Washington Internships for Students of Engineering

Development from the Bottom of the Pyramid

An Analysis of the Development Innovations Ventures Program

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WISE Program – ASME

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SETTING THE STANDARD

Executive Summary

In October 2010, in response to President Obama's Global Development Policy Directive and other related policy statements, the U.S. Agency for International Development announced the Development Innovation Ventures (DIV) program. The DIV program is an initiative intended to "identify, develop, test, and scale innovative approaches to achieve cost-effective, scalable approaches to development challenges that correct market and government failures while accelerating promising solutions with a proven impact."[1] It provides grant funding to development programs at three distinct stages, with grant amounts ranging from thousands to tens of millions of dollars. Its ultimate goal is to enable programs to scale to reach millions of people in the developing world within ten years or less.

The DIV program is of particular interest to the science and engineering communities because of its support for projects involving science, technology, and innovation. It gives scientists and engineers a unique opportunity to leverage their skills, knowledge and resources to create progress in the developing world. Additionally, the DIV program indicates a possible new direction for USAID: towards a market-based, decentralized international development model, which is more similar to the social enterprise model of recent years than the historical "missionary aid" model.

Since the DIV program is extremely new, it is still developing and changing to best suit the needs of the development practitioner community that it targets. This paper strives to maximize the utility of the DIV program to development organizations by critically examining its current structure and methodology, and comparing it to the needs of the communities that it seeks to serve – developing-world communities and development organizations alike – in the context of the existing funding paradigm and the needs of development practitioners. It focuses specifically on how the DIV program can best serve development organizations that focus on leveraging technological innovations to produce development outcomes; however, the recommendations made by this paper are broadly applicable.

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[1] USAID. (2011, Jun 22). *Development Innovation Ventures: Innovation*. Retrieved Jul 12, 2011, from USAID: http://www.usaid.gov/div/model.html

[2] Office of the Press Secretary, "Fact Sheet: U.S. Global Development Policy," *The White House*, 9 22, 2010.

A series of interviews was conducted with development practitioners, government representatives, funding organizations, and relevant experts in the field. Along with extensive research into the current funding available for technology-based development programs, these interviews were synthesized to yield the following policy recommendations:

In the short term (the next year), the DIV program should…

- Improve publicity of the DIV program's funding opportunities. Very few of the organizations contacted were sufficiently aware of the DIV program to evaluate whether or not to apply, and most had never heard of the program.
- Modify its criteria for program evaluation to ensure that "hardware" technologies such as cookstoves and water filters, which necessarily scale more slowly than other "software" technologies that rely on existing physical infrastructure such as financial and internet-based programs, are evaluated fairly to take this inherent slower scaling rate into account.
- Increase its emphasis on the long-term, local sustainability of programs.
- Focus its funding efforts on projects in its Stage 1 funding class: preexisting, private-sector funding sources already service Stage 2 and 3 programs adequately.

In the long term (the next 5 years), the DIV program should…

- Create new ultra-small-scale funding opportunities targeted at startup groups, with grant amounts up to $50,000.
- Develop alternative grant delivery systems for these ultra-small grants intended to enable startup groups to apply for these opportunities. Alternative methodologies that could be considered include implementing a crowdsourced funding system, providing microloans to new development practitioners, or creating a light-overhead grant application.
- Investigate the possibility of connecting DIV grantees at all levels with other USAID and U.S. government resources, such as the Peace Corps or government logistics resources.

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Preface

About the Author

Julian Leland is a rising senior at Swarthmore College, pursuing a B.S. in Engineering with a minor in Public Policy. Within engineering, he has primarily focused on mechanical engineering and machine design, and has worked with both private companies and the National Institute of Standards and Technology on related projects. He is the current president of the Swarthmore Student Chapter of ASME, a position which he has held for nearly two years.

He first became interested in the intersection of engineering and international development during his freshman year: he has subsequently pursued this through both his engineering and public policy coursework, and is intending to focus in this area for both his public policy thesis and his senior engineering design project.

About the WISE Program

The Washington Internship for Students of Engineering (WISE) program is a nine-week internship program intended to introduce engineering students to the world of public policy. The program is sponsored by seven of the major engineering professional societies, including ASME; each society selects interns from its student membership through a highly competitive nation-wide competition. These interns spend nine weeks living in Washington, D.C., researching an engineering-related policy issue and producing a policy recommendation paper relevant to that issue. In addition to their paper, students interact extensively with leaders in Congress, the Administration, non-governmental organizations, and industry groups, further developing their understanding of the policymaking process.

Acknowledgements

The list of people I would like to thank for their assistance in creating this paper is tremendous. First and foremost, I would like to thank ASME for sponsoring me at the WISE program this summer. I would also like to thank:

- my advisor at ASME, Melissa Carl, and the WISE faculty advisor, Sandy Yeigh, for their patience, support, and hours spent working with me this summer,
- my colleagues at the ASME D.C. office, for welcoming me into their office and helping me throughout the summer,
- and Noha El-Ghobasy, Ian Hoffbeck and John Buydos, for many hours of assistance.

Finally, in the course of this paper, I conducted dozens of interviews over many hours. These interviews, and thus this paper, would not have occurred without the generosity, willingness and patience of my interviewees; I would like to thank them all for the invaluable information and assistance they provided.

Terms and Acronyms

AIDG..... Appropriate Infrastructure Development Group

ASME .....American Society of Mechanical Engineers

ATI.....Appropriate Technology, International, Inc.

BOP ..... bottom-of-the-pyramid

DOE ..... Department of Energy

E4C.....Engineering For Change

EWB ..... Engineers Without Borders

GACC..... Global Alliance for Clean Cookstoves

GIST..... Global Innovation through Science and Technology

ICT..... information and communications technology

iDE ..... International Development Enterprises

IEEE .....Institute of Electrical and Electronics Engineers

LDC.....least-developed country

NCAT ..... National Center for Appropriate Technology

NSF.....National Science Foundation

OISE ..... Office of International Science and Engineering

QDDR .....Quadrennial Diplomacy and Development Review

UDC.....under-developed country

USAID..... United States Agency for International Development

USDA.....United States Department of Agriculture

Introduction

On September 22, 2010, President Obama released the Global Development Policy Directive, an unprecedented policy statement which "…(recognized) that development is vital to U.S. national security and is a strategic, economic and moral imperative for the United States…and (charted) a course for development, diplomacy and defense to mutually reinforce and complement one another…" [2] This policy statement has proved exceptionally broad in its reach, affecting agencies throughout the U.S. government, including many not commonly associated with development activities, such as the Departments of Agriculture, Justice and Labor. Its policy repercussions have been numerous, and their effect is being felt today throughout the government.

One important aspect of the Global Development Policy Directive is the increased focus on using science, technology and innovation to create positive development outcomes. In a press release made in March 2011 through the Office of Science and Technology Policy, the White House outlined a number of programs and initiatives that would be undertaken in fiscal year 2012 by the United States Agency for International Development (USAID) and the U.S. Department of State. These programs included a new development initiative that has already been implemented by USAID: the Development Innovations Ventures (DIV) program. The Development Innovation Ventures program seeks to fund innovative development projects, with a focus on efficient, immediately impactful solutions that can be scaled up to reach broad populations of "tens of millions of beneficiaries."[3] It does not focus on a specific type of development project or a single area of development focus, seeking innovative projects throughout the development spectrum. It offers three levels of funding support to service projects at multiple stages in their maturation, from early proof-of-concept development to broad scaling. Although the DIV program does not specifically focus on technology-based development

[2] Office of the Press Secretary, "Fact Sheet: U.S. Global Development Policy," *The White House*, 9 22, 2010, http://www.whitehouse.gov/the-press-office/2010/09/22/fact-sheet-us-global-development-policy (accessed 7 6, 2011).
[3] USAID, "Seeking New Applicants for DIV," *USAID.gov*, 6 27, 2011, http://www.usaid.gov/div/newapp.html (accessed 7 6, 2011).

projects, it is naturally well-suited to funding such projects: roughly 75% of the first round of grantees have had significant scientific and technological components in their programs.

The DIV program and others like it are indisputably of interest to the science and engineering communities. They offer a unique opportunity for technology professionals to become involved in international development, and to bring their skills to bear in producing cost-efficient, locally appropriate, sustainable development outcomes. Many professional organizations have already begun to work independently on increasing their involvement with international development issues. One example of this is the Engineering for the Developing World Summit, hosted by the American Society of Mechanical Engineers (ASME) in March 2010. Another is the creation of Engineering For Change (E4C), an online community which strives to connect engineers and other technical professionals to NGOs and communities in developing countries. E4C is a multilateral project of ASME, the Institute for Electrical and Electronics Engineers (IEEE) and Engineers Without Borders, USA (EWB-USA). Between increased private interest and new governmental funding, technology-based development programs are a promising source of development outcomes for the 21st century.

This paper strives to maximize the utility of the DIV program to technology-based development organizations by critically examining its current structure and methodology, and comparing it to the needs of the communities that it seeks to serve – developing-world communities and technology-based development organizations alike – in the context of the existing funding paradigm and the needs of technology-based development practitioners. This paper will briefly outline the history of technology-based development, and will discuss the DIV program in greater detail. Then, current options for technology-based development project funding from both the private and public sector will be introduced, and the DIV program will be examined within the context of these funding sources. Insights into the current state of technology-based development and areas within the field that could benefit from government involvement through programs like DIV will then be identified through an analysis of

interviews with technology-based development practitioners. Finally, a set of policy recommendations intended to increase the impact and effectiveness of the DIV program will be made.

Terminology and Scope

Technology-Based Development Projects

This paper focuses on funding for technology-based development projects. The term "technology-based development project" is extremely broad, and requires specific definition to limit the scope of this paper. For the purposes of this paper, a technology-based development project is defined as having the following characteristics:

- **Achievement of development outcomes through science, innovation and technology:** The programs considered by this document focus on producing development outcomes through the leverage of innovative technologies, or through the development of those technologies. This includes programs that are focused on the distribution or local commercialization of these technologies. This **excludes** programs such as microfinance programs, food or material donation programs, or implementation programs for non-technology-based development programs, such as school construction efforts.
- **Not basic science research:** Although technology-based development projects may utilize the results of basic research, they should not include basic physical or social science research components. While research related to technology-based development is permitted, it must be directly linked to specific projects that are intended to be implemented within the next 3-5 years. For example, research into the ultimate strength of different indigenous materials would not be permissible, unless it was in direct support of a specific, larger project that would produce measurable development outcomes.

  While this restriction is placed on the working definition of technology-based development projects for the purpose of this paper, it should be noted that basic, non-project focused physical and social science research has an important

role to play in development. Increasing funding for basic research related to development is a priority for USAID[4]; hopefully, through increased collaboration with U.S. science and engineering agencies, more support for basic scientific and engineering research in development-related areas will be available in the future.

- **Emphasis on producing immediate development outcomes:** Technology-based development programs should be rapidly implementable (within 3-5 years). These programs do not necessarily have to produce their intended final development outcomes within this time period, but should be able to present some metrics of success or failure.
- **Targeting individuals:** The programs considered by this document should target individuals or local communities within developing countries, rather than targeting industries or governments.
- **Targeting the bottom of the pyramid (BOP):** The technology-based development projects considered here should focus specifically on the bottom of the pyramid, or BOP. The definition of the BOP market is that used originally by C.K Prahalad in his 2004 book, *The Fortune at the Bottom of the Pyramid*: it defines the bottom of the pyramid as being "the world's 4 billion poor…who live on less than $2 a day".[5]

Scope of Activities

Since the majority of the technology-based development practitioners profiled in this paper work on international development, this paper will largely focus on technology-based development in the international context. However, it must be noted that the theories, methods and even specific innovations discussed by this paper are highly applicable within the United States and other developed countries. Consequently, a

[4] Representative. (2011, Jul 25). Email Interview - USAID Office of Science and Technology. (J. Leland, Interviewer)

[5] Prahalad, C. (2010). *The Fortune at the Bottom of the Pyramid.* New Jersey: Pearson Education.. It should be noted that there is significant disagreement within the development community about what the exact definition of the "bottom of the pyramid" should be. For further reading on this topic, readers are recommended to the latest edition of Mr. Prahalad's book.

deliberate choice has been made to avoid attaching the prefix "international" to "development"; when this prefix is included, it is intended to demonstrate an organization's specific focus.

Additionally, it should be noted that this paper does not attempt to prove either a) that development is best approached through science, technology and innovation, or b) that the United States should be an active participant in international development efforts. Since the DIV program and other similar development initiatives focus on pursuing development through science, technology and innovation, and in light of the President's stated commitment to increasing the role of those fields in development, it is considered a given that U.S. development policy will be following this trajectory in the foreseeable future: the recommendations of this paper are intended to ensure that these activities are conducted as efficiently as possible.

Background

Although the federal government's interest in technology-based development programs is relatively new, technology-based development programs have an extensive history. This section will outline the history of science, technology and innovation in development, and will focus specifically on two major schools of thought that have contributed significantly to this field: the appropriate technology movement, and the more recent social enterprise movement. It will then outline the events leading to the formation of the DIV program, explain the program's structure and function in detail, and examine the program's future prospects in light of the current fiscal climate.

Science, Technology and Innovation in Development

The role of technology in development has been realized for many years. The Solow-Swan economic growth model was the first widely recognized growth model to incorporate the effects of technology on growth. By assuming that technology increases the productivity of workers by a multiplicative factor, the Solow-Swan model can be used to show that growth in technology creates permanent increases in steady-state per-capita output (unlike changes in the savings or investment rate), demonstrating that

technological development is the only viable method of producing economic growth.[6] Later growth models, such as those proposed by Romer, concur with this assertion.[7] Technology-based development projects interpret this theory literally by focusing on either delivering or promoting the use of new technologies to create development outcomes. Such initiatives have appeared throughout the history of development aid, targeting developing countries' economies at a wide range of scales. In the past few decades, two theories of development aid have focused particularly closely on producing development outcomes through the innovative use of technology: the appropriate technology movement between 1960 and the 1990s, and the social entrepreneurship movement from 1980 to today.

Appropriate Technology

The appropriate technology (AT) movement developed primarily out of the work and philosophy of Indian activist and leader Mohandas Gandhi and British economist E.F. Schumacher; it reached the peak of its popularity between 1960 and 1980.

Definition

The concept of appropriate technology has proved notoriously difficult to define. The term was first used by Schumacher in his seminal *Small Is Beautiful*, published in 1973; however, in that context, it was only used in passing, as Schumacher preferred the term "intermediate technology."[8] The characteristics of intermediate technology that Schumacher identified would form the basis of subsequent definitions of appropriate technology. The most important of these characteristics are:

- Significant improvements in productivity over existing, indigenous technologies.
- Preference for labor intensity rather than capital intensity in technology selection.

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[6] Jan Fagerberg, "Technology and International Differences in Growth Rates," *Journal of Economic Literature* 32, no. 3 (Sept. 1994).
[7] Paul M. Romer, "Endogenous Technological Change," *The Journal of Political Economy* 98, no. 2 (Oct. 1990): S71-S102.
[8] E.F. Schumacher, "Small Is Beautiful: Economics as if People Mattered," Nov 6, 2007, http://www.ee.iitb.ac.in/student/~pdarshan/SmallIsBeautifulSchumacher.pdf (accessed Jul 8, 2011). Pp 122-123

- Simplicity of technology and consequent ease of local adoption.

Since the publication of *Small Is Beautiful*, many authors have written extensively on the definition of appropriate technology. Some important characteristics that these works have developed include:[9,10,11,12]

- Small-scale. Typically, appropriate technology programs are intended to implement innovation at the individual scale, although the programs ideally affect large populations.
- Social and cultural acceptability. These are difficult characteristics to define, but are commonly understood to mean that the technology does not negatively interact with local cultural and social structures, and ideally integrates well into those structures. An example of this would be a biogas digester that runs on animal manure. As Ian Smilie points out, many communities in the developing world were extremely reticent to use manure-based fuel systems because of cultural prohibitions, even though this was "…a problem that did not exist in India or China where animal dung had long been a traditional source of fuel."[13]
- Locally sustainable. The technology should be able to be created locally, and should be able to use local inputs.
- Non-detrimental to the environment.
- Contributory to sustainable job and industry creation.

It should finally be noted that many scholars have argued that appropriate technology does not necessarily have all the characteristics outlined above. "…(Special) characteristics…are less important than the overall measure of adaptation to the social and natural environment, which may imply large scale and centralized control in some

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[9] Julian Leland, "DIY Development: Technological Improvements for Sub-Micro Industries in the Developing World," Course Final Paper, Swarthmore College (2010).
[10] Anthony Akubue, "Appropriate Technology for Socioeconomic Development in Third World Countries," *The Journal of Technology Studies* XXVI, no. 1 (Winter/Spring 2000).
[11] Mike Morris, "The Early Years of the National Center for Appropriate Technology," Internal Report (Butte, 2011).
[12] Nicolas Jéquier and Gérard Blanc, *The World of Appropriate Technology*, Book, Organization for Economic Co-operation and Development (Paris: OECD, 1983).
[13] Ian Smilie, *Mastering the Machine* (Boulder, CO: Westview Press, 1991). P. 91

instances, small scale and decentralized control in other or some symbiotic combination of the two."[14] For example, in urban areas, improvement of community water treatment facilities may be more valuable than distributing water filtration systems to households.

History

Although the appropriate technology movement is commonly regarded as originating with the work of E.F. Schumacher in the 1960s, scholars trace its genesis as far back as the 1940s[15], to organizations working in fields that would later be included under the umbrella of "appropriate technology." Additionally at this time, the "sarvodaya" community movement in India, founded by Gandhi, had grown to prominence, and its effects were being felt widely. Jéquier and Blanc find that the number of international organizations involved in appropriate technology remained relatively stagnant until the late 1950s. The field entered its "crystallization stage" between 1957 and 1966[16]. During this period, a number of major appropriate technology organizations including Volunteers in Technical Assistance (VITA) and the Intermediate Technology Development Group (ITDG) were founded, the latter by Schumacher.

Between 1966 and the mid-1970s, the appropriate technology movement had begun to gain widespread traction, in both underdeveloped and developed countries[17]. The average number of organizations created every three years almost quadrupled from "crystallization stage" levels. Additionally, appropriate technology organizations began to broaden their focus, with increasing numbers of organizations focusing on developed-world problems including energy, agriculture, and urban renewal. Finally,

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[14] Harvey Brooks, "A Critique of the Concept of Appropriate Technology," in *Appropriate Technology and Social Values - A Critical Appraisal* (Cambridge, MA: Ballinger, 1980). From Office of Technology Assessment, *An Assessment of Technology for Local Development*, Government Report (Washington, D.C: U.S. Government Printing Office, 1981).

[15] Nicolas Jéquier and Gérard Blanc, *The World of Appropriate Technology*, Book, Organization for Economic Co-operation and Development (Paris: OECD, 1983).

[16] Nicolas Jéquier and Gérard Blanc, *The World of Appropriate Technology*, Book, Organization for Economic Co-operation and Development (Paris: OECD, 1983). P. 25

[17] Jéquier and Blanc, 25.

this period also marked the publication of Schumacher's *Small Is Beautiful*, which arguably brought the concept of appropriate technology to the broader public[18].

By the mid 1970s, aid institutions and developed-world governments were becoming involved in appropriate technology. In the United States, the first major appropriate technology programs were created by the 94th Congress, between 1975 and 1976. These programs included[19,20]:

- the National Center for Appropriate Technology (NCAT), which focused on appropriate technologies for low-income Americans, mostly in the fields of energy conservation and agriculture;
- a series of National Science Foundation (NSF) reports and programs focused on appropriate technology research within the U.S.;
- the creation of Appropriate Technology, International, Inc. (ATI), a private non-profit corporation founded through USAID that funded appropriate technology-focused development activities in the developing world.

Later projects included the creation of the Office of Small-Scale Technology within the Department of Energy, and a number of other agency-specific programs within the U.S. Department of Agriculture and the Environmental Protection Agency.

By the mid-1980s, though, the appropriate technology movement had fallen from favor in the United States and elsewhere. In addition, funding for appropriate technology programs within the United States federal government had never been particularly robust, with annual funding for the aforementioned entities was typically in the single millions annually. For example, the total budget of DOE's Appropriate Technology Small Grants project was usually between $3-5 million[21], while NCAT's budget was around $2

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[18] It should be noted here that at this time, Schumacher still referred to his work as concerning "intermediate technology" rather than appropriate technology.
[19] United States Agency for International Development, *Proposal for A Program in Appropriate Technology*, Congressional Report (Washington, DC: US Government Printing Office, 1977).
[20] Office of Technology Assessment, *An Assessment of Technology for Local Development*, Government Report (Washington, D.C: U.S. Government Printing Office, 1981).
[21] Peach, J. D. (1981, Sept 15). Ineffective Management of the Appropriate Technology Small Grants Program. Washington, DC.

million.[22] Furthermore, the appropriate technology movement had long been perceived as a "passive" aid methodology, because of its small scale, focus on collaboration with local groups, and relatively passive nature. In the aftermath of the Vietnam War, the U.S. public had no taste for "passive" foreign policy[23]: this was exacerbated by the changing political climate of the early 1980s. By the mid-1990s, all four federal organizations mentioned above were either defunct, had lost their grant stream, or had been absorbed by larger private organizations.

In addition to its political troubles, the appropriate technology movement had encountered a number of fundamental problems that it had failed to surmount. Chief among these was the "better mousetrap"[24] tendency of the appropriate technology movement post-1980, where appropriate technology groups would focus almost exclusively on technology development while neglecting to develop diffusion, implementation and upkeep frameworks for the technologies created. By failing to ensure the availability of relevant training, parts and administrative assistance, many appropriate technology groups unwittingly ensured the ultimate failure of their programs.[25,26] Today, the appropriate technology movement in its historical form is commonly regarded as having been "dead" since the end of the 1990s[27], although the term continues to persist in regard to technology-based development.

Lessons Learned

A number of useful lessons can be learned from the failures of the appropriate technology movement.

- **Recognize the importance of technology diffusion and logistical support.** The appropriate technology movement clearly demonstrated that relying on the

[22] Morris, M. (2011, Jul 27). Email Interview. (J. Leland, Interviewer)
[23] Carroll Pursell, "The Rise and Fall of the Appropriate Technology Movement in the United States, 1965-1985," *Technology and Culture* 34, no. 3 (Jul 1993): 629-637.
[24] Ian Smilie, *Mastering the Machine* (Boulder, CO: Westview Press, 1991).
[25] Gupta, A. (2011 6 Jul). Phone Interview. (J. Leland, Interviewer)
[26] Fisher, M. (2010). Income Is Development: Kickstart's Pumps Help Kenyan Farmers Transition to a Cash Economy. *Innovations* , 9-30.
[27] Paul Polak, "The Death of Appropriate Technology I: If You Can't Sell It, Don't Do It," *Paul Polak: Out Of Poverty*, Sept 10, 2010, http://blog.paulpolak.com/?p=376 (accessed Jul 11, 2011).

quality of inventions and the logistic capability of bottom-of-the-pyramid (BOP) consumers to ensure the diffusion of inventions is impractical.[28] Future programs seeking to implement technology-based development programs should be cognizant of this when planning projects.

- **Importance of community involvement in design and diffusion planning.** Appropriate technology organizations too frequently produced products that failed due to unforeseen constraints extant in their target communities. One example of this is the Animal-Drawn Wheeled Tool Carrier, developed by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and others in the 1960s and 70s. The tool carrier performed well in research station conditions, but failed completely in implementation. Local farmers found it easier and less risky to continue to use multiple, separate agricultural implements rather than use the bulky tool carrier and accept the risk associated with its pneumatic tires.[29]
- **Quality control is difficult in distributed production situations.** Many appropriate technology practitioners found, and continue to find today, that local, small-scale production of technology products makes quality control difficult – for products targeted at BOP consumers, the consequent short life and unreliability of the product is unsustainable.[30] Whirlwind Wheelchair International, among other groups, has opted to largely minimize small-scale in-country fabrication because of past quality control issues.[31]
- **Sustained subsidization indicates inappropriateness.** As mentioned above, one of the major criteria for an appropriate technology is that it be locally sustainable: in the pursuit of technological achievement, many appropriate technology programs failed in this respect. Paul Polak, the founder of International Development Enterprises (iDE) points again to the Animal-Drawn

[28] Fisher, M. (2010). Income Is Development: Kickstart's Pumps Help Kenyan Farmers Transition to a Cash Economy. *Innovations* , 9-30.
[29] Starkey, P. (1988). *Animal-Drawn Wheeled Toolcarriers: Perfected yet Rejected.* GATE. Braunschweig: Friedr. Vieweg & Sohn.
[30] Krizack, M. (2011 28-Jun). Phone Interview. (J. Leland, Interviewer)
[31] Krizack, M. (2011, Jul 27). Email Interview. (J. Leland, Interviewer)

Wheeled Tool Carrier as an example of this: "…It cost far too much to be affordable to small African farmers and it relied heavily on donor subsidies for distribution. It eventually died after wasting millions of dollars."[32] Although some effective projects may not be able to survive without subsidy due to market failures, projects should strive for self-sustainability.

- **Considering market impacts of solutions is critical:** Some appropriate technologies, while proving useful, may have undesirable effects on other local economic sectors. Bull and Hazeltine point to how, during the Green Revolution in India, developments in agricultural technology significantly improved the livelihood of agricultural workers and over time the economic condition of the country at large; unfortunately, traditional craft sectors such as carpentry and textiles found "…[that] they were losing business to cheaper or more versatile machines in the nearest city."[33]

Social Enterprise

In recent years, a movement that has begun to fill the void left by the appropriate technology movement is the concept of social enterprise. Unlike appropriate technology, social enterprise is neither specifically focused on development or on technology; it simply describes a business philosophy. However, it has become a major concept in the technology-based development field in recent years, and is relevant to the design and methodology of the Development Innovation Ventures program.

Definition

Like appropriate technology, social enterprise has proved extremely difficult to define. It is used to describe a broad variety of organizations, including both not-for-profit and for-profit organizations. These organizations typically share a number of common features, however, which are expressed eloquently by Haugh and Tracey:

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[32] Polak, P. (2010 10-Sept). *The Death of Appropriate Technology I: If You Can't Sell It, Don't Do It.* Retrieved 2011 11-Jul from Paul Polak: Out Of Poverty: http://blog.paulpolak.com/?p=376

[33] Hazeltine, B. & Bull, C. (1999). *Appropriate Technology: Tools, Choices and Implications.* San Diego: Academic Press.

> "Social enterprise[s] [are] business[es] that trade for a social purpose. They combine innovation, entrepreneurship, and social purpose and seek to be financially sustainable by generating revenue from trading. Their social mission prioritize[s] social benefit above financial profit…"[34]

Because social enterprises typically try to address the market failures created by undervaluation of social improvement, they are consequently not well supported by market structures.[35] Historically, they have relied heavily on grants and subsidies from philanthropic groups and governments: however, "in recent years, many social entrepreneurs have been driving towards the commercial end of the [social enterprise] spectrum…"[36] Finally, although there are many examples of social enterprises using technology to create positive development outcomes, they are neither limited to focusing on development issues, nor to using technology to solve the problems that they attempt to address. However, most contemporary technology-based development practitioners (especially at the smaller scale) describe themselves as social enterprises, making the field relevant to the current technology-based development debate.

History

Although the concept of a business designed to provide a social good is not new, the recent vogue that social enterprise has enjoyed is often credited to the work of Muhammad Yunus, founder of the Grameen Bank in Bangladesh. Yunus, who founded Grameen in 1976, found that dramatic improvements in the well-being of the extremely poor in Bangladesh could be produced at a profit through what is commonly known today as microcredit. This early example of social entrepreneurship has provided a model for future organizations, showing that development and profit were not mutually exclusive. Popularization of the term "social entrepreneurship" is widely credited to William Drayton, the founder of the nonprofit social enterprise incubator Ashoka, in

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[34] Quote from Mair, J. M. (2005). *Social Entrepreneurship Research: A Source of Explanation, Prediction and Delight.* IESE Business School, University of Navarra. Barcelona: IESE Business School.

[35] Dees, J. G. (1998). *The Meaning of "Social Entrepreneurship".* Working Paper, Stanford University, Kauffman Center for Entrepreneurial Leadership.

[36] Dees, J. G. (2009). Social Ventures as Learning Laboratories. *Innovations* .

1980. Like the Grameen Bank, Ashoka has created a model for many similar enterprise incubators, ranging from grantmaking philanthropies to traditional investment groups.

Social Enterprise Today

Today, the field of social enterprise is largely split between these two classes: social enterprises and enterprise incubators. In many cases, former appropriate technology organizations, such as Compatible Technology International and EnterpriseWorks/VITA (formerly ATI – now a division of Relief International) now describe themselves as social enterprises. Arguably, for these and other social enterprise ventures, moving towards this market-driven model is an important and needed move. By selling, rather than giving, a product to developing-world consumers, they ensure that the most "appropriate" product is selected for implementation through the natural selection of the market. Additionally, consumers who pay for a product invest in it, and are thus more likely to follow up with maintenance and future dissemination efforts.[37] Furthermore, even for social enterprises still relying heavily on grant funding and donations, selling a product can still reduce the organization's funding load.

However, social enterprise is still an imperfect model. There is significant contention in the social enterprise community that the amount of funding available to social enterprises is insufficient and/or inefficiently distributed.[38] Additionally, both non-profit and for-profit social enterprises face their own unique problems. Non-profit enterprises are typically unable to offer ownership stakes to potential investors, which limits their ability to utilize traditional investment sources such as angel investors. Even for-profit enterprises are hard-pressed to find investors, since they are usually not able to deliver returns that are competitive with other investment opportunities.[39] Finally, the youth and relative nebulousness of the social entrepreneurship model produces its own problems. Social enterprises are extremely varied in objective, structure and business

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[37] Gupta, A. (2011, Jul 6). Interview about KickStart. (J. Leland, Interviewer)

[38] Center for the Advancement of Social Entrepreneurship. (2008). *Developing the Field of Social Entrepreneurship.* Duke University, The Fuqua School of Business.

[39] Ransom, D. (2008, Sept 12). *Starting Up: Funding Your Social Venture.* Retrieved from The Wall Street Journal: Small Business: http://online.wsj.com/article/SB122124827514029295.html

plan: this makes it extremely difficult for investors to evaluate these enterprises pre-investment, or to understand and compare their impact as they begin to develop. [40]

Recent Federal Involvement in Science, Technology and Innovation for Development

In the past year and a half, the U.S. government has taken significant steps to promote the application of science, technology and innovation to development problems, a number of which are specifically focused on technology-based development programs. The genesis of this policy shift was the release of the U.S. Global Development Policy Directive, released in September 2010. This policy directive was far broader in its impact than any previous development policy, making development a whole-government priority rather than solely the provenance of USAID and the Department of State. It also heavily emphasized the role that science, technology and innovation would play in the new development paradigm.[41]

Contemporaneous to the development and release of the Global Development Policy directive was the Quadrennial Diplomacy and Development Review (QDDR), conducted by the U.S. Department of State and USAID. The QDDR outlined a number of routes for the State Department and USAID to promote science, technology and innovation within their greater missions; among these was the Development Innovation Ventures program.

The Development Innovation Ventures Program

The Development Innovation Ventures program is intended to "identify, develop, test, and scale innovative approaches to achieve cost-effective, scalable approaches to development challenges that correct market and government failures while accelerating

[40] Center for the Advancement of Social Entrepreneurship. (2008). *Developing the Field of Social Entrepreneurship.* Duke University, The Fuqua School of Business.
[41] Office of the Press Secretary. (2010 22-September). *Fact Sheet: U.S. Global Development Policy.* Retrieved 2011 6-July from The White House: http://www.whitehouse.gov/the-press-office/2010/09/22/fact-sheet-us-global-development-policy

promising solutions with a proven impact."[42] In keeping with the shift in development thinking to social enterprise, the DIV program models itself strongly after the work of Ashoka, the Acumen Fund and others as an investor in innovative technology-based development programs. Although it is focused specifically on international development efforts, its purview is not limited to technology-based development programs. Its primary criteria for programs is their innovativeness, and a number of the programs that the DIV program has funded use financial or social tools to promote development.

As of this writing, the primary activity of the DIV program is the provision of grant funding to three "stages" of projects:

- **Stage 1:** Intended to develop projects to demonstrate proof-of-concept. Funding for this stage is usually capped at $100,000.
- **Stage 2:** Intended to allow implementation of existing projects at larger scale. Funding is usually capped at $1,000,000.
- **Stage 3:** Intended to develop existing projects countrywide, or even internationally. Funding is expected to be between $1,000,000 and $15,000,000 for projects in this stage.

Projects may apply for any "stage" of DIV funding, and no special dispensation is given to projects that have previously been awarded funding. All three stages require significant quantitative impact and cost assessment, with requirements rising between stages. Projects are evaluated primarily in terms of their innovativeness, cost-effectiveness and potential to reach sufficient scale to affect tens of millions of people. Other concerns are the experience and talent of key project personnel, and the degree to which new resources are leveraged.[43] Further information about the DIV program can be found at the DIV webpage: www.usaid.gov/div

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[42] USAID. (2011, Jun 22). *Development Innovation Ventures: Innovation*. Retrieved Jul 12, 2011, from USAID: http://www.usaid.gov/div/model.html

[43] USAID. (2011). *Annual Program Statement: FY 11 & FY 12 Development Innovation Ventures.*

Development of the DIV program concept began in July 2010, as the Global Development Policy Directive and the QDDR were being written.[44] A request for proposals was released at the end of September 2010, and the DIV program announced its first round of grantees in October 2010, alongside the public announcement of the program's creation[45]. Roughly $1 million in grants was provided in this first round. The ventures funded were all Stage 1 and Stage 2 programs, and included an affordable fuel cell technology, mobile phone-based health programs, an industry development program focusing on solar lantern creation in Ugandan villages, and a maternal health test technology. More grants are expected to be awarded shortly. A second request for proposals was released in June 2011; additionally, the WASH for Life program, a collaborative effort with the Bill and Melinda Gates Foundation that focuses on providing water, sanitation and hygiene-focused innovations, was announced in July.

Thus far, the DIV program has enjoyed some success, moving it closer to the goal stated in the QDDR of "[becoming] a central mechanism for sourcing and scaling what works."[46] However, its future is still in question. For fiscal years 2010 and 2011, the DIV program reprogrammed existing USAID funds to support itself; the funding received has thus far been put entirely towards grants, with no funding going towards operating costs.[47] In the FY 2012 budget, the first budget request for the DIV program specifically has been made, for $30 million. However, in addition to the possibility of this budget request being denied, a bill introduced in the House of Representatives by Rep. Donald Manzullo (R-IL) seeks to prohibit any current or future funding for DIV program. This bill (H.R. 1625) was approved by the House Foreign Affairs Committee on July 21st: although it has yet to pass the full House or be considered in the Senate, it is a serious threat to the future of the DIV program given the current tight fiscal situation.

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[44] Representative, DIV Program (2011 18-Jul). Phone Interview. (J. Leland, Interviewer)
[45] USAID. (2010, Oct 8). *USAID Announces Development Innovation Ventures Program.* Retrieved Jul 28, 2011, from USAID Press Releases: http://www.usaid.gov/press/releases/2010/pr101008.html
[46] U.S. Department of State. (2010). *Quadrennial Diplomacy and Development Review.*
[47] Representative, DIV Program. (2011 18-Jul). Phone Interview. (J. Leland, Interviewer)

Current Funding Climate

In order to identify how the DIV program can best serve the needs of the technology-based development community, the larger development paradigm within which the program is operating must be understood. Funding is one of the most critical inputs into any sort of development program. In this section, private and public funding options outside of the Development Innovation Ventures program are examined.

Public Funding Sources

Since the demise of the federal appropriate technology programs of the 1970s and 80s, government funding specifically targeted at technology-based development projects has shrunk. USAID provides the vast majority of funding for technology-based development activities, and development generally. Additionally, some government organizations do offer funding programs which have funded or could be used to fund technology-based development projects: these are listed here by organization.

- **USDA:** Through its Rural Development division, USDA offers a number of grants intended for application to development challenges in rural areas of the United States, with a focus on utility- and energy-related projects as well as grants for promoting community development. These grants range between $1,500 and $500,000; the majority of these grants are between $10,000 and $50,000.They also provide a number of information and technical assistance services, including until recently the National Sustainable Agriculture Information Service. This service, which was provided by NCAT, sought to provide technical information about sustainable agricultural practices to farmers and ranchers. Funding for this program was eliminated in the 2011 budget, and has not been restored as of this writing.[48]
- **NSF:** The National Science Foundation focuses primarily on funding basic research in the sciences, and applies this constraint to its efforts regarding technology-based development. The primary funding source for technology-

[48] National Sustainable Agriculture Information Service. (2011). *ATTRA Homepage*. Retrieved Jul 13, 2011, from https://attra.ncat.org/index.php

based development research efforts are grants awarded through the Office of International Science and Engineering (OISE). To date, the OISE has funded basic research projects into alternative energy technologies for developing countries[49] and geologic exploration techniques for well drilling[50]; it also is currently running the Basic Research to Enable Agricultural Development (BREAD) program, which seeks to fund proof-of-concept research into new agricultural technologies and techniques for implementation in the developing world[51]. Awards from NSF programs are typically in the hundreds of thousands of dollars; the expected average award size for the BREAD program is listed at $600,000. Other NSF groups, such as the Environmental Research and Education division, also offer funding opportunities that could be used for technology-based development projects. However, with the exception of the BREAD program, no NSF programs are specifically focused on funding technology-based development solutions.[52]

- **Department of Energy:** Despite its strong history supporting appropriate technologies, the Department of Energy is not currently involved in funding technology-based development programs either within the U.S. or in foreign countries. There are some programs through the Office of Energy Efficiency and Renewable Energy that are conducted with government partners in developing countries; however, these are typically large-scale, national-level programs which target entire industries. The Department is scheduled to contribute $10 million over the next five years to the Global Alliance for Clean Cookstoves (see below); however, it is involved in a research capacity, and is not offering grants to private groups.

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[49] Watrous, A. (2008, Jun 6). *My Research: I Burn Stuff*. Retrieved Jul 13, 2011, from OISE Discovery: http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=111637&org=OISE

[50] Bruning, J. (2009, Jun 5). *The Search for Drinking Water in Nicaragua*. Retrieved Jul 13, 2011, from OISE Discovery: http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=114822&org=OISE

[51] National Science Foundation. (2011, Feb 8). *Basic Research to Enable Agricultural Development (BREAD)*. Retrieved Jul 13, 2011, from OISE Funding Opportunities: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503285&org=OISE&sel_org=OISE&from=fund

[52] It should be noted that NSF and USAID recently signed a memorandum of understanding indicating a shared commitment to foster increased collaboration between academics in the US and in developing countries. Hopefully, this project will lead to further involvement on NSF's part in the development field.

- **Department of State:** The Department of State is involved in numerous development-related projects, including some that are directly related to technology-based development. These include the Global Alliance for Clean Cookstoves (GACC), the Global Innovation through Science and Technology (GIST) initiative, and the 2011: Investing with Impact initiative. The most acutely focused initiative of these is the Global Alliance for Clean Cookstoves, which seeks to provide 100 million clean cookstoves by 2020. Although the initiative is extremely well-funded and has strong momentum, the existence of funding opportunities for technology-based development practitioners, either through the Department of State or through GACC, is unclear. This is widely the case with Department of State programs; while the Department may be involved in a program relevant to technology-based development, they do not directly provide funding for those activities.
- **USAID:** USAID is the primary federal funder of international development projects in the United States. In addition to more traditional development programs such as food assistance, education and medical supply programs, USAID provides funding for technology-based development programs through multiple programs, in fields such as energy, agriculture, humanitarian assistance, water and sanitation, and health. Some technology-based development projects that USAID is involved with are listed below:
    - **Consultative Group on International Agricultural Research:** The CGIAR, which is partially funded by USAID, focuses on developing technologies and policies for small agricultural organizations. Their members include the International Rice Research Institute (IRRI), which was a member of the appropriate technology community through the 1970s and 80s.
    - **Development Grants Program:** The DGP focuses on providing funding to U.S. private volunteer organizations and local, indigenous NGOs. It provides awards between $100 and $2 million for development activities with an average award size of $1 million. DGP also offers significant capacity building support to those organizations.

- **Small Projects Assistance Program:** The SPA is a mission-based program that facilitates collaboration between in-country USAID missions and local Peace Corps volunteers. The development activities typically pursued are "implement[ation of] small, self-help activities such as improving access to clean, potable water while gaining critical training in building latrines, maintaining water systems and reducing the spread of water-borne diseases."[53]
- **Mission-based Programs:** This overview does not cover programs funded by USAID's foreign missions, who have great latitude in what projects they fund. Of the organizations contacted for this paper, EnterpriseWorks/VITA and Kickstart had collaborated with foreign missions; both organizations had largely positive experiences working with USAID in this capacity.[54,55]
- **Grand Challenges for Development:** The Grand Challenges for Development program is one of the broadest and most visible of the programs listed here. The Grand Challenge (only one has been announced thus far) has consisted of a $13 million grant program funded by USAID along with private and foreign public partners[56]. It will distribute two types of grants: grants of up to $250,000 for proof-of-concept development, and grants of up to $2 million for transitioning programs to scale. These grants are distributed to private entities with programs focused on the topic of the Grand Challenge – in the case of the first Grand Challenge, reducing mother and child mortality rates during childbirth. Future Grand Challenges focusing on education, energy and agriculture are planned for the next few years.

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[53] USAID. (2011, Jun 15). *Private Voluntary Cooperation*. Retrieved Jul 13, 2011, from USAID Cross-Cutting Programs: http://www.usaid.gov/our_work/cross-cutting_programs/private_voluntary_cooperation/index.html#dgp
[54] Naugle, J. (2011 6-Jul). Phone Interview. (J. Leland, Interviewer)
[55] Gupta, A. (2011 6-Jul). Phone Interview. (J. Leland, Interviewer)
[56] Grand Challenge For Development. (2011, Mar). *Frequently Asked Questions.* Retrieved Jul 13, 2011, from Saving Lives At Birth: http://savinglivesatbirth.net/sites/default/files/faq.pdf

Private Funding Sources

Private funding for technology-based development programs, and social enterprises (both for-profit and non-profit) more broadly, is available from a wide range of sources, including philanthropic organizations, universities, crowdsourcing websites, competition foundations, banks, and traditional investment groups among others. There are hundreds of private funding sources available throughout the world[57], providing funding for activities in a wide variety of fields. Although there are far too many potential funding sources to detail individually, even within the subset of groups focused on technology-based development, a brief listing of some of the more important groups in the field follows. While not exhaustive, this list is intended to be representative of the types of funding opportunity available and the mechanisms by which they are provided.

- **Ashoka:** One of the oldest groups involved in social enterprise funding, Ashoka focuses on supporting individual social entrepreneurs and social ventures through competitions and their flagship Ashoka Fellows program, which pays a living stipend to social entrepreneurs for three years. Ashoka does not focus specifically on the developing world, or on technology-based development, but is involved in both areas.
    - **Similar Organizations:** Echoing Green, Lemelson-MIT Program.
- **Acumen Fund:** The Acumen Fund is a younger social enterprise incubator, which focuses exclusively on BOP communities. Acumen provides funding through investment in the form of "patient capital" – an investment where social returns are valued over financial returns, and which allows high investment risk and long return timeframes. Acumen's investments typically range in size between $300,000 and $2,500,000: as of 2009, they had $25 million invested in their five portfolios (water, health, housing, energy and agriculture)[58]. Acumen also offers a yearlong fellowship program, enabling nascent social entrepreneurs to gain experience working with existing organizations in Acumen's funding portfolio.

[57] Ned.com. (2011, Feb 24). *Social Entrepreneurship Funding.* Retrieved Jul 14, 2011, from Ned.com: http://www.ned.com/group/seeb/ws/social_entrepreneur_funding/

[58] Acumen Fund. (2009, Dec 31). *Financial Information.* Retrieved Jul 14, 2011, from Acumen Fund: http://www.acumenfund.org/about-us/financial-information.html

- **Similar Organizations**: Grassroots Business Fund, Invested Development.

- **AKVO:** AKVO is a Netherlands-based organization that strives to connect development organizations with potential funders through an online "crowdsourcing" interface, which facilitates progress reporting by the development organizations. They focus primarily on water, sanitation, education, health, agriculture, and internet and communications technologies (ICT) projects. Funding is currently donation-based, although most organizations are entrepreneurial projects seeking to become sustainable businesses. Funding requests are screened by AKVO before being posted to the AKVO projects page. Once there, potential funders (both individual and institutional) can browse through and fund projects directly from the website interface. Historically, the mean funding request for programs featured by AKVO has been around €15,000.[59]
    - **Similar Organizations:** GlobalGiving, Kickstarter.
- **Skoll Foundation:** The Skoll Foundation funds organizations via grants given through the Skoll Awards for Social Entrepreneurship program. Applicants are typically larger, more developed organizations; they receive a three-year core support grant, as well as an award for the organization's founder(s). The organization distributed nearly $21 million (individual grants of approximately $1 million) in FY 2009 to individuals working in a variety of fields, the majority of which focus their work in the developing world.[60]
    - **Similar Organizations:** The Bill and Melinda Gates Foundation, Draper Richards Kaplan Foundation.
- **InnoCentive:** InnoCentive allows organizations to offer awards for solutions to problems to the wider community through their website interface. Although the organization is not focused on development, its Developing Countries and Global Health pavilions both feature a number of technology-related development projects. Additionally, the LAUNCH program (a joint program funded by the U.S.

[59] van der Linde, P. (2011, Jul 9). (J. Leland, Interviewer)
[60] Skoll Foundation. (2009). *2009 Annual Report.* Retrieved Jul 14, 2011, from The Skoll Foundation: http://www.skollfoundation.org/wp-content/uploads/2010/10/2009_annual_report.pdf

Department of State, USAID, NASA and Nike) was run through InnoCentive. InnoCentive has coordinated awards between $5,000 and $1,000,000, and has over 1,300 challenges posted to its site.

- **Similar Organizations:** MIT Muhammad Yunus Innovation Challenge, NextBillion Case Writing Competition, Apps For Development.

Interview Results

Despite the many sources of funding available to technology-based development practitioners, there are still challenges that are not addressed through existing funding mechanisms, gaps in funding streams that organizations struggle to cover, and market failures that prevent organizations from realizing their full potential. In order to identify these failings in the technology-based development market, 26 interviews were conducted with a wide variety of organizations, including government organizations within both the U.S. and foreign governments, non-governmental organizations, private philanthropies, university groups, private businesses, and individuals involved in technology-based development theory or practice. Although not all organizations interviewed are featured here, a full list of organizations interviewed for this report is attached in Appendix 1: Interviewed Organizations. Further information about these interviews may be obtained from the author by request.

Interviews were conducted via email, phone, or a combination of the two, between June 17th and August 1st. Although interviews were not conducted using a questionnaire form, all followed a similar format and used a common base question set which was modified to be appropriate to the organization being interviewed. A copy of the standard interview question set is attached to this document, and may be seen in Appendix 2: Sample Questionnaire.

The interviews conducted yielded a number of insights into problems in the current technology-based development paradigm. These insights are included here, along with background information on the interviewees and brief anecdotes about their experiences.

Social enterprise models are becoming more common – but are not self-sufficient.

Although only half of the organizations interviewed described themselves as social enterprises or supported themselves through the sale of their technologies, the organizations that did so were among the "youngest" organizations interviewed. They included groups such as Dimagi (one of the first DIV grantees), Kickstart (a well-known designer and manufacturer of foot-powered water pumps), and Global Cycle Solutions (a small, recently incorporated group producing bicycle-powered cell phone chargers and corn shellers). Additionally, some older groups such as Compatible Technology International have transitioned recently "from a classic missionary model to a model that aims to be largely sustaining from….donor contributions and earned income from its technologies."[61]

Unfortunately, despite this trend, very few of these organizations were actually able to self-sustain without donor contributions. Most organizations only managed to provide 5-25% of total funding through product sales[62,63,64]. Even Dimagi, which is self-sustaining, points to the DIV grant as having allowed them to shift their research and development focus from addressing the needs of specific consumers to strategic R&D projects[65] – indicative of the limited financial flexibility of these companies.

There is insufficient funding at small scales.

Some organizations described a dearth of available funding between $1,000 and $100,000. Especially for the smallest organizations, this proved extremely problematic. Because of the tremendous competition for available funding at this level[66], many programs had been unable to complete pilot projects that would have allowed them to expand further. The broad consensus on the dollar amount required for pilot projects

[61] Salway, R. (2011, 6 29). Email Interview. (J. Leland, Interviewer)
[62] Mokrauer-Madden, D. (2011, Jun 30). Phone Interview. (J. Leland, Interviewer)
[63] Salway, R. (2011, 6 29). Email Interview. (J. Leland, Interviewer)
[64] Fisher, M. (2011, Aug 1). Phone Interview. (J. Leland, Interviewer)
[65] Jackson, J. (2011, Jul 5). Phone Interview. (J. Leland, Interviewer)
[66] Gupta, A. (2011, 6-Jul). Phone Interview. (J. Leland, Interviewer)

was between $50,000 and $100,000[67,68], a range which DIV already services through its Stage 1 funding stream.

It should be noted that most organizations believed that the root cause of this funding dearth was the administrative requirements placed upon grant organizations providing these small grants. Compatible Technology International described approaching a major private foundation for grants but ultimately being rejected because, from the perspective of that organization, "it takes as much time to [administer] a $10,000,000 grant as it does a $100,000 grant.[69]"

Grant-making process is inflexible and slow.

The most common complaint of organizations interviewed about the current technology-based aid paradigm was that the grant-making process is inflexible and slow, especially in the case of government grants. Of the five organizations interviewed that were familiar with the DIV program, only three had actually applied for grants: the other two, the Appropriate Infrastructure Development Group (AIDG) and Global Cycle Solutions (GCS) had chosen not to do so because of the time and personnel requirements that the grant entailed. Many other organizations reported similar experiences both with government and private funding sources. Even groups who had applied for or received USAID grants described low payoff-per-time-spent ratios[70], onerous reporting requirements[71] and long lag times[72], especially in the case of smaller grants.

Implementation of successful, sustainable programs takes time.

Many organizations emphasized the importance of recognizing the amount of time required to successfully implement programs, even on very small scales. Estimates of

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[67] Barrie, J. (2011, Jul 14). Phone Interview. (J. Leland, Interviewer)
[68] Salway, R. (2011, 29-Jun). Email Interview. (J. Leland, Interviewer)
[69] Salway, R. (2011, 29-Jun). Email Interview. (J. Leland, Interviewer)
[70] Salway, R. (2011, 29-Jun). Email Interview. (J. Leland, Interviewer)
[71] Krizack, M. (2011 28-Jun). Phone Interview. (J. Leland, Interviewer)
[72] Jackson, J. (2011, 5-Jul). Phone Interview. (J. Leland, Interviewer). It should be noted that Dimagi did not find that the DIV grant process was prone to these long lag times – they describe it as having a fast turnaround time.

implementation time requirements ranged between 3 years and 5 years. Typically, organizations who quoted time requirements lower than three years also quoted commensurately higher funding requirements. For example, EnterpriseWorks/VITA indicated that it would require "[between] $500,000 and $750,000 annually over at least 3 years to successfully implement a regional program to transfer technology to the private sector"[73].

The importance of recognizing the amount of time required to successfully implement a program may be especially applicable to the DIV program. Dr. Martin Fisher, the founder of Kickstart, points out that while "…new software solutions, which have scaled on the back of hardware solutions, have scaled rapidly…scaling a brand-new physical product through the private sector takes a much longer time." He suggests 10-15 years as a reasonable time frame for hardware products to be brought to scale.[74] The level of scaling required by the DIV program – namely, reaching millions of people within ten years – is only really feasible for ICT- or business-centric projects; successful funding of lower-tech projects may require relaxing scaling time requirements.

Better visibility of programs is important.

Out of the eighteen technology-based development organizations interviewed, ten (including some large, well-established groups) described themselves as either unaware or only marginally aware of the existence of the DIV program. Even organizations that were involved with USAID through other programs, such as Whirlwind Wheelchair, were only vaguely aware of the DIV project[75].

Conclusions and Recommendations

By considering the current state of the funding paradigm surrounding technology-based development, as well as the needs of the technology-based development community, a number of recommendations for the DIV program have been developed to maximize

[73] Naugle, J. (2011, Jul 6). Phone Interview. (J. Leland, Interviewer)
[74] Fisher, M. (2011, Aug 1). Phone Interview. (J. Leland, Interviewer)
[75] Krizack, M. (2011 28-Jun). Phone Interview. (J. Leland, Interviewer)

the utility of the program to that community. Although they are specifically targeted at the DIV program and its interaction with the technology-based development community, the majority of these recommendations will benefit all of the development communities serviced by the DIV program.

Observations

- **There is significant and growing interest in technology-based development programs.** As the interviews presented above show, more organizations appear every day striving to address development problems through the leverage of innovative technological solutions. They are primarily approaching the problem from a business perspective, seeking to create self-supporting social enterprises that can serve the bottom of the pyramid. In addition to these newcomers to the field, there are a number of older organizations transitioning from classical "missionary-style" models to the new market-based paradigm. The DIV program, and other science, technology and innovation-centric development initiatives, are in a prime position to meet this upsurge in involvement and embrace its new market-based philosophy.
- **There are market failures within the funding system for technology-based development projects that the U.S. could address.** Through looking at the existing funding climate and the reported experiences of technology-based development practitioners, it is clear that the existing funding system for technology-based development initiatives is imperfect. For small organizations, there are few funding opportunities available that are appropriate to their size, and the funding process is extremely costly for these organizations to navigate in terms of time and organizational effort. Furthermore, the existing conventions of the funding process also reduce incentives for funding providers to offer small grants to service this sector of the market, since it costs them only marginally less to service a small grant as opposed to a large grant. Finally, there is tremendous competition for existing funds, potentially causing many game-changing innovations to be ignored.

Recommendations

Short Term

- **Improve publicity of the DIV program's funding opportunities.** As mentioned earlier, of the organizations interviewed, only five were familiar enough with the DIV program to evaluate whether or not to apply; among the organizations who were not familiar with the DIV program were a number that had been previously involved with USAID. Especially with regards to programs targeted at the technology-based development community, it is important that the DIV program and other similar opportunities be sufficiently well-publicized. Advertising new programs through community web hubs such as Engineering For Change, or soliciting proposals from existing organizations, could both help increase federal development programs' throughput.

- **Broaden/modify definition of innovative technologies.** Thus far, the DIV program has focused largely on "high-tech" solutions that have the potential to scale rapidly. This produces rapid results, but the program also needs to recognize that simple, low-tech solutions such as the pine needle cookstove or solar autoclave (both featured at a forum hosted by USAID in March 2010)[76] have potential to contribute to development outcomes at far lower cost than many higher-tech solutions, albeit with a similarly lower scaling rate. Unfortunately, under the current project evaluation system, it is unclear that this slower scaling rate of these projects is fairly accounted for. The DIV program should be careful not to ignore valuable, effective solutions in the pursuit of rapid scalability by ensuring that low-tech projects with lower scaling rates are fairly evaluated against other faster-scaling projects, such as ICT- and financial-based projects.

[76] USAID. (2011, Mar 17). *Transforming Development through Science, Technology and Innovation*. Retrieved Jul 15, 2011, from USAID.gov: http://www.usaid.gov/scitech/

- **Increase emphasis on sustainability of solutions.** The importance that the appropriate technology movement placed on the sustainability of solutions is still highly relevant; many of the organizations interviewed for this report pointed to the long-term or local sustainability of their solutions as one of their primary strengths. In the current Annual Program Statement, however, little importance is placed on either characteristic. While it is mentioned that programs seeking Stage 3 funding should be able to "demonstrate scalability and sustainability at [the] multi-country level," the value of long-term sustainability is not nearly as clearly emphasized for Stage 1 and 2 projects, and there is no specific mention of local sustainability. While this lack of specific emphasis may simply be due to the necessity of writing a broadly applicable, nonspecific program statement, it is an unfortunate omission.

  DIV should ensure that the sustainability of solutions is sufficiently weighted in selecting between projects, and should clearly indicate the value of these characteristics in its annual program statement. It should evaluate the sustainability of solutions both in terms of the reliability and efficiency with which implementing organizations can continue to support their solutions in the long-term, and to what degree the technology implemented can be maintained and expanded by the targeted population. Additionally, strong preference should be given to projects that create local businesses as part of their program. At higher funding stages, the DIV program should recognize the current trend towards social enterprise models and give funding preference to organizations based on the degree of sustainability available to their business models. By clearly emphasizing the importance of long-term and local sustainability of solutions, the DIV program will attract more cost-effective solutions, as well as solutions which may be able to support themselves within developing countries.

Long Term

- **Focus more on providing small-scale funding opportunities.** Currently, the gap in funding for technology-based development activities is at the bottom of the

funding scale, between what individuals or small groups can raise on their own (under $10,000) and the lowest level of funding provided by groups like the Acumen Fund ($300,000). Providing funding for this range of activities would allow more innovations to be developed first to the proof-of-concept stage (an area that the DIV program is equipped to support), and then on to the pilot phase, where private funders such as those mentioned earlier would take over. At this stage, these existing funding organizations would be better-equipped than the DIV program to address these funding needs through virtue of their greater experience, long-term stability and larger contact networks.

- **Investigate new funding methodologies.** In order to appropriately service these smaller grants, the DIV program needs to investigate alternative funding methodologies. As examples above show, the time and effort required to apply for the existing DIV grants are too great for most small technology-based development practitioners. Furthermore, the timescale of current funding opportunities – both the lag between when the funding is applied for and when it is received, and the length of time over which the funding is to be used – may be shutting out some potential producers of development solutions such as undergraduate university programs. Of course, any strategy pursued would still need to be resistant to fraud, and ensure that investments were not wasted. However, successful implementation of such a program, and the consequential redirection of the DIV program's focus, could actually result in an increase in impact per dollar spent as more development solutions were developed to a stage where other funding mechanisms could support them.

  To accomplish this, the DIV program could consider a number of different alternative funding strategies, including:

  - **Microloans to early-stage development practitioners**: Organizations could be allowed to apply for low- or zero-interest loans from the DIV program to

finance early development of their products. They could then either pay these loans off traditionally, or have their loan forgiven by DIV in the event that they applied for and received higher-level DIV grants. While an organization carried a loan with DIV, it would not be allowed to apply for other U.S. government funding, effectively blacklisting organizations that defaulted on their commitments.

- **Crowdsourced funding clearinghouse**. The DIV program could host a site similar to that run by AKVO, where organizations could list their projects and request funding. This listing would be available to the wider development community, but would also be circulated within the USAID network, allowing local missions with particular interest in a solution to invest in it.

- **Light-overhead traditional grants.** A less-intensive version of the current DIV Concept Note form could be developed, allowing organizations without existing performance records or contacts in their target markets to pursue DIV grants. Concurrently, a fourth funding "stage" could be established, distributing grants between $5,000 and $50,000. This would effectively prevent new organizations from having to compete against more established groups.

- **Leverage other U.S. government assets to assist technology-based development practitioners.** USAID has many useful assets at its disposal that it could potentially leverage to assist development practitioners. The primary areas where this would be most useful are in logistics/transport and in implementation, both problematic areas for some of the groups interviewed.

  One possible resource that could prove useful to technology-based development practitioners is the Small Project Assistance program, a collaborative effort

between USAID's Office of Private and Voluntary Cooperation and the Peace Corps. While this program has historically been used to allow Peace Corps workers to partner with USAID on development projects, it could also be a mechanism for partnership with USAID grantees, wherein Peace Corps volunteers could assist grantees with the implementation of their projects.

Another potentially useful resource would be federal logistics resources. Two of the organizations interviewed – Whirlwind Wheelchair and GCS – pointed to the cost of shipping their product from production facilities to their target communities as one of their primary incurred costs. If these costs were reduced through government logistics resources, the costs of their product and the consequential increase in their impact could be significant. Some existing programs at USAID could serve as frameworks for such an addition to the DIV program, such as the Ocean Freight Reimbursement Program.

Conclusion

The Development Innovation Ventures program offers tremendous promise, through both the valuable programs it seeks to fund as well as the profound shift in approach to development practice that it represents for USAID. The aforementioned recommendations are intended to help the program deliver on that promise. However, given the recent threats to the budget and existence of the DIV program, it is unclear whether these recommendations will even have a program to be implemented on. The science and engineering communities, too, have a part to play in implementing these recommendations and helping the DIV program to grow and expand; they should work to support and maintain the existence of the DIV program, both through patronage of the program and through political activism. Like any bold experiment, the DIV program needs adequate time and attention to deliver valid measurements of its performance. Considering the tremendous opportunities that the DIV program provides to leverage science, technology and engineering to make a positive difference in the developing

world, we in the science and engineering communities must at least ensure that this program is given a sufficient opportunity to demonstrate its value.

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Appendix 1: Interviewed Organizations

This list contains all the organizations and individuals that were interviewed for this report, organized alphabetically.

Organizations

AKVO

Appropriate Infrastructure Development Group

Appropriate Rural Technology Institute

Appropriate Technology Collaborative

Compatible Technology International

Dimagi

Ecological Building Network

EnterpriseWorks/VITA (a division of Relief International)

The Empowerment Plan

Global Community Development

Global Cycle Solutions

International Development Enterprises

Kickstart International

Maya Pedal

National Center for Appropriate Technology

Practical Action UK

USAID Development Innovation Ventures Program (DIV)

USAID Office of Science and Technology (PPL)

Water For People

Whirlwind Wheelchair International

Individuals

Dr. Bernard Amadei, University of Colorado at Boulder

Dr. Martin Fisher, Kickstart International

Noha El-Ghobashy, Engineering for Change

Dr. Paul Polak, International Development Enterprises

Appendix 2: Sample Questionnaire

This is the basic question list that all interview question lists were drawn from. This list is targeted at technology-based development practitioners: in some cases (especially for government organizations), these questions were heavily modified.

Questions:

- _____'s Project and Model
    - How would you describe _____'s aid model? Why is this aid model the best option for your goals?
        - Are there alternative models that you think are better suited to other problems?
    - How many people do your activities serve?
- Determining Project Effectiveness
    - What metrics does _____ use/recommend for determining project effectiveness?
    - Do you have any studies demonstrating the effectiveness of your programs, especially in contrast to traditional aid projects?
- Where does _____ receive its funding?
    - What (if any) percentage comes from the U.S. government? How is this funding obtained?
    - **Are you aware of the existence of the Development Innovation Ventures fund, available through USAID?**
- I am specifically interested in small-scale, low-cost, appropriate technologies that are intended to be locally sustainable (local populations are able to repair/recreate the technology with locally available tools and materials).
    - Is this the kind of technology that the developing world needs? How would you modify this definition to reflect the developing world's needs/the realities of the aid world?
    - **I'm concerned that market failures make this sort of technology difficult to produce with a for-profit model**. What are your thoughts on this?
    - In your organization's experience, how much money is required to take a project from problem identification to a point where the local community is able to move the project forward autonomously/with minimal advisement?
    - What recommendations would you make for a federal program to support programs focused on the technologies I describe above?
- Who else should I talk to?