital (VC) group would not provide more than $30,000 in funding, which is a low value for any product-focused venture. In addition, since TransitSource does not have a business plan going forward, their odds of receiving private sector funding is extremely low due to the non-profitable nature that results. That being said, the efficiency is a positive, since communicating with and applying to local VC's in Pittsburgh, an area where there are several startup accelerators, is a relatively easy task, which we propose should not require more than 200-250 hours to go through. The low chance of receiving funding, however, does make this option prohibitive.

SBIR/SBTT Grants:

SBIR/SBTT grants are typically in the range of $150,000-$250,000, which is on its own extremely promising. However, typically, only 1 in 5 companies applying for their first time are rewarded the grant.[28] That being said, there are several ways to improve the chance of receiving the reward. For example, TransitSource could use their remaining funds to pull in a consultant who is familiar with the process, which would cost on the order of $5,000 dollars, or they could do

[27] The four criteria are extracted from lecture notes.
[28] Extracted from phone conversations with Kelly S Wyam.

significant research into what each department is looking for in their annual grant process. TransitSource can also contact the Small Business Development Center at Duquesne University for additional resources. [29] All three of these options increase the cost in exchange for increasing the benefit. However, there is also significant work involved in the application process, and it can also take 9-15 months after receipt of the grant to actually receive funds. As such, we give this option a very high effectiveness and a low efficiency score.

Envision Downtown Partnership:

Partnering with Envision Downtown provides certain benefits over the status quo options, namely that Envision Downtown would be asked to take responsibility for the pilot study operation in addition to providing a requested R&D funding of $30,000.[30] This would bring the effective value of the partnership to $50,000-$60,000. In addition, it is more likely to succeed than the SBIR/SBTT grant since it is a new organization and is well funded. Furthermore Mayor Peduto has vocally supported biking initiatives. However, the efficiency is low, since we have reason to believe that working with Envision Downtown may be extremely difficult. We have found that, in all of our and TransitSource's attempts to contact them, there has been very few successes with the communication recently improving. As such, the amount of work required brings the efficiency score down.

Police Department Partnership:

Partnering with the Police Department provides, in effect, the same benefits as the Envision Downtown partnership. However, the cost would likely be slightly higher since TransitSource would be responsible for training officers on the devices. The cost of this partnership is easier to characterize though. The Pittsburgh Police Department has 17 bike offices, which we assume would all use the device, meaning 17 devices would need to be manufactured. We approximate the cost of manufacturing a single device as $100 and approximately five hours of work, since the prototype device is made from standard components and a 3D printed box. This places the cost of manufacturing devices at $1,700 and 85 hours of worktime, plus 2-3 hours of officer training. We also assume that TransitSource can ask for funding for this and also continued R&D, suggesting that the effective monetary cost is negligible and the real cost is the approximately 88 hours of work needed. Efficiency is relatively high since the only necessary step for beginning this process is drafting a Memorandum of Understanding, a standard requirement when interacting with Pittsburgh City Departments.

[29] The Center provides free resources to small business.
[30] An amount quoted from Nicole Muise-Kielkucki at the Idea Foundry.

Policy Option	Effectiveness	Efficiency
Status Quo	-	+
SBIR/SBTT Grant	+++ (if successful)	-
Envision Downtown Partnership	++	-
Police Department Partnership	++	+

FIG. 4: GRAPHICAL DESCRIPTION OF TRANSITSOURCE'S STATUS QUO COVERAGE OF NON-MARKET ISSUES

BARGAINING CONTEXT:

The following challenges to bargaining are explained below:

Status Quo:

Due to it being the "default" option, the Status Quo receives a neutral score for Ease of Political Acceptability, as is suggested by the Prince Analysis.[31] We also find Equity to receive a neutral score since under TransitSource's status quo option, no major third parties except Venture Capital are interacted with, meaning that there are no parties that will be affected other than TransitSource and their investors.

SBIR/SBTT Grant:

For the SBIR/SBTT Grant, should it be funded, we find Equity to be Neutral again. This is because, like the Status Quo, no other parties are involved except the Federal Government, who is essentially not affected by the outcome. Our Prince Analysis, due to the power of players at the Federal Level and their low interest in a city-level project, found a score of 58%, implying the acceptance is relatively low.

Envision Downtown Partnership:

Since the general public benefits from the improved transportation, meaning the Pittsburgh Taxpayer would be positive towards the implementation in this case, Ease of Political Acceptability is very high. Our Prince Analysis suggested a score of 93%, suggesting that should the deal go through with Envision Downtown, there will be very little opposition within the city.

Police Department Partnership:

This option does create a significant change in bargaining options compared to the Envision Downtown partnership due to the added concern of privacy. Should the devices be put in Police Officer hands, privacy becomes a chief concern. This brings the equity score down

[31] The Prince Analysis is a tool used in public policy analysis.

significantly. However, due to the relatively low power in the local government of privacy activists, the Prince score remains at 76%.

Policy Option	Equity	Ease of political acceptability
Status Quo	0	0
SBIR/SBTT Grant	0	-
Envision Downtown Partnership	+	++
Police Department Partnership	-	+

FIG. 3: BARGAINING CONTEXT TABLE

STRATEGY AND ARGUMENTS

The following strategy considers **pros** and **cons** of the proposed short-term and long-term strategies:

SHORT-TERM STRATEGY (3-6 MONTHS):
TransitSource should first draft an official Business Plan that aims to address the original question: "Am I selling information or hardware?" The Plummers should spend 1-2 months drafting the business plan, seeking resources at the Carnegie Library of Pittsburgh since they have already established a relationship. Once they have drafted a Business Plan, the Plummers should set an appointment with Chistopher Millard, Project Manager at AlphaLab Gear to discuss resubmitting an application for funding. Rick Stafford and Alice Hlidkova have offered to provide feedback on the drafting of The Business Plan and MOU, which will (1) feature the market analysis report from the Idea Foundry, (2) this Hedberg/Hlidkova Report and PowerPoint Presentation to be used as supplemental materials, and (3) information on the Chattanooga Case Study.

FIG. 4: SIMILAR ULTRASONIC-BASED DEVICE NOW BEING USED BY CHATANOOGA POLICE

The Chattanooga Case Study:
Alabama Gov. Robert Bentley signed a bill into law in June, 2015, requiring drivers to allow three feet between the car and the bicycle when passing.[32] The Chattanooga Police Department like

[32] "Chattanooga, Tenn., Tests Technology That Could Make Roads Safer for Cyclists". July 15, 2015. For more information, read the article here.

many other across U.S. cities had issues with statute enforcement. Officers were unlikely to stop drivers or issue a violation ticket unless it was part of a sting operation between officers on bikes and in cars.

To change the situation and improve enforcement, Chattanooga Police Chief Fred Fletcher contracted an Austin software company Codaxus to mount the devices to the police bikes.[33] As a result of this public-private partnership, and with additional funding from a local nonprofit, the police force was successful in adopting the pilot.[34] Previously, Fletcher served as a police liaison to the cycling community in Austin, Texas, where he has acquired insights to public-private partnerships. Fletcher continues to train officers on identifying the three-foot violation in the City. Meanwhile Codaxus continues to supply clients across departments and beyond state borders. Recently, the company has received inquiries from international clients, including municipal governments in Spain and in Australia.[35]

LONG-TERM STRATEGY (9-18 MONTHS):

In the long-term, we recommend TransitSource pursue an SBIR-grant. We cannot, at this time, provide significant direction in terms of the grant application itself. However, we do recommend that to begin the process, TransitSource either reach out to a consultant familiar with the grant process who can provide insight into where to begin, or reach out to project directors at the providing departments to request information on likelihood of being provided a grant. Once this information is obtained, TransitSource can begin to draft a proposal, although it should be reviewed with a consulting party over the course of several months. While we cannot provide more information due to our limited time on this project, we do believe that the significant potential gain would make the application worthwhile.

[33] From March conversations with Codaxus CEO Christopher Stanton.

[34] From March conversations with Codaxus CEO.

[35] From March conversations with Codaxus CEO with references from numerous sources, including this YouTube video.

FINAL POLICY RECOMMENDATIONS

The policy recommendation for TransitSource highlights a public-private partnership between TransitSource and the Pittsburgh Police Department. This partnership will aim to establish a working relationship between the two to develop a pilot program in testing the Sentinel Box.

The working relationship will be documented in an MOU agreement, a one-page document outlining the relationship between two parties (The Pittsburgh Police Department and TransitSource). The MOU will outline project scope and goals of each party. The key component of the MOU is to secure a meeting with the Police Department in order to discuss project scope and set expectations of the working relationship, including the sponsorship of the pilot in order to commercialize the product in the long-run. Both parties will provide signatures for the document.

Rick Stafford has spearheaded numerous MOUs between Carnegie Mellon University and Metro21, a research initiative on campus that researches, develops, and deploys existing and new technologies across sectors in the Pittsburgh area.[36] He has agreed to facilitate the meeting and advise the process of writing the MOU. Rick Stafford has a strong working relationship with the Police Chief and looks forward to meeting Allison and Ethan Plummer, before they present the MOU, Business Plan and PowerPoint to the Police Department. Attendees for the meeting to be held at City Hall will include: Alice Hlidkova, William Hedburg, Rick Stafford, City Planning Community Program Manager Christa Koehler, Chief Innovation Officer Debra Lam, and Pittsburgh Police Chief Cameron S. McLay.

In evaluating this recommendation or the correct path for TransitSourrce there are arguments supporting and opposing the proposed strategy. The opposing arguments include, lack of sufficient business plant to measure scalability. It also includes the cost of the project. Since there are no recent developments on Envision Downtown's formal agreement to sponsor the prototype development, TransitSource is stuck finding a corporate sponsor in order to secure the InterSector funding, and further gain credibility as a key player in the bike safety/bike infrastructure space. The supporting arguments include a timely component. The City of Pittsburgh made the finalist round in the Smart Cities Challenge, a Department of Transportation Initiative that will award a $40 million grant to one city to deploy its smart cities technological developments.[37] The Award will be announced in June and is timely for TransitSource to argue the benefits of this technology—aligned with city and national priorities. Because TransitSource is providing cost upfront, which may only cover a few devices, the Plummers can negotiate testing on a select few to reduce resource spending. Both arguments must be considered to address current issues in the bike infrastructure.

The final policy recommendation raises the profile of bicycling as a leading mode of transportation. Bicycling is low-cost form of recreation and a necessary mode of transportation mode of transportation. Through strategic capital improvements and better internal programming

[36] For more information on the format of the MOU, visit the Metro21 website.
[37] News of the Smart Cities Challenge was released by the White House in October 2016. More information on the initiative can be found here.

coordination, cycling will become safer and truly accessible in the City of Pittsburgh. As cycling conditions continue to improve, so will the policy decision-making that are starting to contribute to this situation, both locally and nationally. Fortunately, a conscientious bicycle planning effort made possible through a public-private partnership can reverse any negative factor associated with cycling.