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ACRONYMS

AAA	American Anthropological Association
AC	Alternating Current
ADSL	Asymmetric Digital Subscriber Line
ANA	Afghan National Army
ATA	Analogue Telephone Adaptor
BTA	Basic Telecommunications Agreement
CDMA	Code Division Multiple Access
CIA	Central Intelligence Agency
COG	Center of Gravity
CLIC	Community Learning and Information Center
CROPS	Culture, Religion, Organizational patters, Perceptions of U.S., Societal markers
CRT	Cathode Ray Tube
DC	Direct current
DSL	Digital Subscriber Line
DWT	Double Walled Tank
EBU	Electronic Bailiff Unit
EPA	Environmental Protection Agency
FCC	Federal Communication Commission
FDA	Food and Drug Administration
GATS	General Agreement on Trade and Services
GDP	Gross Domestic Product
GICT	Global Information and Communication Technologies
GISC	Global Innovation and Strategy Center
GPS	Global Positioning System

GSM	Global System for Mobile communications
GSMA	GSM Association
HTS	Human Terrain System
ICASA	Independent Communications Authority of South Africa
ICT	Information and Communication Technologies
IFC	International Finance Corporation
IGO	Intergovernmental Organization
IMCO	Independent Medical Co-Op
ISP	Internet Service Provider
ITAFE	Internet Technology Access for Everyone Initiative
ITU	Internet Telecommunications Union
LCD	Liquid Crystal Display
LEC	Local Exchange Carrier
LED	Light Emitting Diode
LRA	Lord's Resistance Army
MFI	Microfinance Institute
MSF	Médecins Sans Frontières
MTN	Mobile Telephone Network Uganda
NASA	National Aeronautics and Space Administration
NFA	National Front of Afghanistan
NGO	Non-governmental Organization
NRM	National Resistance Movement
NSF	National Sanitation Foundation
OECD	Organization for Economic Co-Operation and Development
OLPC	One Laptop Per Child
PIH	Partners In Health
PMESII	Political, Military, Economic, Social, Infrastructure, and Information systems

POTS	Plain Old Telephone Service
PSTN	Public Switched Telephone Network
PV	Photovoltaic
PVA	Photovoltaic Arrays
SDV	Seawater Desalination Vessel
SOPAC	South Pacific Applied Geoscience Commission
SSL	Space Systems Loral
UofM	University of Michigan
UN	United Nations
UPDF	Ugandan People's Defense Force
URC	Uganda Railways Association
USAF	United States Air Force
USAID	United States Agency for International Development
USCENTCOM	U.S. Central Command
USD	United States Dollar
USPACOM	U.S. Pacific Command
USSTRATCOM	U.S. Strategic Command
UTL	Uganda Telecom Limited
VHS	VIKA Hardware Selector
VIKA	Village Infrastructure in a Kit-Alpha
VoIP	Voice-over-Internet-Protocol
VSAT	Very Small Aperture Terminal
WHO	World Health Organization
WSIS	World Summit on Information Society
WTO	World Trade Organization

PREFACE

This report is the product of the United States Strategic Command (USSTRATCOM) Global Innovation and Strategy Center (GISC) internship program. A team of graduate and undergraduate students from the University of Nebraska-Lincoln, University of Nebraska-Omaha, and Creighton University worked together to provide this multidisciplinary, unclassified comprehensive report.

The Spring 2009 team was tasked to investigate potential designs, and methodologies to develop, test, manufacture, and deploy a Village Infrastructure in a Kit-Alpha (VIKA). The purpose of the kit would be to provide power, a water production and purification system, and telecommunications capabilities for villages of 500-1,000 people in approximately 200 homes. The kit would concentrate on electrical generation and distribution, and water purification and distribution.

This project took place between January and May of 2009, with each team member working twelve to twenty hours per week. While the GISC provided the resources and technology for the project, development of the project design, conducting research and analysis, and providing recommendations were left solely up to the team.

EXECUTIVE SUMMARY

Deterrence is a primary objective of the U.S. Strategic Command and can be indirectly achieved by creating opportunities for development, stability, and strategic alliances with underserved populaces. As mentioned by experts, individuals often participate in terroristic activities as a means of generating income to support his or her family, or village. A Village Infrastructure in a Kit-Alpha (VIKA) provides essential services and meets humanitarian needs, presenting an alternative to committing acts of terrorism. Specifically, VIKA would contain a method of energy generation, water production or purification, and telecommunications, all of which have been linked to increased development and stability. Furthermore, VIKA could lessen the odds of anti-U.S. sentiments and attacks as it would be provided by the U.S. to underserved populaces by means of the deterrence mission. However, the three basic components of energy, water, and telecommunications are not the only factors to be considered when implementing the VIKA. The local political, economic, and social climates must also be addressed in order to assure acceptance and successful implementation occurs.

The initial focus of the project was to identify available technologies that could be used in the VIKA which should cost less than \$40,000, consist of sustainable technologies, and serve 500 to 1,000 people.

After speaking with experts ranging from international development to sustainable technology, it became clear to the team that a significant obstacle to the success of VIKA would depend heavily on the acceptance of the technology and U.S. intervention. An analysis of a community's socio-cultural elements must take place prior to implementation. To this end, the team developed the Culture, Religion, Organizational patterns, Perception of U.S., and Societal markers or

CROPS framework to aid in this analysis effort. Additionally, in order to expedite the process of deploying the VIKA, the team constructed a notional computer program called the VIKA Hardware Selector (VHS) that would take into account geography, population size, climate, and other factors necessary in determining the composition of the VIKA. Additions to the VHS could include cultural, political, and economic variables.

The team was allotted 120 days to conduct unclassified, open-source research, write a comprehensive report, and provide an executive briefing to the U.S. Strategic Commander and Staff, U.S. government agencies, academia, industry, and contributors. The team proposed six strategies for successful implementation of the VIKA:

- Analyze existing economic and political conditions of states and villages
- Incorporate CROPS analysis into existing PMESII framework
- Utilize VIKA Hardware Selector to choose appropriate technology
- Establish efficient supply chain to ensure quick implementation of the VIKA
- Generate community ownership with methods such as microfinance
- Cooperate with U.S. government agencies and non-governmental agencies to sustain the VIKA

INTRODUCTION

To strengthen tactical, operational, and strategic initiatives, interested parties worldwide desire to build strategic alliances at the base level of partner nation societies. In addition to offering basic human services, the U.S. seeks to take advantage of the VIKA to create goodwill among the most underserved populations in the world. These kits could be capable of providing renewable energy, water, and telecommunication services, and therefore could impact economic activity, community stability, and loyalty to the U.S. in partner countries.

The team broadly defined “underserved” as any group of people lacking the basic necessities of food, water, and shelter. Although the VIKA would not generally provide a means of shelter, the potential economic growth the kit is intended to generate could provide additional resources for the development of shelter. Additionally, it is important to note that not all eligible populations for a VIKA could be completely lacking all three necessities, but even a community having shelter and food but no clean water source could be a potential recipient of the VIKA. Therefore, it is important to consider the parameters for the VIKA provided by the customers: serving a village of 1000 people or fewer, and costing at or below \$40,000. These parameters will be naturally self-limiting in terms of communities to which the VIKA could be deployed.

Deficient economies in partner countries can lead ordinary citizens to consider violence as a means of generating income. In a personal interview, Stephen Epstein, an official at the U.S. Department of State involved in civil affairs in Iraq, verifies this reality when stating “In Iraq, planting a bomb is a business opportunity. It could get you a few hundred dollars.”¹ While some

¹ Epstein, Stephen. Personal Interview. 20 Feb. 2009.

people perform terrorist activities for ideological reasons, others are motivated by economic considerations, and providing economic opportunity is one way to deter citizens from taking up arms to provide for their families and themselves.

No matter the motive, grassroots insurgency in the armed conflicts in Iraq and Afghanistan over the last eight years has undermined traditional war-fighting techniques. Suicide bombers, improvised explosive devices, and rocket-propelled grenades repeatedly place U.S. armed forces abroad in significant danger. The growth of guerilla warfare has fundamentally altered strategic approaches to combat; technological and hard-power advantages held by U.S. forces do not always equate to the upper hand in these non-traditional conflicts. Military interest in the VIKA demonstrates greater emphasis on soft power techniques to complement U.S. hard power capabilities. As Christian Wagner, in his publication “From Hard Power to Soft Power: Ideas, Interaction, Institutions, and Images in India’s South Asia Policy,” wrote, “Soft power strategies emphasize common political values, peaceful means for conflict management, and economic cooperation in order to achieve common solutions.”² At least at face value, it appears as though the VIKA could affect these facets of soft power by increasing economic activity and helping to develop a longstanding relationship between the U.S. and a local community abroad.

The VIKA seeks to address the problem of how to gain strong, loyal allies at the base level of a society. Accordingly, the VIKA project’s tasks include identifying sustainable energy technologies, water generation and purification, and telecommunications (or telecom), as well as understanding how the U.S. can benefit from successful implementation. After further research, the VIKA team sought to generate an objective method to determine the appropriate hardware

² Wagner, Christian. “From Hard Power to Soft Power? Ideas, Interaction, Institutions, and Images in India’s South Asia Policy.” *Heidelberg Papers in South Asian and Comparative Politics*. 23 Mar. 2009 <<http://archiv.ub.uni-heidelberg.de/volltextserver/volltexte/2005/5436/pdf/hpsacp26.pdf>>.

for specific regions and to consider implementation methods for mutual effectiveness. In response to the tasking, the VIKa team has identified a hierarchy of strategic initiatives for VIKa deployment: primarily, the deployment of the kit intends to foster strong alliances at the base of an underserved community. Once the initial efforts of the kit establish trust with the community, VIKa deployment could complement the socio-cultural aspects inherent in the community. Advanced provision of basic services by the VIKa may encourage economic development and empowerment of underserved communities, build goodwill, and counteract base-level insurgency. The execution of these three initiatives could create firm, strategic grassroots alliances with the underserved populaces in U.S. partner countries. These alliances can certainly be mutually beneficial for the U.S. and its allies. Figure 1 is a visual interpretation of the VIKa's hierarchical initiatives.

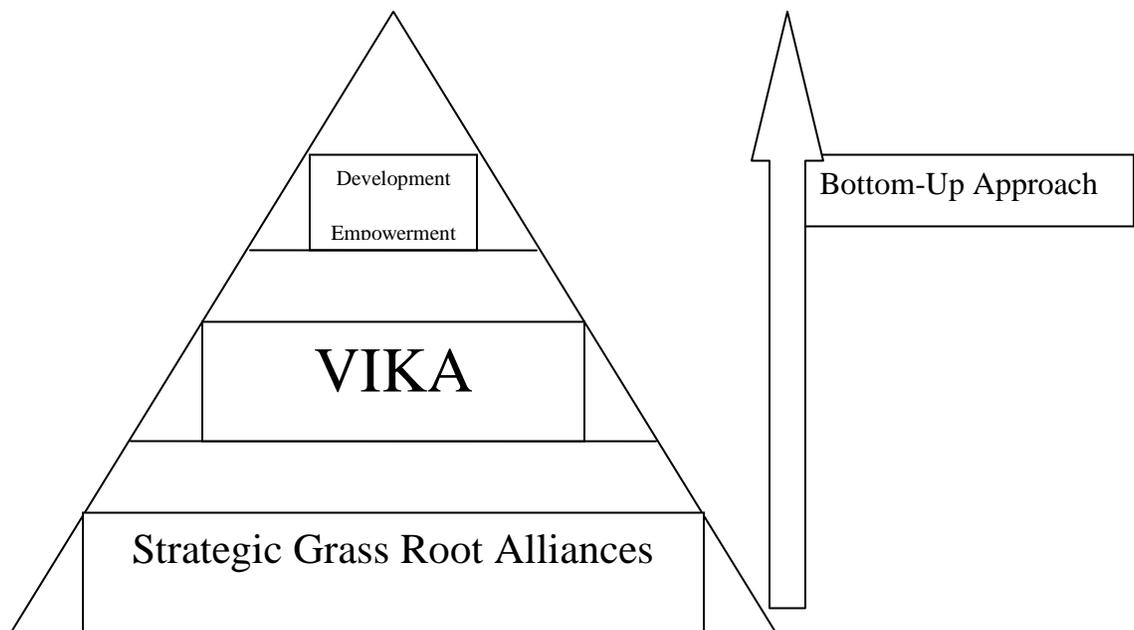


Figure 1: VIKa Strategic Initiatives

The desired outcome of this project is the manifestation of these intangible goals (i.e., economic development, empowerment, and goodwill) via a tangible package of technology, which reinforces USSTRATCOM's mission to, "...Deter attacks on U.S. vital interests...."³ VIKA fits into this mission because it is a measure to prevent conflict before it even begins to take root. Before VIKA implementation, forming community relationships could be a firm basis for executing the U.S. Strategic Command's (USSTRATCOM) deterrence mission by improving options for income, health, and information connectivity. Availing these resources to the underserved people in partner countries can positively influence sentiment towards the U.S. and general social, political, and economic stability in a targeted region.

In the past, the U.S. used its commanding military strength to overcome its opponents and advance U.S. interests. Both World War I and World War II document the overwhelming advantage of the U.S. in conventional tactics. In recent years, however, the shift in emphasis to cooperative determination for post-conflict reconstruction is noticeable. To construct a war-fighting strategy that integrates hard and soft power components, the November 2005 Department of Defense Directive 3000.05 asserts:

Stability operations are a core U.S. military mission that the Department of Defense shall be prepared to conduct and support. They shall be given priority comparable to combat operations and be explicitly addressed and integrated across all Department of Defense activities including doctrine, organizations,

³ "Vision, Mission, Priorities." United States Strategic Command. 23 Mar. 2009 <<http://www.stratcom.mil/mission/>>.

training, education, exercises, materiel, leadership, personnel, facilities, and planning.⁴

Directive 3000.05 explicitly notes that soft power is as important as hard power. Stability operations include, "...To provide the local populace with security, restore essential services, and meet humanitarian needs"⁵ The VIKA's functionality serves to restore essential services, thereby meeting the most basic humanitarian needs. As the nature of conflict evolves and enemies become less and less willing to fight a conventional war against the U.S., strategic advantages should be leveraged through acts of goodwill and relationship-building to mitigate grass root insurgency.

VIKA development coincides with this shift in military mindset. Lieutenant Colonel (USAF) Beck from USCENTCOM said "These people have very little, so firepower doesn't work, but if you give them something, you have a fighting chance to show them that America is the preferred ally."⁶ His remarks imply the importance of soft power. Ideally, VIKA should be an arm of the U.S. strategy that generates stability and empowerment via the creation of opportunities for development.

The VIKA team adhered to the following five parameters during research efforts:

- Make available potable water, renewable energy, and telecommunications infrastructure
- Use sustainable technologies
- Service a community of 500 to 1,000 people

⁴ Dept of Defense. "Department of Defense Instruction: Number 3000.05." DTIC. 23 Mar. 2009 <<http://www.dtic.mil/whs/directives/corres/pdf/300005p.pdf>>.

⁵ Dept of Defense. "Department of Defense Instruction: Number 3000.05." DTIC. 23 Mar. 2009 <<http://www.dtic.mil/whs/directives/corres/pdf/300005p.pdf>>.

⁶ Beck, Ron. Personal Interview. 3 Feb 2009.

- Keep total kit cost under \$40,000
- Uses able to span the continuum of development to disaster relief

Given these constraints, the team embarked on initial research to identify which technologies would be most appropriate to fit these constraints. Surprisingly, the team encountered numerous technologies conforming to the mold set forth by the customer. However, in further conversation with subject matter experts about the VIKA concept, the team realized that technology was not the primary issue, thus reaching the conclusion that other determinants were more important in ensuring a kit's efficacy in a given community.

Primarily, talking with experts shifted the team's attention to the socio-cultural, political, and economic factors surrounding a proposed development concept. For instance, U.S. Secretary of State Robert Gates said on November 26, 2007:

Success will be less a matter of imposing one's will and more a function of shaping behavior—of friends, adversaries, and most importantly, the people in between. Arguably the most important military component in the War on Terror is not the fighting we do ourselves, but how well we enable and empower our partners to defend and govern themselves.⁷

In theory, the VIKA supports Gates' insights by initiating greater stability and potentially winning strong allies to the U.S. More importantly, success in winning stability and allies may be a function of how well the U.S. can service the needs of a targeted community. As a result of a thorough socio-cultural understanding of a locality, appropriate configurations of a VIKA can be made to best position the community to increase social and political stability and economic

⁷ Gates, Robert M. "Beyond Guns and Steel: Reviving the Nonmilitary Instruments of American Power." Military Review. 10 Mar. 2009 <http://usacac.army.mil/CAC2/MilitaryReview/Archives/English/MilitaryReview_20080228_art004.pdf>.

viability. Magnifying and empowering these areas should lead to desired results, such as positive perceptions of the U.S., social integrity, economic growth, and security in the underserved populations.

This research paper will include discussion of technologies fitting the parameters set forth by the customers, a proposal of the notional VHS, presentation of the concept of a CROPS analyses as an extension of a PMESII analysis, examination of political-economic considerations, discussion of testing and the analysis of end-to-end VIKA integration, final recommendations, and suggestions for further research.

ENERGY

Solar Energy Overview

Solar energy is a renewable source that can provide an alternative to the electrical grid. It is an increasingly popular energy technology due to its efficiency, accessibility, and low carbon footprint. Despite being eco-friendly, solar energy can also be beneficial to those areas that may not have regular access to an electrical grid system. In the case of the construction of a VIKA, solar energy provides an ideal alternative for climates rich in sunlight that may not currently have power due to distance from the grid or war-time destruction of power lines.

Solar technologies can collect heat (thermal) and light (photovoltaic) energy. Thermal solar energy is heat collected from the sun that is used primarily for heating a household or providing warmth for cooking. Photovoltaic (PV) solar energy is light energy converted into an alternating current (AC) to run anything requiring power. All solar energy is collected as direct current (DC), thus, an inverter is required to convert to AC. PV is the most common and widely used form of solar energy, but thermal collection can be used to create electricity from heat through a turbine or steam generator.⁸

There are several designs for solar energy collection. The cell is the most basic structural aspect of a solar energy system, producing one to two watts of energy.⁹ Cells can be connected to form modules that can then be connected to form arrays. Figure 2 graphically depicts PV cell panels.¹⁰

⁸ "How does solar power work?" [solar home.org](http://www.solarhome.org/infohowdoessolarpowerwork.html). 19 Mar. 2009 <<http://www.solarhome.org/infohowdoessolarpowerwork.html>>.

⁹ "PV Systems." [U.S. Department of Energy: Energy Efficiency and Renewable Energy](http://www1.eere.energy.gov/solar/pv_systems.html). 19 Mar. 2009 <http://www1.eere.energy.gov/solar/pv_systems.html>.

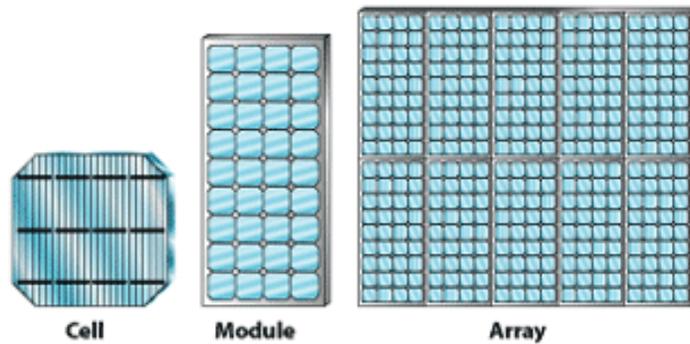


Figure 2: Photovoltaic cell panels

Solar Energy Options

At the very innovative end of the spectrum, architect Joseph Cory has developed a PV system utilizing light energy which he calls SunHopes. SunHopes is a design consisting of helium-filled balloons containing photovoltaic arrays (PVA) on the outer skin surface.¹¹ Cory states the goal of SunHopes is to “develop an efficient, portable, land area-independent, inexpensive and reliable energy source for all, thus contributing to promoting society by decentralizing and diversifying energy resources while generating an ecological coherence between humans and nature.”¹²

Figure 3 illustrates the SunHopes solar balloons.¹³

¹⁰ "PV Systems." U.S. Department of Energy: Energy Efficiency and Renewable Energy. 19 Mar. 2009 <http://www1.eere.energy.gov/solar/pv_systems.html>.

¹¹ "SunHopes." Geotectura. 1 Feb. 2009 <<http://www.geotectura.com/New/geotectura.htm>>.

¹² "SunHopes." Geotectura. 1 Feb. 2009 <<http://www.geotectura.com/New/geotectura.htm>>.

¹³ "SunHopes." Geotectura. 1 Feb. 2009 <<http://www.geotectura.com/New/geotectura.htm>>.



Figure 3: SunHopes Solar Balloons

SunHopes, although still in the prototype stage, is expected to function extremely well in desert and barren landscapes, withstanding many weather conditions.

A more common option than SunHopes is the solar lantern, which is an additional technology that uses PVs to harvest solar energy to provide light. While electricity can be provided by converting energy from PV cells, the solar lantern is a more direct, immediate way of providing light. A solar lantern needs only a PV panel, storage battery, and lamp to provide adequate lighting. The PVs convert solar energy into electrical, and the battery collects and stores this energy during periods of sunlight to be used by the lamp at night or on cloudy days. A single charge would be able to operate the lamp for 4-5 hours. The price of a solar lantern varies, but will likely remain under \$100.

Another way to use the sun's energy is to collect heat via thermal solar panels. Thermal solar energy can be collected passively or actively. "Passive solar design doesn't involve the use of mechanical and electrical devices, such as pumps, fans, or electrical controls to move the solar

heat.”¹⁴ Essentially, this type of system would be able to provide solar heat in the winter and reject it in the summer. An active solar collection system “collects and absorbs solar radiation, then transfers the solar heat directly to an interior space or a storage system, from which the heat is distributed.”¹⁵ Active solar collection can be achieved using liquid or air. A liquid-based system “heats water or an antifreeze solution in a ‘hydronic’ collector, whereas, air-based systems heat air in an ‘air collector.’”¹⁶ An example of an active thermal solar heating system is the FreedomWon system, which employs a network of pipes that run from a storage tank through a thermal solar panel. Water in the pipes is heated as it passes through the thermal solar panels and stored in the tank until needed. Installed in a house, the system would operate according to the Figure 4 depiction of the FreedomWon water heating system.¹⁷ The FreedomWon system ranges in price from \$8,000 to \$15,000 depending on size.¹⁸

¹⁴ "Passive Solar Home Design." U.S. Department of Energy: Energy Efficiency and Renewable Energy. 19 Mar. 2009. <http://apps1.eere.energy.gov/consumer/your_home/designing_remodeling/index.cfm/mytopic=10250>.

¹⁵ "Active Solar Heating." U.S. Department of Energy: Energy Efficiency and Renewable Energy. 19 Mar. 2009. <http://apps1.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12490>.

¹⁶ "Active Solar Heating." U.S. Department of Energy: Energy Efficiency and Renewable Energy. 19 Mar. 2009. <http://apps1.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic=12490>.

¹⁷ "Freedom Won: How it Works" Simple Solar Heating. 1 Feb. 2009. <<http://simplesolarheating.com/FreedomWon.html>>.

¹⁸ "Freedom Won: How it Works" Simple Solar Heating. 1 Feb. 2009. <<http://simplesolarheating.com/FreedomWon.html>>.

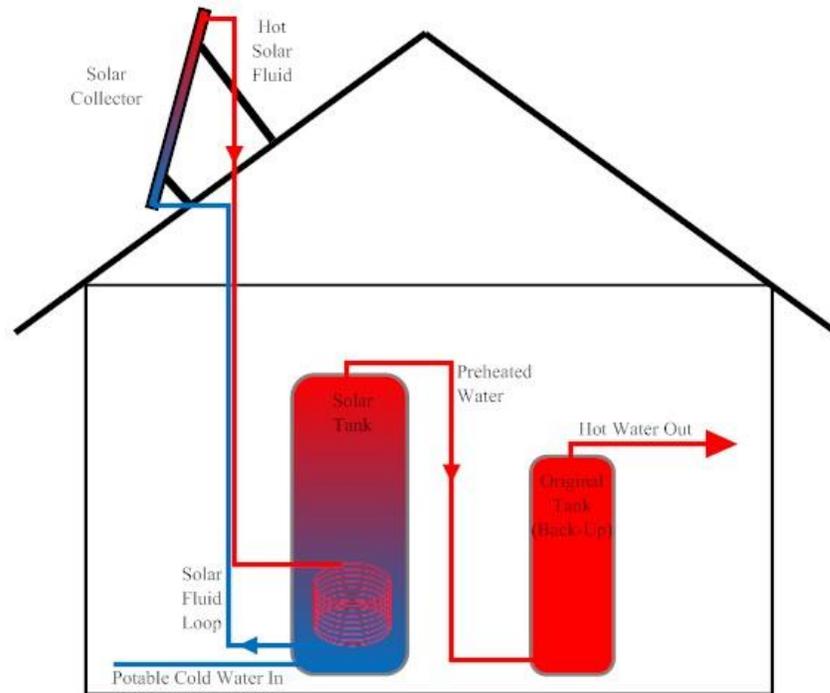


Figure 4: FreedomWon Water Heating System

Even though a climate may be suited for solar technology, it is not guaranteed that there will always be abundant sunlight to provide energy and electricity. Therefore, it is sometimes more efficient to employ a hybrid solar-wind system to provide energy. Such a solar-wind hybrid system, or Mobile Power Station, was developed by blending the technologies.¹⁹ The creation is a combination of solar and wind energy technologies mounted on a shipping container. Figure 5 depicts a full diagram of the Mobile Power Station as available in a brochure.

¹⁹ “The Mobile Power Station™ (MPS): The Best Solution for Distributed Generation.” SkyBuilt Power. 1 Feb. 2009 <http://www.skybuilt.com/news/pdfs_products/SkyBuilt_SkyStation.pdf>.

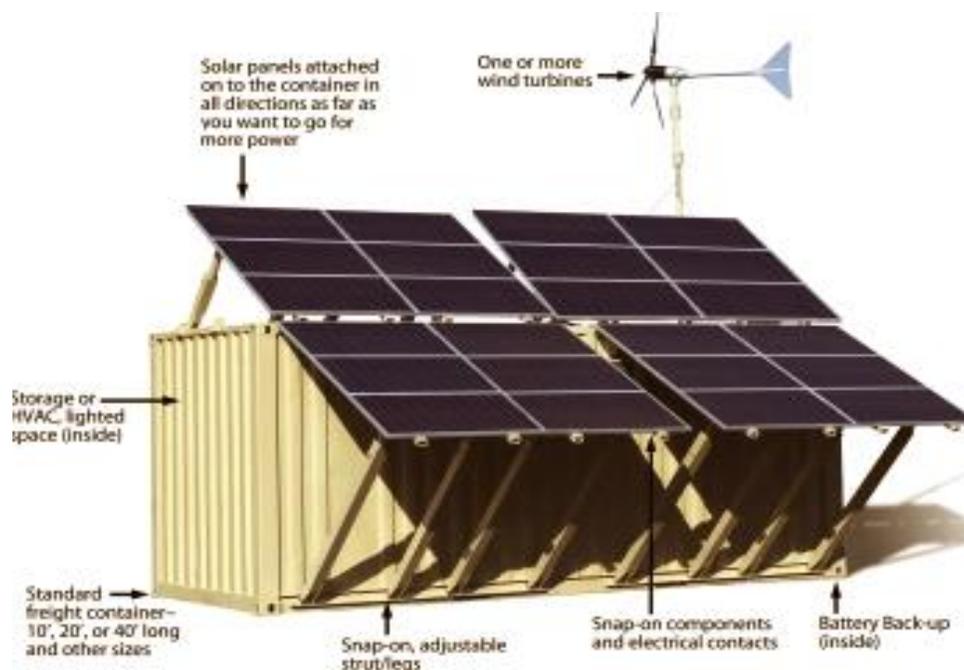


Figure 5: Full diagram of Mobile Power Station²⁰

This module is estimated to provide enough electricity to power a large (3,500 to 4,000 square foot) U.S. home.²¹ It is designed to be “idiot-proof”²² requiring no prior knowledge of such technologies. As a test, four 19-year old males were given the unassembled module with no instructions or prior knowledge; they were able to assemble it correctly in about four hours.²³ The inside of the container can also open up and be used as a storage space, living area, office, etcetera. This module can be implemented in areas that do not necessarily have abundant sunshine. When the solar energy is lacking the wind energy can compensate, and the container can provide shelter or storage space as an added benefit, which in the team’s opinion, makes the Mobile Power Station a unique and viable option for use in the VIKA.

²⁰ “The Mobile Power Station™ (MPS): The Best Solution for Distributed Generation.” SkyBuilt Power. 1 Feb. 2009 <http://www.skybuilt.com/news/pdfs_products/SkyBuilt_SkyStation.pdf>.

²¹ Sklar, Scott. Personal Interview. 19 Feb. 2009.

²² Sklar, Scott. Personal Interview. 19 Feb. 2009.

²³ Sklar, Scott. Personal Interview. 19 Feb. 2009.

Solar technology is becoming an increasingly important factor in renewable energy. “PV is much more economical to electrify rural villages on a household basis than conventional diesel generators.”²⁴ Not only is it more economical, but is more practical for rural and war-torn areas since it can operate separately from the grid. Many different forms of solar technology are being developed; it is just a matter of matching specific area needs to the appropriate technology.

Wind Energy Overview

One of the renewable energy technologies perhaps most appropriate for the VIKA is wind energy. Because wind results from the sun’s abundant energy, wind is a renewable resource and can be relatively cost-efficient. The various biomes on earth have varying capacity for wind energy generation. However, it has been clear as renewable technologies have been developed over the last 30 years that wind is a practical alternative to traditional fossil fuel systems.

Estimates by the U.S. Department of Energy estimate, “...The world's winds could theoretically supply the equivalent of 5,800 quadrillion BTUs (quads) of energy each year--more than 15 times current world energy demand” (a quad is equal to about 172 million barrels of oil or 45 million tons of coal.)²⁵ A National Aeronautics and Space Administration (NASA) map of average wind speeds for the months of January and July and a conversion table of wind speed to wind power density (or the amount of wind power that could be gained from a certain area) are provided in Figure 6 in order to estimate the potential energy to be gained from global wind power depending on varying heights. Wind speed generally is stronger at heights farther from the

²⁴ Wells, Linton. Personal Interview. 19 Feb. 2009.

²⁵ "Wind energy's potential." *Culture Change*. 6 Apr. 2009 <<http://www.culturechange.org/wind.htm>>.

surface of the earth. Figure 7 is the basic principles of wind resource evaluation; it shows that a higher wind power class means more electricity stands to be generated from a particular area.

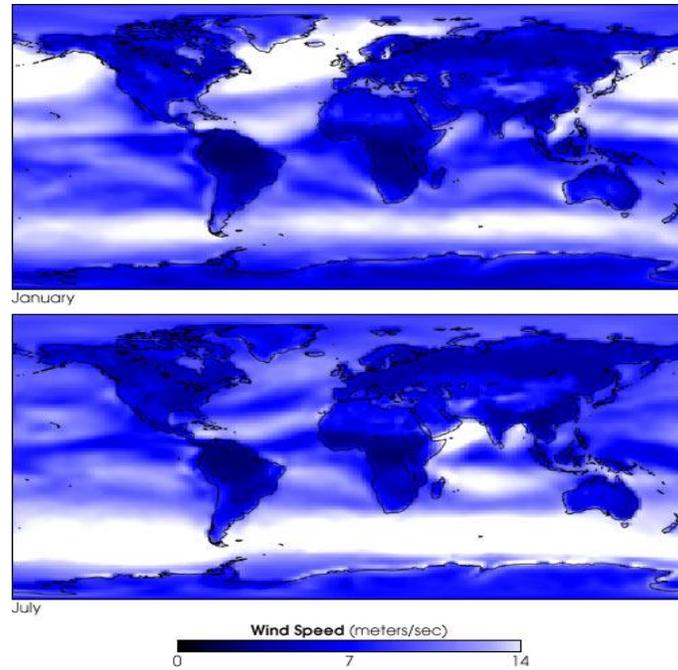


Figure 6: Average global wind speed²⁶

²⁶ "Global Wind Speed." NASA Visible Earth. 6 Apr. 2009 <http://visibleearth.nasa.gov/view_detail.php?id=2154. >.

Classes of Wind Power Density at 10 m and 50 m ^(a)				
	10 m (33 ft)		50 m (164 ft)	
Wind Power Class	Wind Power Density (W/m ²)	Speed ^(b) m/s (mph)	Wind Power Density (W/m ²)	Speed ^(b) m/s (mph)
1	<100	<4.4 (9.8)	<200	<5.6 (12.5)
2	100 - 150	4.4 (9.8)–5.1 (11.5)	200 - 300	5.6 (12.5)–6.4 (14.3)
3	150 - 200	5.1 (11.5)–5.6 (12.5)	300 - 400	6.4 (14.3)–7.0 (15.7)
4	200 - 250	5.6 (12.5)–6.0 (13.4)	400 - 500	7.0 (15.7)–7.5 (16.8)
5	250 - 300	6.0 (13.4)–6.4 (14.3)	500 - 600	7.5 (16.8)–8.0 (17.9)
6	300 - 400	6.4 (14.3)–7.0 (15.7)	600 - 800	8.0 (17.9)–8.8 (19.7)
7	>400	>7.0 (15.7)	>800	>8.8 (19.7)

(a) Vertical extrapolation of wind speed based on the 1/7 power law

(b) Mean wind speed is based on the Rayleigh speed distribution of equivalent wind power density. Wind speed is for standard sea-level conditions. To maintain the same power density, speed increases 3%/1000 m (5%/5000 ft) of elevation.
(from the Battelle Wind Energy Resource Atlas)

Figure 7: Basic principles of wind resource evaluation²⁷

The most common system that captures wind energy is a wind turbine. A wind turbine employs blades to capture kinetic energy from air in motion. The wind propels a series of blades on either a horizontal or vertical axis. The series of blades is attached to a rotor, which is then attached to a shaft. The shaft has a gear box on it, which connects to a generator. The gear box turns the generator, producing electric current. Finally, the electric current moves from the generator to the

²⁷ “Basic Principles of Wind Resource Evaluation.” American Wind Energy Association. 6 Apr. 2009 <<http://www.awea.org/faq/basicwr.html>>.

tower base, and then to the end user (i.e., electrical utility or homeowner).²⁸ These turbines operate most efficiently at approximately 30 meters from the surface of the ground where wind speeds are faster and less turbulent.²⁹

Wind Energy Options

While wind farms have become prevalent around the U.S., smaller systems would be more applicable to the rural, underserved areas that the VIKA could aid for several reasons. First, larger wind turbines may be more difficult to defend from an attack. Second, larger turbines are costly. Third, larger turbines may provide more electrical capacity than is necessary for a village of 500 to 1,000 people. In other words, a larger turbine may be too easily destroyed in a war torn area, cost more than an underserved population can afford, or simply be a waste as it serves more than the total population.

There are multiple options for wind technology integration into a VIKA package. The SolarStik™ system integrates solar and wind technology (see Figure 8). According to its manual, the system can be assembled in 10 minutes by one person, stands under 12 feet tall, and weighs just over 100 pounds. This quality fits with the desire for the VIKA to be easily usable across diverse populaces and also minimizes the risk of an attack. The system includes two solar panels putting out 100 watts and a small wind turbine that produces 200 watts of electricity daily.

Energy not used immediately is stored in a few batteries and there is an outlet at the base of the

²⁸ "How Wind Turbines Work." U.S. Department of Energy Wind and Hydropower Technologies Program. 6 Apr. 2009 <http://www1.eere.energy.gov/windandhydro/wind_how.html>.

²⁹ "How Wind Turbines Work." U.S. Department of Energy Wind and Hydropower Technologies Program. 6 Apr. 2009 <http://www1.eere.energy.gov/windandhydro/wind_how.html>.

tower to plug applications into directly. Cost of the system starts at \$9,750.³⁰ However, alone, this system may still not produce enough energy to meet the needs of a village of 500 to 1,000 people. A few of these systems can be set in an array for increased energy production.

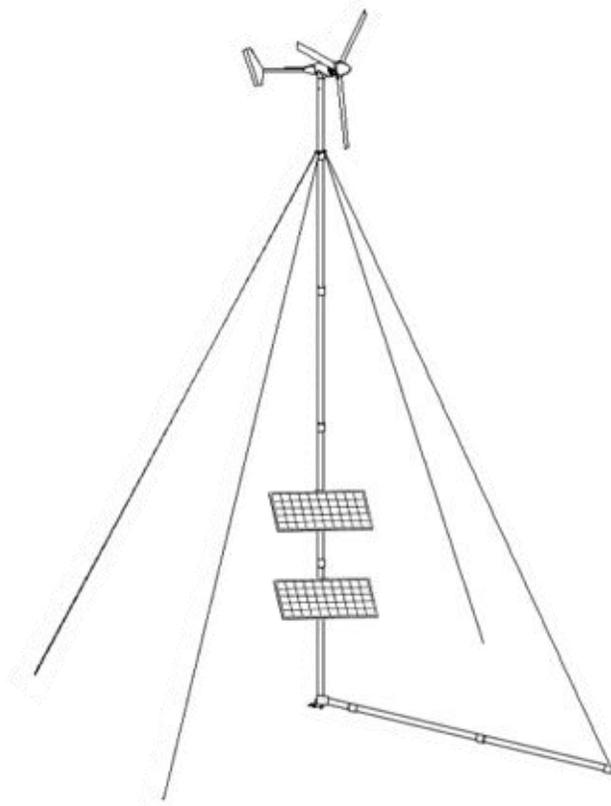


Figure 8: SolarStik

³⁰ "Solar Stik Pro Series Breeze Instruction Manual." Solar Stik. 8 Apr. 2009
<<http://www.solarstik.com/pdf/Solar%20StikInstructions-StikPro-Series%20Breeze.pdf>>.



Figure 9: Bergey 1.2 kW Hybrid System Package

Another small wind technology appropriate for the VIKA is the Bergey 1.2 kW Hybrid System Package shown in Figure 9. This system, much like the SolarStik, employs solar and wind technologies to harness energy from varying climate conditions. This wind turbine has already been used in small-scale development projects in rural Afghanistan for powering water treatment systems.³¹ This system uses two 90W solar panels in conjunction with a 1 kW potential small wind turbine. It includes a 60-foot guyed tower (a tower stabilized by an array of cables attached to the tower and anchored in the ground), an electricity regulator, a bank of deep cell batteries for storage, and an inverter to convert DC to AC electricity. The cost of the unit after installation would be close to \$10,000 to \$12,000.³² The height of the system renders it vulnerable to attack, but it provides greater capacity to generate electricity (roughly 3-5 kWh per day). Maintenance is

³¹ “American Wind & Solar Hybrid Power Systems Can Electrify Afghan Village in 4 Hours.” [Bergey.com](http://www.bergey.com/Examples/Afghan.Hybrids2.doc). 23 Apr. 2009
<<http://www.bergey.com/Examples/Afghan.Hybrids2.doc>>.

³² “Wind & Solar Hybrid System Value Package: 1.2kW Hybrid.System Package.” [Bergey.com](http://www.bergey.com/Products/VPkg.Hybrid1.htm). 22 Apr. 2009
<<http://www.bergey.com/Products/VPkg.Hybrid1.htm>>.

fairly minimal since the system has few moving parts. In all, this system would appear to be a potential alternative for the VIKA to incorporate.

AeroVironment Architectural Wind Systems is another applicable product for the VIKA, presented in Figure 10. These small turbines are just under nine feet tall and six feet wide, weighing 130 pounds. Smaller than other turbines that rely on taller towers, these systems minimize the risk of attack. The units can be combined with solar panels to form a hybrid energy system. At optimal wind speeds around 12 m/s, one of these small turbines can churn out 1kW of electricity. A select few private entities around the U.S. are currently using this technology.³³ For the most part, Architectural Wind has been commercialized, which could indicate cost savings and proven performance for potential VIKA use.

The downside to the AeroVironment Architectural Wind system is the cost, which was given to the research team during a teleconference with AeroVironment sales representative Jason Groves.³⁴ Groves estimated the cost at \$8.50 watt and with 1,000 watts for each system, the final cost for the minimum system would hover around \$50,000 and could potentially increase considering other installation costs. Downsides are that the company will only install a minimum of six turbines for a given system and it would not be the easiest technology to install as it has not been tested in remote, rural areas internationally.³⁵

³³ “Architectural Wind™: AVX 1000 Building Integrated Wind Turbine.” [Avinc.com](http://www.avinc.com/downloads/AVX1000_online.pdf). 21 Apr. 2009
<http://www.avinc.com/downloads/AVX1000_online.pdf>.

³⁴ Groves, Jason. Personal Interview. 22 Apr. 2009.

³⁵ Groves, Jason. Personal Interview. 22 Apr. 2009.



Figure 10: AeroVironment Architectural Wind™³⁶

A commercialized technology that may be cost effective and readily deployed in the VIKA is the SkyStream 3.7 Compact Wind Turbine manufactured by Southwest Windpower (see Figure 11). It is light, weighing 170 pounds, and uses fiberglass blades that are durable in many weather conditions, but are costly to replace. Its specification sheet rates its electrical output at 2.4 kW.³⁷

The system calls for a guyed tower or concrete-anchored tower over 20 feet high to maximize wind power. It is a smaller wind turbine that provides significant electrical production that can be stored in batteries to optimize use during less windy weather. Nebraska Solar and Wind Power, a dealer near the Global Innovation and Strategy Center (GISC) cited the overall cost of the system at \$15,000.³⁸ This of course can vary with respect to location and configuration of the product (e.g., tower height, installation costs, etc.). The system can also be combined with solar panels to

³⁶ "Architectural Wind™: AVX 1000 Building Integrated Wind Turbine." [Avinc.com](http://www.avinc.com/downloads/AVX1000_online.pdf). 21 Apr. 2009
<http://www.avinc.com/downloads/AVX1000_online.pdf>.

³⁷ "Skystream 3.7." [Windenergy.com](http://www.windenergy.com/documents/spec_sheets/3-CMLT-1338-01_Skystream_spec.pdf). 20 Apr. 2009
<http://www.windenergy.com/documents/spec_sheets/3-CMLT-1338-01_Skystream_spec.pdf>.

³⁸ Anthis, Monty & Anthis, Tracy. Personal Interview. 17 Apr. 2009.

maximize productivity. Moreover, electrical production can be monitored via web-enabled software for remote management of the system.³⁹ This product may be vulnerable to attack due to tower height but comes with a limited five-year warranty.⁴⁰ The manufacturer has established relationships with dealers throughout the U.S., which could ease procurement of this product in a centralized VIKA warehouse before actual packages are sent abroad to host countries.⁴¹



Figure 11: Skystream⁴²

The research team determined one of the most effective systems appropriate for use in the VIKA is the AeroCam wind turbine (see Figure 12). It operates on a horizontal axis close to the ground utilizing surface winds from or over 4 to 80 mph to generate energy. It can be permanently stationed in the ground or trailer mounted for mobility and requires minimal maintenance.

³⁹ “Skystream 3.7.” [Windenergy.com](http://www.windenergy.com/documents/spec_sheets/3-CMLT-1338-01_Skystream_spec.pdf). 2009. Southwest Windpower. 20 Apr. 2009
<http://www.windenergy.com/documents/spec_sheets/3-CMLT-1338-01_Skystream_spec.pdf>.

⁴⁰ “Skystream 3.7.” [Windenergy.com](http://www.windenergy.com/documents/spec_sheets/3-CMLT-1338-01_Skystream_spec.pdf). 2009. Southwest Windpower. 20 Apr. 2009
<http://www.windenergy.com/documents/spec_sheets/3-CMLT-1338-01_Skystream_spec.pdf>.

⁴¹ Anthis, Monty & Anthis, Tracy. Personal Interview. 17 Apr. 2009.

⁴² “Skystream 3.7.” [Windenergy.com](http://www.windenergy.com/documents/spec_sheets/3-CMLT-1338-01_Skystream_spec.pdf). 2009. Southwest Windpower. 20 Apr. 2009
<http://www.windenergy.com/documents/spec_sheets/3-CMLT-1338-01_Skystream_spec.pdf>.



Figure 12: AeroCam wind turbine

This system differs from the previously discussed small wind turbines that operate on a vertical axis. The AeroCam consists of inexpensive components and installation, and can be maintained with relative ease.⁴³ Overall, the AeroCam, if scaled down (presently, the common AeroCam model provides output of 250kW which is likely too great an output for VIKA use), could be a truly viable option to include in a VIKA.

For the most part, the AeroCam systems meet the cost, production, and methodological parameters defined by VIKA customers. They are small, scalable, simple to install and maintain, affordable, and minimize the risk of attack. They have been tested in a variety of environments, both domestically in the U.S. and internationally. In reviewing numerous other models producing wind power, these are the most appropriate for the VIKA.

Energy Storage

The primary renewable energy sources the VIKA will employ (i.e., solar and wind technology) may not provide a consistent supply of electricity so energy storage must also be considered. If the wind lessens or clouds block the sunlight, then the VIKA system may very well be inhibited

⁴³ "BroadStar achieves breakthrough in low-cost energy production with new generation wind turbine." BroadStar Wind Systems. 29 Jan. 2009 <http://www.broadstarwindsystems.com/news_pr_2008_06_02.php>.

from providing steady electrical output, even if a community only requires electricity during a select number of hours each day. The repercussions of inconsistency could include a local community's dissatisfaction and distrust of U.S. technology and an interruption to the normal way of life.

Intense development is ongoing for efficient means of storing energy, but the VIKA team has identified banks of deep cycle batteries as the most applicable method. In the market today, there are also capacitors and flywheels that serve the same purpose. Capacitors use two physical pieces of conductors to store electricity and simply store energy.⁴⁴ On the other hand, flywheels use electricity to spin a rotor in a low-friction environment. If the electrical current comes to a halt, the spinning rotor's kinetic energy undergoes a process that converts this kinetic energy to electricity.⁴⁵ While these methods are possibilities, capacitors exist merely to serve in roles that require fast, intense power surges and flywheels cannot deliver the type of power as other methods.

Batteries are optimal for the VIKA for various reasons. According to a recently published article from the University of Maryland, "Batteries, particularly lithium ion, store large amounts of energy but cannot provide high power or fast recharge."⁴⁶ Considering that batteries cannot recharge quickly or supply much power, it can be assumed that in many communities the VIKA would serve (comprised of households making less than \$1000 USD per year) do not use electrical-intensive appliances like refrigerators or microwaves extensively, if at all.

⁴⁴ Brain, Marshall & Bryant, Charles W. "How Capacitors Work." [HowStuffWorks.com](http://electronics.howstuffworks.com/capacitor3.htm). 22 May 2009 <<http://electronics.howstuffworks.com/capacitor3.htm>>.

⁴⁵ "Flywheel Technology." [Active Power](http://www.activepower.com/no_cache/solutions/ups-systems/flywheel-technology/?sword_list%5B%5D=Flywheel). 22 May 2009 <http://www.activepower.com/no_cache/solutions/ups-systems/flywheel-technology/?sword_list%5B%5D=Flywheel>.

⁴⁶ Corley, Missy & Tune, Lee. "For New Energy Options to Work, Better Storage Methods Needed: Maryland NanoCenter Researchers Create New Device to Store Electrical Energy." [University of Maryland A. James Clark School of Engineering Media](http://www.eng.umd.edu/media/pressreleases/pr031609_energy-storage.html). 22 May 2009 <http://www.eng.umd.edu/media/pressreleases/pr031609_energy-storage.html>.

Normally, low incomes inhibit people from owning high-power appliances. A recent study at Lawrence Berkeley National Laboratory attests to this tenet: “[Refrigerator] Ownership at the very low income levels is below 50% for every [developing] country studied [Brazil, Mexico, Nicaragua, Panama, South Africa, and Peru], while for the wealthier countries, market saturation can clearly be seen at incomes of over about \$1000 per month.”⁴⁷ Therefore, it is probable that communities suitable for the VIKA might not have electrical appliances like refrigerators, air-conditioning units, microwaves, or toasters. Since demand for electricity may be steady and because of the absence of some appliances, batteries could work for efficiently supplying the community’s baseline electrical needs.

The primary need for electricity in the developing world is low-power lighting, such as light-emitting diodes (LED). Globalissues.org notes that “1.6 billion people – a quarter of humanity – live without electricity.”⁴⁸ Additionally, the bulk of this population resides in South Asia, Sub-Saharan Africa, and East Asia, areas all of which have been identified as target areas for the VIKA.⁴⁹ Lighting should do the following things for a community: enable education after the sun goes down, increase productivity in homes and schools, and provide more stable and effective medical care among other things.

The team identified three primary products to meet energy storage for basic services like lighting: TR 10 Liquid Battery, Trojan Deep-Cycle Gel Battery™, and Optima Battery™. The TR 10 Liquid Battery is a recent development in battery technology. This battery is made with

⁴⁷ McNeil, Michael A. & Letschert, Virginie E. “Forecasting Electricity Demand in Developing Countries: A Study of Household Income and Appliance Ownership.” Energy Efficiency Standards. 1 Jun. 2009. <<http://efficiency.lbl.gov/drupal.files/ees/6259%20paper%20McNeil%20final.pdf>>.

⁴⁸ Shah, Anup. “Poverty Facts and Stats.” Globalissues.org. 2 June 2009 <<http://www.globalissues.org/article/26/poverty-facts-and-stats>>.

⁴⁹ Shah, Anup. “Poverty Facts and Stats.” Globalissues.org. 2 June 2009 <<http://www.globalissues.org/article/26/poverty-facts-and-stats>>.

all liquid active materials, which means a cheaper cost of manufacturing. The three primary materials are antimony, magnesium, and an electrolyte such as sodium sulfide. According to the diagram below, at the battery's equilibrium state (left), there is a positive magnesium electrode (blue), a sizable electrolyte component that has magnesium and antimony ions dissolved in it (green), and a negative antimony electrode (yellow). When current flows into the battery (center), magnesium ions would gain electrons and antimony ions would give up electrons to form metals. The positive and negative metals would join with the molten electrodes at either end of the battery, thus storing electric potential. When an external source draws upon the electric current stored in the electrodes, the metals are reconverted back into ions and the process can begin again.⁵⁰

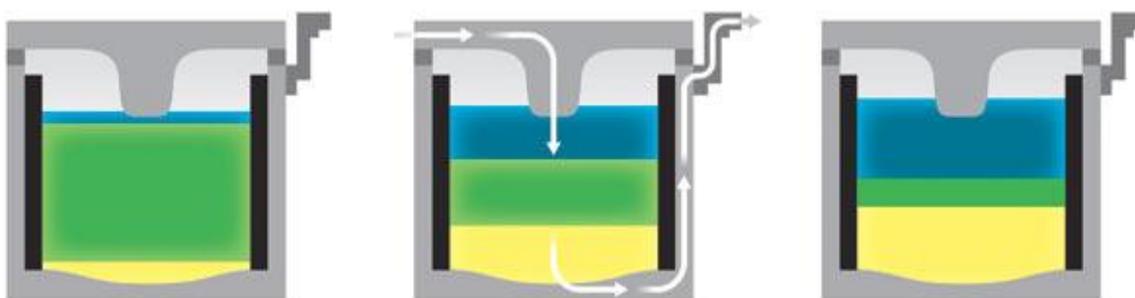


Figure 13: TR 10 Liquid Battery™⁵¹

This type of liquid battery allows for expansive storage in many different locations with relatively inexpensive materials. Such criteria are perfectly suitable for a VIKA. The downside to this option is that it is not commercially available yet, but development over the next five years should yield a viable alternative to lead-acid batteries.

⁵⁰ Bullis, Kevin. "TR10: Liquid Battery." *Technology Review*. 27 Apr. 2009

<http://www.technologyreview.com/read_article.aspx?id=22116&ch=specialsection&pg=1>.

⁵¹ "Deep Cycle Gel™ Product Specifications." *Trojan Battery Company*. 3 May 2009.

<http://www.trojanbattery.com/Products/documents/DeepCycleGel_ProductSheet_LowRes.pdf>.

The Trojan Deep Cycle™ 12V Gel Battery would also be a viable option for the VIKA's electricity storage. These batteries can be connected for use in banks for renewable energy storage from solar and wind applications. They weigh no more than 69 pounds, which translates to relative ease of transport.⁵² According to the Northern Arizona Wind & Sun website, deep cycle gel batteries normally have a lifespan of 2-5 years, pending on how much the battery is discharged before recharging.⁵³ To educate the community members to avoid discharging the battery to the extent of killing its future usability would be an initial challenge, and some of the other maintenance procedures, such as watering, may prove incredibly sophisticated for a developing village. However, this battery is one of the most commercialized alternatives to longer-term energy storage for renewable energy applications that are integral to the VIKA system.

Finally, Optima Batteries™ are another deep-cycle alternative to store the energy the VIKA will generate. They weigh slightly less than the Trojan Deep Cycle Gel™ and are able to purvey a more powerful discharge under colder temperatures. Pending the strength of the current, the battery can be recharged to 90% in 35 to 140 minutes.⁵⁴ This characteristic could translate to easier use on the part of the community. Batteries of this nature, while not necessarily renewable in nature, are the most viable options on the market for VIKA implementation. The future holds great promise for development of more environmentally friendly methods to store energy. These developing technologies should, of course, be considered and potentially integrated into the VIKA program.

⁵² "Deep Cycle Gel™ Product Specifications." [Trojan Battery Company](http://www.trojanbattery.com/Products/documents/DeepCycleGel_ProductSheet_LowRes.pdf). 3 May 2009. <http://www.trojanbattery.com/Products/documents/DeepCycleGel_ProductSheet_LowRes.pdf>.

⁵³ "Deep Cycle Battery FAQ." [Northern Arizona Wind & Sun](http://www.windsun.com/Batteries/Battery_FAQ.htm#Lifespan%20of%20Batteries). 12 May 2009. <http://www.windsun.com/Batteries/Battery_FAQ.htm#Lifespan%20of%20Batteries>.

⁵⁴ "Optima Battery Model D34/78 Product Specifications." [Optimabatteries.com](http://www.optimabatteries.com/_media/documents/specs/D34_78.pdf). 5 May 2009. <http://www.optimabatteries.com/_media/documents/specs/D34_78.pdf>.

Other Energy Technology Overview

Although solar and wind energy are the most prevalent, a number of other technologies are available providing renewable energy. These include micro-hydro power, geothermal, and biomass energy. Each of these technologies requires more specific geographical conditions, but can provide considerable benefit for the areas in which they are appropriate.

Other Energy Technology Options

Micro-hydro power generates electricity through a “water turbine that converts the energy of flowing and falling water into mechanical energy that drives a generator, which generates electrical power.”⁵⁵ Thus, micro-hydro systems function well in areas with an abundant water supply year round. There must also be a large enough head, meaning the distance the water can fall, in order to create enough power to generate electricity. Micro-hydro systems can last up to 30 years, and are more cost-effective than connecting to the grid.⁵⁶ When determining whether to use a micro-hydro system, the formula in Figure 14 can be used to assess the amount of electrical power that can be generated.

⁵⁵ "Micro-Hydropower Systems: A Buyer's Guide." Natural Resources Canada. 2004. 1 Feb. 2009 <<http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/79276/buyersguidehydroeng.pdf>>.

⁵⁶ "Micro-Hydropower Systems: A Buyer's Guide." Natural Resources Canada. 2004. 1 Feb. 2009 <<http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/79276/buyersguidehydroeng.pdf>>.

$P_{th} = Q \times H \times g \rightarrow$
P_{th} = Theoretical power output in kW
Q = Usable flow rate in m^3/s
H = Gross head in m
G = Gravitational constant ($9.8 m/s^2$)

Figure 14: Microhydro system is a formula that can assess the amount of electrical power generated.⁵⁷

For example, “a site has a head of 10 m with flow of $0.3 m^3/s$; therefore, the potential power output is given by $0.3 \times 10 \times 9.8$, which 29.4 kW.”⁵⁸

Construction of a micro-hydro system is rather expensive and there is some maintenance required. Monthly adjustments of the intake valve, nozzle, or guide vane may be needed to match the water flow and amount of power being used.⁵⁹ Cleaning of the system will also need to be performed periodically to ensure pipes do not get clogged. A micro-hydro power system is beneficial for areas with an abundant water supply that may not have as much access to solar or wind energies. However, the cost and maintenance required may deter individuals from being able to install and use it.

⁵⁷ "Micro-Hydropower Systems: A Buyer's Guide." Natural Resources Canada. 2004. 1 Feb. 2009 <<http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/79276/buyersguidehydroeng.pdf>>.

⁵⁸ "Micro-Hydropower Systems: A Buyer's Guide." Natural Resources Canada. 2004. 1 Feb. 2009 <<http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/79276/buyersguidehydroeng.pdf>>.

⁵⁹ "Micro-Hydropower Systems: A Buyer's Guide." Natural Resources Canada. 2004. 1 Feb. 2009 <<http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/79276/buyersguidehydroeng.pdf>>.

Geothermal energy is another renewable source that utilizes high-pressure hot water and steam from inside the earth to produce heat and electricity. The high-pressure hot water and steam is brought up to directly heat buildings or to drive generators producing electricity.⁶⁰ Volcanoes, hot springs, and geysers are outputs of geothermal energy that have found their way to the surface without having to be brought up.⁶¹ Most sources of geothermal energy are found along the ring of fire that circumscribes the Pacific Ocean.⁶² However, to be certain of geothermal potential, drilling a well to test temperatures must be performed, which can be expensive.⁶³ Geothermal energy requires a system to bring up the water and steam, a generator to create electricity, and a means to transfer the electricity. Because of these factors geothermal energy may not be the most ideal immediate solution, but is something to consider when looking at long-term development. This is especially the case in areas that have geothermal potential, such as Afghanistan.⁶⁴ The two main prerequisites for geothermal, technology and a high temperature water source, are present in Afghanistan. Furthermore, the “tectonic structure of Afghanistan suggests the presence of vast hot water circulation systems underground,”⁶⁵ making geothermal energy a very real prospect.

Lastly, biomass is proving to be an efficient renewable energy producer. Biomass consists of plant and animal waste that is burned to create energy. This can be done directly by using the

⁶⁰ “Geothermal Energy.” Energy Information Administration. 1 Feb. 2009
<<http://www.eia.doe.gov/kids/energyfacts/sources/renewable/geothermal.html#Uses>>.

⁶¹ “Geothermal Energy.” Energy Information Administration. 1 Feb. 2009
<<http://www.eia.doe.gov/kids/energyfacts/sources/renewable/geothermal.html#Uses>>.

⁶² “Geothermal Energy.” Energy Information Administration. 1 Feb. 2009
<<http://www.eia.doe.gov/kids/energyfacts/sources/renewable/geothermal.html#Uses>>.

⁶³ “Geothermal Energy.” Energy Information Administration. 1 Feb. 2009
<<http://www.eia.doe.gov/kids/energyfacts/sources/renewable/geothermal.html#Uses>>.

⁶⁴ Wells, Linton. Personal Interview. 19 Feb. 2009.

⁶⁵ Azizy, Parnijan & Meisen, Peter. “Rural Electrification in Afghanistan.” Global Energy Network Institute. 10 Mar. 2009
<<http://www.geni.org/globalenergy/research/rural-electrification-in-afghanistan/Rural%20Electrification%20in%20Afghanistan.pdf>>.

heat for temperature regulation and cooking, or indirectly to produce electricity.⁶⁶ However, some of this is lost in the burning process and pollutants are given off if not carefully regulated.⁶⁷ Thus, biomass as an energy producer is adequate, but needs some improvement to be entirely efficient and widely used. Regardless, biomass reduces “air and water pollution, increases soil quality and reduces erosion, and improves wildlife habitat.”⁶⁸

Solar and wind energy are the most commonly known and widely advocated forms of renewable energy. In addition, micro-hydro, geothermal, and biomass energies are increasing in popularity and efficiency. Each is more specific on geographic location and availability of resources. However, if a region is capable, these technologies are worth a feasibility assessment regarding the production of heat and electricity for the area.

⁶⁶ "How Biomass Energy Works." Union of Concerned Scientists. 1 Feb. 2009
<http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html>.

⁶⁷ "How Biomass Energy Works." Union of Concerned Scientists. 1 Feb. 2009
<http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html>.

⁶⁸ "How Biomass Energy Works." Union of Concerned Scientists. 1 Feb. 2009
<http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html>.

WATER PRODUCTION AND PURIFICATION

Water Overview

Just as energy is important to boost productivity and stability in an underserved region, so is a method for water production and/or purification. Water production is necessary in areas where ground water or any other water source is lacking, while water purification is useful when water is available, but is too unsanitary for consumption. Additionally, water purification could be a valuable asset along a coastal region, such as the shore lines of rural Thailand and Sri Lanka.

Water Options

An important new innovation in water collection technology simultaneously reconciles foreign aid demands of efficiency and community acceptance. One such water collector is the Play Pump, which harnesses energy from playground equipment and combines it with water pump technology (see Figure 15). Playground equipment bores can reach depths up to 330 feet and only take a few hours to install. Once the pumps are installed, children can use merry-go-rounds to pump up to 370 gallons of water per hour into 660-gallon above-ground tanks. The water in the tank is easily accessible with a simple tap and unused water is recycled.⁶⁹

⁶⁹ "Facts About the PlayPump." Welcome to the PlayPump Service Project. 7 Feb. 2009
<<http://playpumpa2p3.org/playpumpfacts.aspx>>.



Figure 15: Play Pump⁷⁰

The initial cost of the Play Pump is \$14,000 USD, but maintenance costs are covered by advertisements, which are placed on the sides of the storage tank. The “four billboards on the storage tank carry education, health and consumer product messages, and provide advertising revenue that funds a decade of pump maintenance.”⁷¹ Play Pumps strongly emphasize the importance of advertising HIV/AIDS education, which is especially important to have near school facilities in developing countries.

The greatest appeal for playground technology is its dual purpose for directly serving the community. The see-saws and merry-go-rounds are almost always placed outside of schools. The correlation between school and water is particularly essential for female education. In the majority of traditional villages, women and young girls spend hours walking to collect water for

⁷⁰ “Facts About the PlayPump.” Welcome to the PlayPump Service Project. 7 Feb. 2009 <<http://playpumpa2p3.org/playpumpfacts.aspx>>.

⁷¹ “Facts About the PlayPump.” Welcome to the PlayPump Service Project. 7 Feb. 2009 <<http://playpumpa2p3.org/playpumpfacts.aspx>>.

their families. Easy access to water placed near schools encourages the education of children, particularly young girls.

Another benefit of playground technology is the extent to which the international foreign assistance community has embraced it. Many international institutions and foreign-assistance organizations appreciate the cost-effectiveness and importance of playground technology. The World Bank recognized Play Pump as one of the best new grassroots level technologies.⁷²

Additionally, Play Pump has partnered with groups like the United States Agency for International Development (USAID), Save the Children, the Lemelson Foundation, and the Case Foundation.

The South African non-governmental organization (NGO) Roundabout International installs, markets, and maintains the Play Pump. It has overseen the successful installation of more than 700 Play Pumps in South Africa, Mozambique, Swaziland, and Zambia to provide water to over one million people.⁷³ The PlayPump's previous success, appeal to communities, and large-scale water collection capacity make it an important technology to consider for the VIKA.

A Seawater Desalination Vessel (SDV) is water purification technology that extracts salt from water on an offshore desalination unit. The units are typically housed on old converted vessels, such as tankers or barges, which range in size from a 20,000 gallon double walled tank (DWT) to a 100,000 gallon DWT. The SDV uses off-coast water because it is not as contaminated with waste and chemicals that often increase treatment costs and time. The advantages of a water-based desalination system over a land-based water desalination system are that the former

⁷² Bennion, Jackie. "South Africa: The Play Pump: Turning Water into Child's Play." Frontline World Rough Cut. 31 Jan. 2009 <http://www.pbs.org/frontlineworld/rough/2005/10/south_africa_th.html>.

⁷³ "Facts About the PlayPump." Welcome to the PlayPump Service Project. 7 Feb. 2009 <<http://playpumpa2p3.org/playpumpfacts.aspx>>.

“delivers a mobile, cost effective, environmentally responsible solution, producing fresh water in an accelerated time frame.”⁷⁴

The SDV is sized to fit water demands from 5 to 50 million gallons of water per day. Fresh water can be provided within 12 to 16 months, which is much more efficient than land-based desalination. Water collection amounts can be increased in phases if it becomes necessary without docking. SDVs eliminate the costs of purchasing coastal land for water, or pre-treating water. The use of a water-based vessel is important for permitting mobility in times of natural disasters or socio-economic instability. The self-generating power source of the SDV renders it independent from land-based energy issues, and its power source can actually be used in emergency situations.

In an SDV, low velocity intake pumps draw seawater through a passive screen. This screen prevents the intake and entrapment of sea life in the vessel while allowing seawater to continue through the system. The water is pretreated with low-pressure membrane filtration to remove impurities and bacteria. Unused water is released back into the ocean through discharge pumps that regulate environmentally safe temperature and salinity level of the released water. Salt removed from retained water is mixed back with the pretreated released water. Following the pretreatment, the retained water is treated with reverse osmosis membrane filtration. This is a proven desalination process that produces high-quality drinking water and is much more cost and energy efficient than thermal desalination. Additional post-treatments and pH adjustments ensure that the water is compatible to pipe distribution and drinking standards for the U.S. and World Health Organization (WHO).

⁷⁴ “The Water Standard Advantage.” Water Standard. 3 Apr. 2009 <<http://www.waterstandard.com/advantage.htm>>.

One of the biggest accomplishments of the sea-based desalination system is its purpose to prevent negative impacts on oceanic ecology and marine life. With eco-friendly filters, temperature regulation, and re-salination techniques on unused water, the SDVs are sustainable and do not have adverse environmental effects. This technology is best suited for areas with population concentrated around a coastline, such as the Marshall Islands, but the Water Standard flexibly develops plans unique to each contract. For example, Water Standard accepts joint-ownership for the technology.⁷⁵

SDV technology may be an invaluable technology for near-ocean communities, especially after natural disasters. However, the hardware has not been implemented on a broad-scale, and its effectiveness remains to be determined. The size of the vessel presents additional concerns, while the costs also remain vague.

The LifeStraw is a simple point-of-use water purifier that is a portable, durable, individualized means of accessing pure water (see Figure 16). The personal LifeStraw is worn around the user's neck and can filter any source of ground water or otherwise impure water. Its active ingredients and microbiological filters are effective to kill and remove 99.9999% of waterborne bacteria and 98.2 % of waterborne viruses. It filters a minimum of approximately 700 liters of water, which allows the Life Straw to last up to one year with a water consumption rate of two liters per day.⁷⁶

The LifeStraw also comes in a family option that provides a more stationary straw for members of a family of five or fewer. It filters a minimum of 18,000 liters of water, which is estimated to last for three years with a total water consumption rate of 20 liters per day. This hardware is

⁷⁵ "Water Standard." A Global Water Solution in Partnership with Nature. 17 Feb. 2009 <<http://waterstandard.com/contact.htm>>.

⁷⁶ "LifeStraw®: Portable Water Filter." Vestergaard Frandsen. 29 Mar. 2009 <<http://www.vestergaard-frandsen.com/lifestraw-claims.htm>>.

similar to water cooler technology, which releases water through a tap. The LifeStraw Family has a high flow rate, and removes 99.9999% of all bacteria, 99.99% of all viruses, and 99.9% of all parasites.⁷⁷



Figure 16: Use of LifeStraw in muddy, contaminated river water

The individual and family Life Straws are inexpensive: the individual straw costs \$5 USD and the family straw costs \$25 USD. Low cost is one of the many advantages of the LifeStraw technology. They are also extremely user-friendly, easily distributed, and require almost no maintenance, which makes it an excellent technology for urgent water needs like after natural disasters. Following the 700 or 20,000 liter usage, the LifeStraws must be replaced.

Another point-of-use technology, the HaloPure developed by HaloSource is a cost efficient water purification system. HaloSource is a spherical brominated bead that residually releases bromine to purify the water. The beads can be enclosed in a water treatment device, wherein water is poured through the device and is disinfected from viruses and bacteria. HaloPure uses newer

⁷⁷ “LifeStraw®: Instant Microbiological Purifier.” Vestergaard Frandsen. 22 Mar. 2009 <<http://www.vestergaard-frandsen.com/lifestraw-f-claims.htm>>.

technologies that bond bromine; this reduces any harmful and dangerous affects to the user when handling and inhaling.⁷⁸

Chlorine and Iodine are common chemicals used to purify water, but research has proven there are many advantages to Bromine. Duane Dunk, Director of Drinking Water Systems, looks at these benefits in the article “A New Look at Bromine: A Potential Sleeping Giant?” Bromine is a stronger oxidizer and more effective against many pathogens without jeopardizing the quality of the water. In blind testing, consumers prefer the taste and odor of the bromine treated water that is described as sweet rather than bitter.⁷⁹ In the treatment system, bromine reduces the buildup of biofilm and algae that other chemicals leave behind.⁸⁰ Also, from a health standpoint, bromine does not affect the thyroid gland unlike iodine.⁸¹

Lastly, the cost and carbon savings is extremely advantageous. Carlos Perea, CEO of MIOX, stated “It doesn’t make sense to transport chemicals when you can generate them yourself at a fraction of the cost and a fraction of the impact.”⁸² The Bromine-based HaloPure has an approximate customer cost of \$0.001 per liter creating a viable cure to clean water in low-income areas.

The Thirst Aid Bag, developed by Pure Hydration, has proven to be successful in both emergency situations where water is contaminated and for the use of troops overseas. The bag

⁷⁸ Dunk, Duane. "A New Look at Bromine: A Potential Sleeping Giant?" Water Conditioning & Purification Magazine International. 10 Mar. 2009 <<http://www.wcponline.com/pdf/1007Dunk.pdf>>.

⁷⁹ Dunk, Duane. "A New Look at Bromine: A Potential Sleeping Giant?" Water Conditioning & Purification Magazine International. 10 Mar. 2009 <<http://www.wcponline.com/pdf/1007Dunk.pdf>>.

⁸⁰ Bluestein, Adam. "Blue is the New Green." Inc. Magazine 15 Mar. 2009 <http://www.inc.com/magazine/20081101/blue-is-the-new-green_pagen_7.html>.

⁸¹ Dunk, Duane. "A New Look at Bromine: A Potential Sleeping Giant?" Water Conditioning & Purification Magazine International. 10 Mar. 2009 <<http://www.wcponline.com/pdf/1007Dunk.pdf>>.

⁸² Bluestein, Adam. "Blue is the New Green." Inc. Magazine 15 Mar. 2009 <http://www.inc.com/magazine/20081101/blue-is-the-new-green_pagen_7.html>.

offers an easy three step approach for purifying water to a drinkable state. First, fill the bag with any type of water available, from drainage ditch to muddy water. Second, shake the bag and leave for fifteen minutes to allow the Pure Hydration filter to work. This filter contains a matrix of 2-micron, which filters waterborne pathogens, along with an absorbent media to remove chemicals, heavy metals, odors, and tastes. The third and final step is to squeeze out the newly purified and drinkable water.⁸³

The advantages of the Thirst Aid bag prove it to be a viable option in different situations. The durability of the bag, made with an armour weave, is nearly impossible to penetrate. After being run-over multiple times by a two-ton Landrover, there were no signs of leakage or damage. Multiple safety regulators and government organizations have tested and approved the Thirst Aid Bag for use. Namely, the London School of Hygiene and Tropical Medicines, The Hospital for Tropical Disease London, QinetiQ, and the governments of South Africa and Kenya use the Thirst Aid to combat water contamination in their studies and communities. It also exceeds standards and protocols set by the Environmental Protection Agency (EPA) and National Sanitation Foundation (NSF).⁸⁴ In addition, the product's flat and stackable structure allows for easier shipping, particularly compared to shipping bottles of water that are environmentally harmful, less compact, and heavier. One Water Aid filter can purify 350 liters of water, which is equivalent to approximately 700 20oz water bottles.⁸⁵

⁸³ "Thirst Aid – Safe Drinking for Everyone Everywhere." Pure Hydration. 18 Feb. 2009
<http://www.bwtechnologies.com/thirstaid_1.html>.

⁸⁴ "Thirst Aid – Safe Drinking for Everyone Everywhere." Pure Hydration. 18 Feb. 2009
<http://www.bwtechnologies.com/thirstaid_1.html>.

⁸⁵ Vochin, Alex. "Thirst Aid Bag, One of the World's Most Portable and User-Friendly Water Filters." Softpedia. 18 Mar. 2009
<<http://news.softpedia.com/news/Thirst-Aid-Bag-One-of-The-World-039-s-Most-Portable-and-User-Friendly-Water-Filters-71870.shtml>>.

Currently, the Thirst Aid bag has been issued in multiple emergency situations where the damaged infrastructure has caused a contaminated water supply. It is nearly impossible to get fresh water to the harmed area in a timely manner; therefore the Water Aid is a feasible method to purify contaminated drinking water.⁸⁶

The Mobile PureWater System is a wagon-like purification unit that can transform nearly any size body of water; even those in remote regions, into safe potable water (see Figure 17). The rather compact high-volume purifier can be towed or mounted in the bed of a pickup, safely deployed by low-skill personnel, and easily maintained by the local population. The system is designed to operate in any climate and independent of an external power source, such as a generator, in regions abundant in sunlight and/or wind through the use of sustainable energies like solar panels and wind turbines.

⁸⁶ "Thirst Aid – Safe Drinking for Everyone Everywhere." Pure Hydration. 18 Feb. 2009
<http://www.bwtechnologies.com/thirstaid_1.html>.



Figure 17: The pure and secure Mobile PureWater System⁸⁷

Initially, the water is drawn through a submersible strainer to rid the source of larger debris. It then passes through a series of high-flow rate filters that remove particles as small as five microns thick; these filters can be cleaned on-site and do not require replacement, which greatly assists in the system's long-term sustainability. Finally, remediation is completed with the application of a revolutionary copper sulfate-based micro-biocide formula that eliminates any present algae, weeds, fungi, bacteria, viruses, and heavy metal particles. This chemical agent not only works exponentially longer and is more cost effective to use than chlorine or bromine, but it is non-toxic to humans and animals when applied properly, is safe to handle and, unlike chlorine, does not harm the Earth's ozone layer. This safe acidic formula requires replenishment after 2.5 million gallons have been purified, or about once per year for a population of 1,000, assuming a rate of 2 L/day per person is consumed.

The Mobile PureWater System can effectively process 35,000 gallons of impure water per day, at a rate of 45 gallons/min, and distributes it into large easily accessible storage tanks. Each unit

⁸⁷ "Potable Water and the Mobile PureWater System." Global Ecology Corporation. 25 Feb. 2009 <<http://www.geco.us/mobile-water.asp>>.

is equipped with Global Positioning System (GPS) capabilities that enable the monitoring of critical components and the use of remote controls to perform operations such as agent replenishment. Though the Global Ecology Corporation could not be reached for clarification, it is assumed that the employment of GPS could aid in the event of vandalism or theft because the GPS would facilitate tracking perpetrators.

The Homeland Security Corporation, operating as the Global Ecology Corporation, holds distribution and deployment rights to this Food and Drug Administration (FDA) and EPA approved and patented water remediation technology. Global Ecology is an environmental restoration company whose mission is to transform existing polluted water and soil sources into those which can sustain human life.

TELECOMMUNICATIONS

TELECOMMUNICATIONS OVERVIEW

It is widely recognized that Information and Communication Technologies (ICT) are a key driver for socioeconomic development. While regional transport, power, and water-related infrastructure are initially the most important needs in order to combat the “hunger and disease” trap, Nthenya Mule, East Africa manager for the Acumen Fund, states “[T]here are so many issues, sometimes you just begin acting where you can.”⁸⁸ If there are secondary reasons or monetary resources available to build out ICT infrastructure, it can certainly benefit the community by allowing information to be communicated freely, for example, by permitting sellers to negotiate directly with buyers.⁸⁹

Many governments and organizations have realized that leveraging information and communication technologies can “increase productivity in agriculture and industry; [help] fight diseases and illiteracy; and [help] communicate across great distances and facilitate the flow of information and knowledge.”⁹⁰ As “fluid communication flows over boundaries and links humans” it brings in global knowledge and fulfills the needs of the users by encouraging development.⁹¹ When the basic communications needs are resolved, what happens is “consequent market saturation [with] a great mass of emerging consumers.”⁹² Considering that 3.3 billion potential customers remain un-served, the World Resources Institute estimates the

⁸⁸ Nicholson, Chris. “Bringing the Internet to Remote African Villages.” 2 Feb. 2009
<http://www.nytimes.com/2009/02/02/technology/internet/02kenya.html?_r=1>.

⁸⁹ “TICAD IV: Yokohama Action Plan.” [Ministry of Foreign Affairs of Japan](http://www.mof.go.jp/press/2009030301.htm). 3 Mar. 2009
<http://www.millenniumvillages.org/docs/news/YokohamaActionPlan_30May08.pdf>.

⁹⁰ Lucas, Sylvie. “Opening Remarks.” 9th United Nations InfoPoverty World Conference, New York, NY. 18 Mar. 2009.

⁹¹ Saporito, Pierpaolo. “Opening Remarks.” 9th United Nations InfoPoverty World Conference, New York, NY. 18 Mar. 2009.

⁹² Saporito, Pierpaolo. “Opening Remarks.” 9th United Nations InfoPoverty World Conference, New York, NY. 18 Mar. 2009.

potential ICT market to top five trillion dollars.⁹³ The benefit for private industry is evident, while the benefit for other nations is an expected increase in development and resultant stability. Telecommunications is not a straightforward field inasmuch as no device can serve as a “jack of all trades.” Rather, individual components of a telecommunications network are customizable to the specific purpose and cost constraints that they need to serve. For example, some technologies, such as WiMax, can serve in multiple roles as both the backhaul and last-mile access technology, which makes the telecommunications chain a little less complex. However, the chain still requires other devices to function properly. Thus, the purpose of the telecommunications section is to lay out the components of a telecommunications network and associated services, identify current efforts and possible partners, and propose best practices and recommendations in the telecommunications field to create a sustainable and scalable project. To some extent, this will be less of a detailed technical section and more of an overview of the project options available, though many technical details will be covered.

Voice Services

Voice communications are entirely necessary, but they do not facilitate a large amount of data transmission. One researcher noted, “With voice communications, it’s a one-to-one relationship,” incapable of transferring significant volumes of data in a two-way exchange.⁹⁴ Nevertheless, basic voice communications are still important and can still bring “access to commerce and other

⁹³ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXT/DEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

⁹⁴ Musich, Paula. “IT first aid for first responders.” *Net Hope*. 22 Mar. 2009 <<http://nethope.org/doc/IT%20First%20Aid%20for%20First%20Responders-eWeek%2007Jan2008.pdf>>.

financial applications into the hands of all citizens.”⁹⁵ Africa, for instance, has done an excellent job in bringing mobile telephony to its citizens.

Broadband Internet

Broadband is not just about internet access; it brings to the table a feast of communication applications from voice to data, from sound to moving images, from wired to wireless telephony, from global services to location-specific services.⁹⁶ Broadband includes the capability to provide Voice over Internet Protocol (VoIP). This involves the delivery of voice communications over the internet or other networks that can support packet-switching. A popular example is provided by the Estonian company Skype, Inc.⁹⁷ VoIP has several disadvantages where phone lines do not, which are that it is not directly connected to E911 in many cases, it is not directly compatible with standard amplified phones, requiring an ATA (analog telephone adapter); or analog-to-digital converters to hook up “fax machines, conference phones and modems,” and it has a propensity for transmission errors that show up as “echo, noise, stutter, static, delay or distortion.”^{98 99 100} In addition to noise, if internet service is "down," there is no telephone service, and more importantly, if power is lost, there is no telephone service.^{101 102}

Regardless, because voice communications is a possibility with broadband internet, its provision is certainly the most flexible and best combined method of providing both voice communications

⁹⁵ Hellerstein, Judith. “World Bank’s e-Development Thematic Group/GICT & EAP Region Training Workshop on ICT for Rural Development: Access & Applications.” *SDN Week*. 26 Feb. 2009. <http://siteresources.worldbank.org/EXT/DEVELOPMENT/Resources/20080226summary_rev2.doc?resourceurlname=20080226-summary_rev2.doc>.

⁹⁶ Utsumi, Yoshio. “Broadband for All.” *Alcatel Telecommunications Review* 29 Mar. 2009 <http://www1.alcatel-lucent.com/com/en/appcontent/apl/A0609-Editorial-EN_tcm172-1110891635.pdf>.

⁹⁷ “Hello, We’re Skype.” *Skype*. 2 Apr. 2009. <<http://www.about.skype.com>>.

⁹⁸ Ahlman, Michele & Uzuanis, Richard. “POTS, DSL, or VOIP?” *The Hearing Review* 15.1 (2008): 18.

⁹⁹ Lebeda, Guy. “Meet VoIP: Introducing telephone’s new look.” *Utah Business* 18.11 (2004): 44.

¹⁰⁰ Ahlman, Michele & Uzuanis, Richard. “POTS, DSL, or VOIP?” *The Hearing Review* 15.1 (2008): 18.

¹⁰¹ Ahlman, Michele & Uzuanis, Richard. “POTS, DSL, or VOIP?” *The Hearing Review* 15.1 (2008): 18.

¹⁰² Ahlman, Michele & Uzuanis, Richard. “POTS, DSL, or VOIP?” *The Hearing Review* 15.1 (2008): 18.

and the internet, which allows for associated services such as telemedicine. Using computers and VoIP phones hooked to a broadband internet connection also eliminates the need for wireline networks.¹⁰³

Benefits and Needs

Benefits

Information asymmetry builds off the classical economic idea of imperfect information. Competitive markets presume “that all buyers and sellers have perfect information about products in the market.”¹⁰⁴ However, without access to information technologies, communication is inhibited, and without knowing what, how, how much, and at what price production should take place, developing populations are subject to producing wastefully or on a subsistence level.¹⁰⁵ Access to ICTs, such as mobile phones, access to internet at schools and community centers, and community radio has multiple benefits: training for health, education, agriculture, and water-systems personnel; better management of health delivery systems; timely information on markets and prices, weather to improve agricultural efficiency; developing access to credit, banking, and small business information; improving health systems by creating accessibility to timely communication with physical services such as emergency medical transport; and increasing access to health-related information and adding wider availability to education.¹⁰⁶ Dr. Thomas Zurbuchen, of the University of Michigan noted that bringing internet to the people

¹⁰³ “Wireless Internet Links Highland Community to the World.” [Airspan](http://download.intel.com/intel/worldahead/pdf/VietnamViMax.pdf?iid=worldahead_home+body_vietnam). 28 Mar. 2009.

<http://download.intel.com/intel/worldahead/pdf/VietnamViMax.pdf?iid=worldahead_home+body_vietnam>.

¹⁰⁴ Lynn, Stuart R. *Economic Development: Theory and Practice for a Divided World*. Prentice Hall: Upper Saddle River, New Jersey, 2003.

¹⁰⁵ Lynn, Stuart R. *Economic Development: Theory and Practice for a Divided World*. Prentice Hall: Upper Saddle River, New Jersey, 2003.

¹⁰⁶ “Millennium Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach.” [Millennium Villages](#). 3 Mar. 2009. <Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach>.

“empowers them,” citing a case study where a local corn grower in Macha, a rural Zambia village, learned about sunflower growing, and a year later, employed 10 full-time workers.¹⁰⁷ Similarly, the villagers of Ta Van, Vietnam, share WiMax workstations that now operate in a variety of settings, including teaching, farming, and cultivating tourism.¹⁰⁸

It has been shown that rural communities directly benefit from modern telecommunications services, in job creation and because telecommunications can serve as a substitute for transport, and reduces the barriers to access of information and knowledge services.¹⁰⁹ Indirectly, ICT uptake can encourage entrepreneurship, level the information asymmetry, and decreases the lack of access.

Needs

According to the IT Access for Everyone Initiative (ITAFE) in its “lessons learned” section, one of the best practices for implementing an ICT project is to tackle a specific issue at the outset and deal with scalability later, once the program is running.¹¹⁰ This has been echoed by USAID, though they also mention that if the project is to be ported to multiple regions, scalability should absolutely be considered initially.¹¹¹

¹⁰⁷ “Satellite based Internet for the developing world.” Internet Society: Washington DC Chapter. 22 Apr. 2009 <<http://isoc-dc.org/wordpress/?p=10>>.

¹⁰⁸ “Vietnam WiMax Alliance: Delivering High-Speed Telecom to Rural Communities.” USAID. 28 Mar. 2009 <http://www.usaid.gov/our_work/global_partnerships/gda/resources/intel_vietnam_WiMax.pdf>.

¹⁰⁹ Bhavnani, Asheeta, et al. “ICT Policy Division: Global Information and Communications Department (GICT).” World Bank Group. 15 Jun. 2009 <http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/The_Role_of_Mobile_Phones_in_Sustainable_Rural_Poverty_Reduction_June_2008.pdf>.

¹¹⁰ “IT Access for Everyone – Global Benchmarking Study.” World Economic Forum. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

¹¹¹ Payne, Judith E. “E-Commerce Readiness for SMEs in Developing Countries: A Guide for Development Professionals.” LearnLink: Academy for Educational Development. 12 Apr. 2009 <http://learnlink.aed.org/Publications/Concept_Papers/ecommerce_readiness.pdf>.

Thus, the first step in building a telecommunications infrastructure is not determining what type of service to provide, but is instead dependent on identifying a community need. For instance, if the need is education, then mobile telephony is probably not an immediate solution to that need. Tying into this is the fact that the “projects that failed most abysmally did not have a focus on the end-user.”¹¹² Thus, simply identifying a need and conceptualizing what the end-user would need and imposing it on the population may not work. “Rigorous, structured, grass roots [sic] research of end-user needs” is necessary to yield a high success rate.¹¹³

End-user needs are additionally constrained by the environment, infrastructure, and population. Often, enabling policy and regulatory environments do not exist, or the policy language is unclear. On the infrastructure side, last mile connectivity is expensive, and power is often intermittent and unreliable. Finally, the rural population possesses their own constraints, which include: “low population density and remoteness, low levels of functional literacy, little or no basic or computer literacy, low awareness, low disposable income, poor health and living conditions, and constant struggle for survival.”¹¹⁴

The community needs helped by ICT initiatives are generally focused into five development sectors: education, governance, health, (agricultural) livelihoods, and the environment.¹¹⁵ In its own ICT Villages, the UN has similarly identified three critical needs: telemedicine, e-learning, and e-governance (leaving agriculture and environment aside).¹¹⁶ Four areas of activities related

¹¹² “IT Access for Everyone – Global Benchmarking Study.” *World Economic Forum*. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

¹¹³ “IT Access for Everyone – Global Benchmarking Study.” *World Economic Forum*. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

¹¹⁴ Bhavnani, Asheeta, et al. “ICT Policy Division: Global Information and Communications Department (GICT).” *World Bank Group*. 15 Jun. 2009 <http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/The_Role_of_Mobile_Phones_in_Sustainable_Rural_Poverty_Reduction_June_2008.pdf>.

¹¹⁵ “Approach.” IICD: About. 18 Mar. 2009 <<http://www.iicd.org/approach>>.

¹¹⁶ “ICT Village Model.” 9th United Nations InfoPoverty World Conference, New York, NY. 18 Mar. 2009.

to the model of the ICT villages were identified: a broadband platform to be used as support for the poor communities, for appropriate services provision; reliable e-services adapted to the needs of the communities and improved on the basis of feedback from actors involved in the project; research and development of new products, services, and procedures expressly created for new markets; and identification of the needs of communities and end-users in developing countries.¹¹⁷ Finally, recognize that “community needs” can also be generalized over a region or country, in many cases. For instance, Macedonia initially accepted internet connectivity on behalf of its schools, but the project changed “substantially, [into] providing connectivity to all the citizens of Macedonia.”¹¹⁸

The ICT objectives of the Millennium Villages provide a guide to general communications improvements, regardless of specific community needs. They are as follows: improving access to voice communications (via cell phone) in the cluster; improving access to outside sources of information and ability to interact with the outside world through internet connectivity; improving intra-community communications (in the form of Community Radio, SMS alerts, etc.); creating functional community-wide emergency response system; providing sector support like technology-driven pedagogical improvements in education, improved delivery of health care services, improved transparency through e-governance, access to market pricing in agriculture; dealing with ICT adoption and capacity building, that is, improved community perception of and

¹¹⁷ “ICT Village Model.” 9th United Nations InfoPoverty World Conference, New York, NY. 18 Mar. 2009.

¹¹⁸ Orne, Peter. “Tackling a Teleco, Connecting Rural Macedonia.” Wireless Government. 13 Mar. 2009. <<http://glennstrachancv.blogspot.com/2009/02/tackling-telco-connecting-rural.html>>.

adoption of ICT and strengthening of practical ICT skills; and project logistical support like improving project communications, and lowering project communication costs.¹¹⁹

Components of Telecommunications Infrastructure

In the overarching scheme, there are two major segments to the implementation of communications technology: large-scale infrastructure, or “central-shared services”; and service, or the “community technology network.”^{120 121} It is important to realize that neither infrastructure nor service is an end in itself once built. Infrastructure can only make delivery of services possible, but actual service delivery requires a network to transfer the data to end-use devices such as cell-phones and cannot function efficiently without central-shared services.

Central-shared services are those services that would ideally be put into place at a national level because the costs and structures are mostly fixed.¹²² The structures that are required to run a fully-efficient network include the satellite backhaul, central VoIP switching, VoIP/PSTN (or Voice over Internet Protocol/Public Switched Telephone Network) & mobile interconnection, internet interconnection, and associated supporting services.¹²³ Supporting services are billing services, help desks/training/technical support, and packaging technology hardware sets (to

¹¹⁹ “Millennium Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach.” Millennium Villages. 3 Mar. 2009. < Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach>.

¹²⁰ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXTDEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

¹²¹ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXTDEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

¹²² Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXTDEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

¹²³ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXTDEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

improve standardization across the VIKA-deployed regions).¹²⁴ The problem with the central-shared service requirement of a network is that the VIKA, as currently conceptualized, only addresses the supporting service, that is, packaging the appropriate technology hardware sets. Thus, there is a problem where the VIKA should either (a) need to limit its calling to a local network only, or (b) it should have to connect up to a central-shared service in order to provide national or global connectivity.

Generally speaking, most, if not all the underserved community's central-shared services will have to be set up the same way as national networks, which is the main problem with sustainability. Because each community network must connect to a backhaul and switching-related services, duplicating these efforts on each community's behalf tends to be expensive. If there is a national or regional network in place, economies of scale (factors that lower the average cost as volume increases) and scope (diversification of products due to decreased cost of production) can be achieved.¹²⁵ For instance, multiple communities can share costly bandwidth from one satellite, which lowers their overall cost, eliminates duplicated costs, and gains operating efficiencies.¹²⁶ Providing telecommunications on a regional basis may seem daunting due to the scope and initial financial requirements (some estimates upward of US\$ 100,000).¹²⁷ However, because the underpinnings of the network are the same whether it is extended to one community or an entire region, it may make fiscal sense to approach service provisioning from a

¹²⁴ Owen, Darrell. "Achieving Rural ICT Access... Providing the Connectivity." USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXT/DEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

¹²⁵ "Idea: Economies of scale and scope." *Economist.com*. 5 Apr. 2009 <http://www.economist.com/business/management/displaystory.cfm?story_id=12446567>.

¹²⁶ Owen, Darrell. "Achieving Rural ICT Access... Providing the Connectivity." USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXT/DEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

¹²⁷ Owen, Darrell. "Achieving Rural ICT Access... Providing the Connectivity." USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXT/DEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

big-picture perspective, especially when spurring community and regional development seems to be the main goal of the VIKA.

Community-technology networks are the end-pieces of the puzzle. Community technology networks are comprised of satellite receivers, antennas, and end-user devices (i.e., computers, radios, VoIP phones). The start-up costs for these components are minimal, and range from or over \$10,000-\$20,000.¹²⁸

To determine how much central-shared service and community-technology network needs to be set up by the VIKA project, there must be a determination of what physical type of infrastructure is needed. There are essentially two choices of physical infrastructure, wireline or wireless. Each can support a similar end-result, that is, the transmission of data, but the physical infrastructure will differ dramatically. For the purposes of this report, telecommunications provisioning through (1) fixed-service “wireline” and (2) wireless methods will be discussed. If wireline infrastructure already exists, then basic voice telecommunications will already be in place and only provisioning of internet needs to be explored, as the central-shared services will likely be in place and operating. Despite the fact that wireline is not common in underserved and rural areas that the VIKA will likely be deployed in, it will be explained below to give a complete picture of telecommunication possibilities.

Aside from the brief descriptions of wireline networks and service, this infrastructure section will mostly focus on building wireless infrastructure. For the most part, within the last 20 years, the growth of wireless communications is becoming more common in many parts of the world for a

¹²⁸ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXT/DEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

multitude of reasons. In many places, while the ability to connect exists, costs of building both the central-shared services and the community technology network can be steep. However, “steep” may not be prohibitive, and building the central-shared network and associated services will be discussed accordingly within the wireless section.

Fixed-Service Providers (“Wireline”)

“Fixed-service” refers to the provision of services to a non-mobile access point, like a school, residence, or hospital. Because of the lack of mobility, fixed-service providers typically use terrestrial-based copper-wire, coaxial cable, or fiber-optic networks.¹²⁹ Although for the most part, these networks are not available in rural or underserved areas, if the VIKA is deployed to an area that already has the wireline infrastructure available, it would presumably be cost-effective to utilize the pre-existing networks. This section makes the assumption that any pre-existing wireline networks should already be hooked into the central-shared services because without connection to the central-shared services, any wireline network would be largely useless.

Voice: Plain Old Telephone Service

The traditional service is an analog “Plain Old Telephone Service” (POTS), which is a plain voice network, or the standard telephone service that most homes use. These include “bi-direction, or duplex,” voice signaling, a voice path with limited frequency range of 300Hz to 1MHz, “dial tone and ringing signals, subscriber dialing, and operator services, such as directory

¹²⁹ Ohrtman, Frank. “Fixed vs. Mobile WiMax: Mobility Monomania?” *Mind Commerce*. 2 Mar. 2009 <http://www.mobilein.com/WiMax_FixedvsMobility.pdf>.

assistance and long distance, and conference calling assistance.”¹³⁰ ¹³¹ POTS services have usually been provided by a twisted pair of insulated wires and are voice-grade.

Non-POTS networks, the digital, high-speed communications lines, are telephone services that can be enhanced with calling features such as voicemail, caller ID, call waiting, speed dialing, three-way calling, and interfaced with modems and facsimile machines. While more recently, fiber-optic cable (“fiber”), has started to replace the traditional copper-wire, both can be traditionally regarded as “wired technologies.”¹³² It is important to recognize, however, where fiber-optic cable exists, it can move large amounts of information at much higher speeds than those over copper-wire or coaxial cable.¹³³

Internet: Dial-Up

U.S. users are familiar with internet access over non-cable and non-fiber POTS lines as “dial-up.” Dial-up connections require either a stand-alone personal computer (PC) or a network server calling an Internet Service Provider (ISP) with a modem over regular telephone lines.¹³⁴ The modem device acts as an interface between the computer and the telephone line, converting the telephone signal into a computer signal and vice-versa.¹³⁵ POTS’ and subsequently, dial-up internet’s main advantages are that it is extremely stable as down-time is minimal, and it can be

¹³⁰ Groth, David & Skandier, Toby. *Network+™ Study Guide (2ed)*. Wiley Publishing: Indianapolis, IN, 2005.

¹³¹ “POTS: Plain Old Telephone Service.” *Network Dictionary*. 26 Feb. 2009
<<http://www.networkdictionary.com/telecom/pots.php>>.

¹³² Levy, Michel, et al. “Combining Access Technologies to Stay Best Connected.” *Alcatel-Lucent*. 16 Mar. 2009
<http://www1.alcatel-lucent.com/en/apphtml/atrarticle/2006q3combiningaccesstechnologiestostaybestconnected09enhtmtcm1721109741635.jhtml;jsessionid=GUNV5YUKVB1Z5LAWFRUE1DNMCYWGI3GC?_DARGS=/common/atr/DATR_table_of_contents.jhtml_A&_DAV=/com/en/appxml/articlepaperlibrary/combiningaccesstechnologiestostaybestconnectedtcm1721107171635.jhtml>.

¹³³ Atkins, Trevor. “Telecommunications: Use, Constraints and Potential in Rural Areas.” *Ministry of Agriculture and Forestry*. 22 May 2009 <<http://www.maf.govt.nz/mafnet/rural-nz/people-and-their-issues/communication/telecommunications-use-and-constraints/teleconst-07.htm>>.

¹³⁴ Mulozi, Dean L. “Rural Access: Options and Challenges for Connectivity and Energy in Zambia.” *IICD*. 6 May 2009
<<http://www.iicd.org/files/Zambia-Rural-Access-Report.pdf>>.

¹³⁵ Mulozi, Dean L. “Rural Access: Options and Challenges for Connectivity and Energy in Zambia.” *IICD*. 6 May 2009
<<http://www.iicd.org/files/Zambia-Rural-Access-Report.pdf>>.

used with E911 systems. Additionally, in urban and suburban areas, dial-up access generally exists because of established wired infrastructure, and is an alternative for people who have limited budgets, as it is available at standard telephone rates.¹³⁶

If used for internet, dial-up access is slow and can be unreliable due to interference and lack of a stable power source.¹³⁷ An additional disadvantage is the amount of money it takes to lay physical infrastructure, especially to rural areas where houses are widely dispersed. Finally, many local exchange carriers (LECs), telephone companies who are “engaged in the provision of telephone exchange service or exchange access,” have such overloaded exchanges and noisy lines that lead to problems “in even accessing or maintaining connection to the Internet, let alone the speed at which it can operate.”^{138 139}

The cost of POTS, and subsequently, dial-up connectivity can be easily and objectively determined. For any connection, the cost of time spent on the internet at any given time is the sum of the cost of a telephone call and the cost of time spent online (factoring in connection speed, which affects time spent online, that is, at a slower connection speed, more time will be spent utilizing the telephone line).

¹³⁶ Mulozi, Dean L. “Rural Access: Options and Challenges for Connectivity and Energy in Zambia.” IICD. 6 May 2009 <<http://www.iicd.org/files/Zambia-Rural-Access-Report.pdf>>.

¹³⁷ Mulozi, Dean L. “Rural Access: Options and Challenges for Connectivity and Energy in Zambia.” IICD. 6 May 2009 <<http://www.iicd.org/files/Zambia-Rural-Access-Report.pdf>>.

¹³⁸ Telecommunications Act of 1996: Public Law 104-104, February 8, 1996. Diane Publishing Company, 1998. 27 Mar. 2009 <<http://books.google.com/books?id=ePaOUWFBvYIC&lpg=PA59&ots=2HwBjls63&dq=engaged%20in%20the%20provision%20of%20telephone%20exchange%20service%20or%20exchange%20access&pg=PA61#v=onepage&q=engaged%20in%20the%20provision%20of%20telephone%20exchange%20service%20or%20exchange%20access&f=false>>.

¹³⁹ Atkins, Trevor. “Telecommunications: Use, Constraints and Potential in Rural Areas.” Ministry of Agriculture and Forestry. 22 May 2009 <<http://www.maf.govt.nz/mafnet/rural-nz/people-and-their-issues/communication/telecommunications-use-and-constraints/teleconst-07.htm>>.

Internet: Digital Subscriber Line (DSL) and Asymmetric Digital Subscriber Line (ADSL)

Digital Subscriber Lines (DSL) and Asymmetric Digital Subscriber Line (ADSL) are technologies that allow the copper wire infrastructure to act as a router for internet connectivity. Both technologies transfer data at speeds of generally 64 to 1024 kbps, though this can be boosted to between 2-4 Mbps and even 8Mbps, the rate needed for videoconferencing.¹⁴⁰ DSL and ADSL do not require additional phone lines to be installed as they make use of different frequencies than the voice services transmitted over already-existing copper wire.¹⁴¹ The extra hardware components required to run a DSL or ADSL connection are a DSL modem and a router, in addition to the telephone and computer.¹⁴²

However, DSL and ADSL suffer from quality issues due to signal degradation proportional to their distance from the exchange. Because high throughput cannot be sustained over distances greater than 3-4 kms, it is not a solution for rural users.¹⁴³ Also, DSL and ADSL tend to be expensive, negating widespread usage. Because they are not generally available at standard telephone rates, they are most often used by corporate users.¹⁴⁴ By the end of 2005, most fixed-service providers in high-growth economies still had only a 2 to 30% penetration of narrowband

¹⁴⁰ Atkins, Trevor. "Telecommunications: Use, Constraints and Potential in Rural Areas." Ministry of Agriculture and Forestry. 22 May 2009 <<http://www.maf.govt.nz/mafnet/rural-nz/people-and-their-issues/communication/telecommunications-use-and-constraints/teleconst-07.htm>>.

¹⁴¹ Mulozi, Dean L. "Rural Access: Options and Challenges for Connectivity and Energy in Zambia." IICD. 6 May 2009 <<http://www.iicd.org/files/Zambia-Rural-Access-Report.pdf>>.

¹⁴² Mulozi, Dean L. "Rural Access: Options and Challenges for Connectivity and Energy in Zambia." IICD. 6 May 2009 <<http://www.iicd.org/files/Zambia-Rural-Access-Report.pdf>>.

¹⁴³ Atkins, Trevor. "Telecommunications: Use, Constraints and Potential in Rural Areas." Ministry of Agriculture and Forestry. 22 May 2009 <<http://www.maf.govt.nz/mafnet/rural-nz/people-and-their-issues/communication/telecommunications-use-and-constraints/teleconst-07.htm>>.

¹⁴⁴ Mulozi, Dean L. "Rural Access: Options and Challenges for Connectivity and Energy in Zambia." IICD. 6 May 2009 <<http://www.iicd.org/files/Zambia-Rural-Access-Report.pdf>>.

POTS and only a minor capability (<5% penetration) to support broadband Internet access.¹⁴⁵

For the most part, this means that most developing economies lack the necessary wireline infrastructure to leverage new technologies such as DSL and ADSL into providing broadband into rural areas.

As explained in the next section, wireless technologies can be said to “leapfrog” over POTS connections where wired deployment would be prohibitively expensive due to distance and terrain, making the rollout of large-scale infrastructure unnecessary. However, with wireless technologies, the associated central-service infrastructure often needs to be built or contracted.

Wireless

As mentioned above, wireless technologies are a viable alternative to traditional POTS or expensive fiber-optic rollouts in places where telecommunications infrastructure is non-existent or cost-prohibitive due to distance and terrain. However, because the central-shared service platform must be established, again, it may make fiscal sense to establish this program on more than a one-community basis. Wireless technologies mainly comprise of two-way radios and satellite, with additional technologies serving as methods of propagating those wireless signals. Again, as mentioned in the introduction, the key factors are the provisioning of the central-shared services and the building of a community technology network.

A key guide to sourcing and evaluating wireless technical infrastructure components is Jack Unger’s book Deploying License-free Wireless Wide-area Networks, which covers how to

¹⁴⁵ Levy, Michel, et al. “Combining Access Technologies to Stay Best Connected.” Alcatel-Lucent. 16 Mar. 2009 <http://www1.alcatel-lucent.com/com/en/apphtml/atrarticle/2006q3combiningaccesstechnologiestostaybestconnected09enhtmtcm1721109741635.jhtml;jsessionid=GUNV5YUKVB1Z5LAWFRUE1DNMCYWGI3GC?_DARGS=/common/atr/DATR_table_of_contents.jhtml_A&_DAV=/com/en/appxml/articlepaperlibrary/combiningaccesstechnologiestostaybestconnectedtcm1721107171635.jhtml>.

choose the right network architecture for a wireless network, how to perform site surveys, and how to select wireless systems.¹⁴⁶ Even more elemental is the book, *Wireless Networking for the Developing World*, a handbook that covers radio physics, network design, antennas and transmission lines, networking hardware, security and monitoring, solar power, building an outdoor node, troubleshooting, economic sustainability, and case studies.¹⁴⁷

Central-shared services: Backhaul

As with wireline technologies, wireless technology also has the capability of providing internet. Wireless systems can be a substitute to wired voice and internet access in rural areas, however, the geographic and cost limitations that exist on current wireless (cellular) technologies can still exist with the new systems. In truly remote areas, access can be provided through satellite, but again, because the satellite itself is expensive to build, operate, and run, and the spectrum (bandwidth) is finite, the costs can be prohibitive. In those cases, the technology is there, but the economic means are not. The main drivers of this high economic cost are backhaul and bandwidth.

An essential part of the central-shared service infrastructure is the provision of backhaul. Backhaul is the means for connecting base stations or cellular sites and the operator's core network over a variety of transport media. It is one of the major costs of building and running a mobile network. Industry consensus indicates that transport equipment accounts for 25 % of the costs of private cellular backhaul infrastructure.¹⁴⁸ Transport outlays vary between 40 to 60 % of

¹⁴⁶ Unger, Jack. "Developing 'Deploying License-Free Wide-Area Networks.'" *Cisco Press*. 8 Mar. 2009 <<http://www.ciscopress.com/articles/article.asp?p=98159>>.

¹⁴⁷ Flickenger, Rob, et al. "Wireless Networking for the Developing World: A practical guide to planning and building low-cost telecommunications infrastructure." *wndw.net*. 5 Mar. 2009 <<http://wndw.net/pdf/wndw2-en/wndw2-ebook.pdf>>.

¹⁴⁸ Junowicz, Gaby. "Overhaul the Backhaul." *Telecom Magazine*. 1 Mar. 2009. <http://www.telecommagazine.com/International/article.asp?HH_ID=AR_2351>.

the total cost of leased lines, with backhaul contributing 75 % of that sum.¹⁴⁹ When the wireless technology links back to a wired network which provides the backhaul, then the costs can be much reduced.¹⁵⁰ Generally, rural LECs “are subsidized through the access cost system,” but when “you go into these green field builds, backhaul is a massive problem.”¹⁵¹

Thus, where the backhaul is entirely provided by satellite due to the inaccessibility or unfeasibility of building wireline infrastructure (such as highly rural areas), it is extremely expensive because of satellite operation costs, and finite amounts of spectrum capacity (bandwidth). Bandwidth, a related term to backhaul, is a measurement of frequency range, or the maximum capacity of a network channel.¹⁵² Bandwidth on any type of backhaul is necessarily limited; for instance, Ethernet has a bandwidth of 10-, 100-, 1000 mega bits per second (Mbps) and 1 and 10 gigabits per second (Gbps).¹⁵³ On the other hand, the representative demands on the backhaul of a network include web browsing, which requires 9.6 to 240 kbps; media streaming, which requires 128 to 384 kbps; and, real-time multimedia, requiring 1 to 3 Mbps.¹⁵⁴

The key is to remember that backhaul is not limited to satellite, but encompasses all telecommunications strategies, and because it makes up a substantial part of the cost of a network, absolutely must be considered prior to the deployment of the VIKA.

¹⁴⁹ Junowicz, Gaby. “Overhaul the Backhaul.” Telecom Magazine. 1 Mar. 2009. <http://www.telecommagazine.com/International/article.asp?HH_ID=AR_2351>.

¹⁵⁰ “Backhaul.” Network Dictionary. 20 Apr. 2009 <<http://www.networkdictionary.com/wireless/b.php>>.

¹⁵¹ Campbell, Fred. Telephone Interview. 3 Mar. 2009.

¹⁵² “Ethernet Glossary: Bandwidth.” Network dictionary. 16 Apr. 2009 <<http://www.networkdictionary.com/Wireless/EthernetGlossary.php>>.

¹⁵³ “Ethernet Glossary: Bandwidth.” Network dictionary. 16 Apr. 2009 <<http://www.networkdictionary.com/Wireless/EthernetGlossary.php>>.

¹⁵⁴ Lebugle, Thierry & Henrotte, Anne. “Boom in Mobile Data Creates Backhaul Urgency.” Alcatel-Lucent. 20 Jun. 2009 <http://www1.alcatel-lucent.com/gsearch/accessFile.jhtml?sendURL=http%3A//www.alcatel-lucent.com/economicrecovery/boom_mobile_data_wp.pdf&sendCollection=root&sendTitle=Boom+in+Mobile+Data+Creates+Backhaul+Urgency+&specialColl=>>.

Voice and Internet: Two-way radios and Satellite

Two-way Radios & Mobile Telephony

Two-way radios include the “walkie-talkies” familiar to most Americans. However, the “two-way radio” category also encompasses the more complex cellular (mobile) telephones that provide voice, and often some limited amount of enhanced calling features. Mobile telephones use full-duplex transmission, which is the transmission of data in two directions simultaneously, while other radios only allow voice transmission on one channel, leading to the walkie-talkie effect of one-communication-at-a-time.¹⁵⁵ Mobile voice standards such as Code Division Multiple Access (CDMA) or Global System for Mobile communications (GSM) are methods of transmitting those dual digital modulations of data over a radio frequency spectrum.¹⁵⁶

Mobile phones and “wireless” infrastructure technologies are especially useful to provide what were previously considered “fixed” services to outlying rural areas. Mobile voice standards are used mainly to transmit voice data, but additional wireless technologies are beginning to carry larger amounts of data, allowing limited amounts of media, and in some cases, internet. Because mobile communications cover two-way text and voice, they surpass the benefits of one-way communications such as radio or TV.¹⁵⁷ Obviously, 2G telephony without broadband would be less costly than attempting to create a high-speed network, so the goal needs to be clearly defined, that is, does the VIKA look to give broadband, or simple voice connectivity?¹⁵⁸ CDMA and GSM systems are more widely available and cheaper, but what WiMax (a wireless

¹⁵⁵ “Full Duplex Transmission.” Network Dictionary. 20 Apr. 2009 <<http://www.networkdictionary.com/hardware/fdt.php>>.

¹⁵⁶ MacPherson, James. “Balloons to be tested as cell-tower replacement.” USA Today. 20 Mar. 2009 <http://www.usatoday.com/tech/news/techinnovations/2006-01-30-cellular-balloons_x.htm>.

¹⁵⁷ Bhavnani, Asheeta, et al. “ICT Policy Division: Global Information and Communications Department (GICT).” World Bank Group. 15 Jun. 2009 <http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATION/ANDTECHNOLOGIES/Resources/The_Role_of_Mobile_Phones_in_Sustainable_Rural_Poverty_Reduction_June_2008.pdf>.

¹⁵⁸ Campbell, Fred. Telephone Interview. 3 Mar. 2009.

technology available for computers, but not mobile telephony) offers over all these technologies is 4G capabilities and 4 Mbps downloads.¹⁵⁹ Mobile networks, however, continue to boom despite their lesser data-carrying capacity.

In 2007, the GSM Association (GSMA) estimated that 90% of the world would be covered by mobile networks by 2015.¹⁶⁰ Currently, the adoption of mobile phones has reached four billion users worldwide, and is expected to grow to six billion connections by 2013.¹⁶¹ One hundred million of these mobile connections also have mobile broadband.¹⁶² The market at the bottom of the pyramid, those who make less than or equal to \$300 USD per capita per year, indicates that 3.96 billion people remain to be served.^{163 164}

The costs of deploying a cellular phone network are difficult to find, but estimates state that one cellular tower can cost \$250,000 USD or more.¹⁶⁵ On the other hand, the cost of adding subscribers to the cellular network is relatively low, new handsets are easily available, and secondary markets for used devices emerge as a result of mobile ubiquity.¹⁶⁶

Cellular telephones are useful and already have a fair amount of coverage, as well as explosive growth fueled by regulatory changes and private sector investment. For example, African

¹⁵⁹ Campbell, Fred. Telephone Interview. 3 Mar. 2009.

¹⁶⁰ Bhavnani, Asheeta, et al. "ICT Policy Division: Global Information and Communications Department (GICT)." World Bank Group. 15 Jun. 2009 <http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/The_Role_of_Mobile_Phones_in_Sustainable_Rural_Poverty_Reduction_June_2008.pdf>.

¹⁶¹ Schwartz, Michael. "Mobile World Congress will celebrate four billion connections – GSMA." Developing Telecoms, 18 Feb. 2009 <<http://www.developingtelecoms.com/content/view/1668/123/>>.

¹⁶² Schwartz, Michael. "Mobile World Congress will celebrate four billion connections – GSMA." Developing Telecoms, 18 Feb. 2009 <<http://www.developingtelecoms.com/content/view/1668/123/>>.

¹⁶³ Hammond, Allen, et al. "The Next Four Billion: Market Size and Business Strategy at the Base of the Pyramid." World Resources Institute. 20 Apr. 2009 <<http://www.wri.org/publication/the-next-4-billion>>.

¹⁶⁴ Hammond, Allen, et al. "The Next Four Billion: Market Size and Business Strategy at the Base of the Pyramid." World Resources Institute. 20 Apr. 2009 <<http://www.wri.org/publication/the-next-4-billion>>.

¹⁶⁵ MacPherson, James. "Balloons to be tested as cell-tower replacement." USA Today. 20 Mar. 2009 <http://www.usatoday.com/tech/news/techinnovations/2006-01-30-cellular-balloons_x.htm>.

¹⁶⁶ Bhavnani, Asheeta, et al. "ICT Policy Division: Global Information and Communications Department (GICT)." World Bank Group. 15 Jun. 2009 <http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/The_Role_of_Mobile_Phones_in_Sustainable_Rural_Poverty_Reduction_June_2008.pdf>.

markets had 10% coverage in 2005, but is expected to increase to 31% by 2011.¹⁶⁷ However, due to the non-transparent cost of infrastructure deployment, the major role of the private sector in building out networks without governmental assistance, and the VIKA's goal of stimulating additional development, the team recommends an additional look at other technologies that enable a wider range of benefits, namely, quality internet.

Satellite

Satellite is the most flexible connectivity solution available, albeit the most expensive.¹⁶⁸ With satellite, reception dishes can be placed in the most out-of-the-way areas, and does not need the ground infrastructure that cellular telephony or wireline telephony requires. However, satellite is limited by “the availability of the hardware and the cost of the solution.”¹⁶⁹ Obviously, affordability is a key indicator of an ICT initiative's continued success, but at some point, the upfront investment must be made to cover the start-up costs of obtaining equipment and building, or connecting up to the infrastructure. Because this is meant to be a moderately short-term solution, in terms of waiting for the private and national telecommunications companies to build out their networks, initial subsidization should be acceptable, with a view towards subsidization tapering off over time.

Satellite solutions providers include Inmarsat Ltd., Intelsat, Ltd., Americom Government Services, Iridium, Xtar, Terrestar Networks, Hughes Network Systems LLC, Mobile Satellite Ventures (MSV), Stratos, SES New Skies, Globalstar, Marshall Communications, and Eutelsat,

¹⁶⁷ Bhavnani, Asheeta, et al. “ICT Policy Division: Global Information and Communications Department (GICT).” World Bank Group. 15 Jun. 2009 <http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/The_Role_of_Mobile_Phones_in_Sustainable_Rural_Poverty_Reduction_June_2008.pdf>.

¹⁶⁸ “IT Access for Everyone – Global Benchmarking Study.” World Economic Forum. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

¹⁶⁹ “IT Access for Everyone – Global Benchmarking Study.” World Economic Forum. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

Inc.¹⁷⁰ In addition to these well-known providers, individual countries may have their own proprietary satellites around the region.

The University of Michigan–Ann Arbor’s College of Engineering, Atmospheric, Oceanic, and Space Sciences (UofM) participated in IMAGINE Africa, a project specializing in designing low-cost, deployable broadband systems for deployment in rainforest, mountains, and deserts. Because these regions were frequently remote, line-of-sight internet connections were not feasible, and satellite internet was the only stable and feasible way to supply backhaul to these villages, similar to the initial VIKA requirements.

According to Joan Ervin, one of the UofM engineering students, initially, they had visualized a global solution for the entire Earth, utilizing Low Earth Orbit satellites hovering at approximately 820 km over the Earth.¹⁷¹ However, the global solution was too expensive and complex, requiring four different types of ground stations, and costing \$2.4 billion to distribute 80,000 ground stations and 90 low earth orbiting satellites.¹⁷² Instead, the team decided to selectively focus on one region to bring the costs down. By selectively focusing on Africa, more specifically, in rural regions that do not have ground-based infrastructure and where infrastructure will likely not be addressed in the future, the UofM team anticipated building a network consisting of one Geostationary satellite, with a ground-station, 41,600 user stations, and four hub stations off-continent.¹⁷³ The hub would be connected to the internet backbone and

¹⁷⁰ “First Responder’s Guide to Satellite Communications.” Satellite Industry Association. 20 May 2009 <http://www.sia.org/frg_files/FirstResponder%27sGuidetoSatelliteCommunications.pdf>.

¹⁷¹ “Satellite based Internet for the developing world.” Internet Society: Washington DC Chapter. 22 Apr. 2009 <<http://isoc-dc.org/wordpress/?p=10>>.

¹⁷² “IMAGINE Africa.” Isoc-ny: Wikipedia. 24 Mar. 2009 <http://www.isoc-ny.org/wiki/IMAGINE_Africa>.

¹⁷³ “IMAGINE Africa.” Isoc-ny: Wikipedia. 24 Mar. 2009 <http://www.isoc-ny.org/wiki/IMAGINE_Africa>.

transmit that signal up to the satellite, which the satellite would relay back down to the user-stations in Africa.¹⁷⁴

The problem with satellites is that the installation and maintaining data throughput can be incredibly expensive, which leads to the question of whether to act as a satellite manufacturer, operator, or an ISP. The manufacture of a satellite is slow and expensive, but control could be kept over its operations during the entire process. As an operator, the option is to purchase an operational satellite from a manufacturer, and then lease capacity out to interested parties. For a 15 Gbps communications satellite, this can cost \$200 million USD, and requires a two-year lead time per satellite.¹⁷⁵ As the third option, purchase ISP capacity from operators and sell the service to the end-user. The benefit is that there is less start-up time and more efficient use of satellite capacity. However, in the long-term, it is cost-prohibitive, and requires dedicated funding to turn into a sustainable solution.¹⁷⁶

For the VIKA, which only handles the community technology network, none of these options make sense because they require involvement on a much-larger scale than initially anticipated. Thus, in the VIKA-context, the best option would be to locate an ISP that is willing to provide the satellite backhaul, and purchasing capacity off existing satellites, such as IPSTAR or Intelsat, if one exists.¹⁷⁷ However, if long-term U.S. subsidization is in mind, then the most cost-effective and low-risk approach, according to UofM's IMAGINE Africa project, may be to initially be an operator, lease capacity purchasing channels from Intelsat for 2.5 years, then later purchasing and operating a satellite (with half the capacity of IPSTAR, i.e., 27Gbps, Ku and Ka band),

¹⁷⁴ "IMAGINE Africa." Isoc-ny: Wikipedia. 24 Mar. 2009 <http://www.isoc-ny.org/wiki/IMAGINE_Africa>.

¹⁷⁵ "IMAGINE Africa." Isoc-ny: Wikipedia. 24 Mar. 2009 <http://www.isoc-ny.org/wiki/IMAGINE_Africa>.

¹⁷⁶ "IMAGINE Africa." Isoc-ny: Wikipedia. 24 Mar. 2009 <http://www.isoc-ny.org/wiki/IMAGINE_Africa>.

¹⁷⁷ Owen, Darrell. "Achieving Rural ICT Access... Providing the Connectivity." USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXTDEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

obtain orbital slots, and acquire spectrum frequency, plus landing rights (the projection of data and frequency onto a country), and work with NGOs to increase user adoption.¹⁷⁸ The major caveat is that most countries would probably fail to welcome the U.S. government as a major provider of their telecommunications solutions, given the sovereignty and national security issues associated with the sector, thus, it would be advantageous to work with NGOs and intergovernmental organizations (IGOs) already focused on ICT issues within the country.

Advantages to satellite connections are that they can be deployed anywhere, are faster and more stable, and some dishes are intended to operate for months with little maintenance under harsh conditions.¹⁷⁹ Additionally, it enables customers to get the same speeds at all locations across the entire network regardless of location, and can deliver the same content to “tens or thousands of locations simultaneously at no additional cost.”¹⁸⁰ As noted above, the main disadvantage to satellite broadband access penetration is that it is cost-prohibitive. For example, a 128 to 32 kbit/s satellite link costs \$300 USD per month, 10 times more than a terrestrial connection.¹⁸¹ Some faster connections, such as the one in the Kenyan village of Entasopia, have been estimated to cost as much as \$700 USD per month, though other reports have 256k connections at approximately \$300 as well.¹⁸²

¹⁷⁸ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009
<http://siteresources.worldbank.org/EXTDEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

¹⁷⁹ Nicholson, Chris. “Bringing the Internet to Remote African Villages.” 2 Feb. 2009
<http://www.nytimes.com/2009/02/02/technology/internet/02kenya.html?_r=1>.

¹⁸⁰ Mulozi, Dean L. “Rural Access: Options and Challenges for Connectivity and Energy in Zambia.” *IICD*. 6 May 2009
<<http://www.iicd.org/files/Zambia-Rural-Access-Report.pdf>>.

¹⁸¹ Arenas, Diego, et al. “Challenges to expanding Fixed Broadband Services in Latin America.” *Alcatel Lucent*. 25 Mar. 09
<http://www1.alcatel-lucent.com/com/en/apphtml/atrarticle/2006q3challengestoexpandingfixedbroadbandservicesinlatinamertcm1721109711635.jhtml;jsessionid=FATRPKUKKEBFFLAWFRUE1C3MICYWGI3GC?_DARGS=/common/atr/DATR_table_of_contents.jhtml_A&_DAV=/com/en/appxml/articlepaperlibrary/challengestoexpandingfixedbroadbandservicesinlatinamericatcm1721107151635.jhtml>.

¹⁸² Nicholson, Chris. “Bringing the Internet to Remote African Villages.” 2 Feb. 2009
<http://www.nytimes.com/2009/02/02/technology/internet/02kenya.html?_r=1>.

Major companies such as Google and Intel have identified rural areas and frequently help subsidize the cost of connectivity for these villages. The companies realize that even though “[b]uilding infrastructure is not necessarily [our] objective... if you look at all the areas that [we] have gone into, in many cases it has been to fill a gap.”¹⁸³ In Vietnam’s Ta Van village, a broadband internet linkage via satellite and distribution via WiMax provides VoIP and broadband to villagers in locally remote and rural areas, subsidized through Intel’s World Ahead program and USAID.¹⁸⁴ Other examples are Google’s subsidization of the broadband costs for the Kenyan village of Entasopia, and Netsat, who funds the satellite technology for African Virtual University.^{185 186}

Community Technology Network

Aside from the central-shared services, a community technology network must be established with the capability to tap into the larger infrastructure. This is where the telecommunications hardware packed in the VIKA would play the largest role, but incidentally, is probably the easiest part of entire project to complete. A community technology network would consist of essentially four major components: a satellite terminal, session border controller, wireless antenna(s), and end-user devices.¹⁸⁷ The community technology networks can be set up quickly and efficiently once the technology has been transported to the area. For instance, Dr. Bernd Nordhausen, a Solutions Architect with Intel Corporation, stated that “Logistics provided one of

¹⁸³ Nicholson, Chris. “Bringing the Internet to Remote African Villages.” 2 Feb. 2009 <http://www.nytimes.com/2009/02/02/technology/internet/02kenya.html?_r=1>.

¹⁸⁴ “Satellite and WiMax Bring High-Speed Wireless Broadband to Remote Northern Vietnam.” Intel: Pressroom.” 28 Mar. 2009 <http://www.intel.com/pressroom/archive/reference/WiMax_in_ta_van.pdf>.

¹⁸⁵ Nicholson, Chris. “Bringing the Internet to Remote African Villages.” 2 Feb. 2009 <http://www.nytimes.com/2009/02/02/technology/internet/02kenya.html?_r=1>.

¹⁸⁶ “World Summit on the Information Society: Geneva 2003 – Tunis 2005.” International Telecommunications Union. 3 Apr. 2009 <http://www.itu.int/osg/spu/wsis-themes/ict_stories/AVUcasestudy.html>.

¹⁸⁷ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXTDEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

the challenges due to the remote location of [Ta Van village in Vietnam], while the actual on-the-ground deployment was completed within only one week.”¹⁸⁸

Satellite Terminal

Very Small Aperture Terminals (VSATs) are small, two-way 75 cm to 1.2m dishes that are devices needed to connect to the satellite backhaul provided as part of the central-services infrastructure.¹⁸⁹ VSATs are an integral part of the network, albeit the community technology network, rather than the central-service network. The terminals consist of satellite dishes that can be installed at a specific location, an outdoor antenna unit, and indoor receivers that connect to user’s equipment.¹⁹⁰ VSATs are generally obtainable from foreign satellite companies or local ISPs, and can range from \$10,000-16,000 USD for a C-band Antenna (dish) to a \$2,000 to \$6,000 USD Ku-band antenna.¹⁹¹ India’s e-Choupal initiative’s VSATs had typical installation costs of \$2,560 US with 256 Kbps throughput.¹⁹²

One unique twist on the VSAT is the system developed by the UofM IMAGINE Africa team. They have produced an internet system as a project that combined a communication system (a modem, Wi-Fi router, laptop, and satellite dish) and a power generation system (a solar panel, batteries and electronics that manage the modem and wireless router) operated by a combination

¹⁸⁸ Nordhausen, Bernd. “WiMax with IPSTAR Backhaul Links Remote Community in Vietnam to the World.” Last-Mile Online Newsletter. 28 Mar. 2009 <http://www.ipstar.com/lastmile/november-december/en/ipstar_solutions.html>.

¹⁸⁹ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXT/DEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

¹⁹⁰ Mulozi, Dean L. “Rural Access: Options and Challenges for Connectivity and Energy in Zambia.” IICD. 6 May 2009 <<http://www.iicd.org/files/Zambia-Rural-Access-Report.pdf>>.

¹⁹¹ Mulozi, Dean L. “Rural Access: Options and Challenges for Connectivity and Energy in Zambia.” IICD. 6 May 2009 <<http://www.iicd.org/files/Zambia-Rural-Access-Report.pdf>>.

¹⁹² “IT Access for Everyone – Global Benchmarking Study.” World Economic Forum. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

of solar energy and battery power.¹⁹³ This combines at least two of the four necessary components of a community technology network, the satellite terminal and the wireless antenna, adding in a self-powered aspect. The physical enclosures were also designed to withstand deserts, mountains, and rainforests, and exist on off-grid electricity.¹⁹⁴ However, as of this writing, the cost for the UofM VSAT system has not been released publicly.

Other Equipment

In addition to the satellite terminal, if VoIP is considered, then a community-level edge-switch is required to continue processing local calls when the satellite link drops, and keeps all local calling within the local network, instead of being processed by the satellite.¹⁹⁵ Also, wireless antennas, such as a WiMax base station, or WiFi access points and antennas must be placed around the area in order to ensure connectivity. Finally, the last components are end-user devices able to connect to the signals transmitted by the antennas, such as VoIP phones, personal computers, and other handheld devices.¹⁹⁶ Darrell Owen, former USAID ICT manager, projected representative hardware costs for the community network to be: (1) VSAT: \$3,000; (2) Edge switch: \$1,000; (3) Antennas: \$1,000 each; (4) Phones: \$100 each; (5) Personal computers:

¹⁹³ Eddy, Deborah K. "IMAGINE Africa: U-M Students Bring the Internet to Africa." University of Michigan College of Engineering, Atmospheric, Oceanic, and Space Sciences: Daily Planet. 20 Mar. 2009
<<http://aoss.engin.umich.edu/files/pages/15-dp.pdf>>.

¹⁹⁴ Beberman, Mallory. "Engineering Students Bring Internet to Africa." The Michigan Daily News. 16 Mar. 2009
<<http://www.michigandaily.com/content/2009-03-17/engineering-students-bring-internet-africa>>.

¹⁹⁵ Owen, Darrell. "Achieving Rural ICT Access... Providing the Connectivity." USAID Presentation. 15 May 2009
<http://siteresources.worldbank.org/EXTDEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

¹⁹⁶ Owen, Darrell. "Achieving Rural ICT Access... Providing the Connectivity." USAID Presentation. 15 May 2009
<http://siteresources.worldbank.org/EXTDEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

\$1,000 each; (6) Solar mats: \$1,000 each; (7) Batteries: \$500 each, and (8) \$1000 for miscellaneous costs.¹⁹⁷

Community-level edge-switch

Edge switches are “switches, routers, routing switches, etc.,” that are located at the meeting point between two networks “to pass packets between the access devices and core/backbone network devices,” generally between the backbone network and the service provider, or connecting users into service provider networks.¹⁹⁸ A community-level edge-switch is required to continue processing local calls when the satellite link drops, and keeps all local calling within the local network, instead of being processed by the satellite.¹⁹⁹

On a larger network, the top-of-the-line switches cost approximately \$13,000-35,995 USD such as the Cisco Catalyst 6500 module, which can “deliver secure, enterprise wireless access to main, branch, and remote campuses.”²⁰⁰ It is designed for medium-sized and large enterprise facilities with “clustering capabilities of up to 3,600 lightweight access points per roaming domain. It scales to 300 lightweight access points per module with support for 10,000 and more wireless client devices.”²⁰¹ On the other hand, because the team is looking for energy efficiency, 3Com claims that their switch 7900E is “up to 75% more energy efficient” than the Cisco Catalyst 6500.²⁰² On a smaller scale, as for the VIKA community network, edge switches should

¹⁹⁷ Belt, Juan, et al. “Expanding Rural Access: Seeking a Rural Community Approach.” [NextBillion.net](http://www.nextbillion.net/archive/files/Expanding%20Rural%20Access-PPT-20Feb07.pdf). 17 Apr. 2009 <<http://www.nextbillion.net/archive/files/Expanding%20Rural%20Access-PPT-20Feb07.pdf>>.

¹⁹⁸ “Edge Device.” [Network Dictionary](http://www.networkdictionary.com/node/1504). 20 Apr. 2009 <<http://www.networkdictionary.com/node/1504>>.

¹⁹⁹ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXTEDEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

²⁰⁰ “Catalyst 6000 – Catalyst 6500.” [icpsales.com](http://www.icpsales.com/cisco6000.html). 28 Mar. 2009 <<http://www.icpsales.com/cisco6000.html>>.

²⁰¹ “Cisco Catalyst 6500 Series Wireless Services Module Expansion Module.” [Google products](http://www.google.com/products/catalog?q=cisco+Catalyst+6500+price&oe=utf-8&rls=org.mozilla:en-US:official&client=firefox-a&um=1&ie=UTF-8&cid=7352270378967442277&ei=CcEjSp-HOJXAM-WE8LIJ&sa=X&oi=product_catalog_result&ct=result&resnum=4#ps-sellers). 18 Mar. 2009 <http://www.google.com/products/catalog?q=cisco+Catalyst+6500+price&oe=utf-8&rls=org.mozilla:en-US:official&client=firefox-a&um=1&ie=UTF-8&cid=7352270378967442277&ei=CcEjSp-HOJXAM-WE8LIJ&sa=X&oi=product_catalog_result&ct=result&resnum=4#ps-sellers>.

²⁰² “3Com Energy Efficient Networks.” [3Com](http://www.3com.com/gogreen/assets/3com_600549-003.pdf). 20 May. <http://www.3com.com/gogreen/assets/3com_600549-003.pdf>.

cost no more than \$1,000, and will be available from providers such as Cisco Systems and 3Com.

Wireless Antennas

Intrinsic to acquiring wireless components such as antenna or base stations (routers) is deciding what wireless networking protocol technology should be used. The two most popular are the 802.11 family of radio protocols known as WiFi, and 802.16 or WiMax. On the whole, WiFi antenna are cheaper than WiMax because of widespread adoption with open-source routers, such as the ASUS WL-520gU available commercially from \$34.99 to around \$100 for the more expensive ones, although WiMax is being increasingly adopted by industry.²⁰³ WiMax has a broader range of coverage than WiFi and 4G data speeds, versus WiFi's short range and relative unreliability.²⁰⁴ However, WiFi equipment is ubiquitous and cheap, and the 2.4 GHz ISM band is usually unlicensed, which makes wireless networking with WiFi equipment easier to both (a) obtain equipment, and (b) set up networks without needing to jump through regulatory hoops.²⁰⁵ Both technologies have the ability to distribute connectivity, but the choice needs to be made based on whether cost (WiFi) or distance (WiMax) is paramount.

The Millennium Village of Sambaina, Africa, utilizes a mixture of WiMax and WiFi routers to ensure connectivity, utilizing iXem Labs of Politecnico di Torino's low-cost method for long-distance point-to-point telecommunication infrastructures by using Hiperlan (Europe's version of WiFi – 802.11h) and WiMax.^{206 207} Two groups of researchers and installers, iXem Labs and

²⁰³ "ASUS." [Newegg.com](http://www.newegg.com). 1 May 2009

<<http://www.newegg.com/Product/ProductList.aspx?Submit=Suggested&Description=33-320>>.

²⁰⁴ Flickenger, Rob, et al. "Wireless Networking for the Developing World: A practical guide to planning and building low-cost telecommunications infrastructure." wndw.net. 5 Mar. 2009 <<http://wndw.net/pdf/wndw2-en/wndw2-ebook.pdf>>.

²⁰⁵ Flickenger, Rob, et al. "Wireless Networking for the Developing World: A practical guide to planning and building low-cost telecommunications infrastructure." wndw.net. 5 Mar. 2009 <<http://wndw.net/pdf/wndw2-en/wndw2-ebook.pdf>>.

²⁰⁶ "iXem Record 2007." [iXem Labs](http://www.ixem.polito.it/research/record_2007/index_e.htm). 1 Mar. 2009 <http://www.ixem.polito.it/research/record_2007/index_e.htm>.

CUWiN Community Wireless Solutions advocate two different types of networking, both based on unlicensed WiFi infrastructure: iXem touts long-distance point-to-point solutions and then individual unlicensed WiFi systems for access distribution; while CUWiN encourages mesh networking, which is a redundant system of routers sharing access, utilizing cheaply available licensed WiFi hardware.²⁰⁸ Mesh networking would work best in more crowded, or urban areas, because private installations “cannot be considered reliable over long periods,” however, for those areas that have negative propagation conditions with a scattered population, wireless antennas, such as a WiMax base station, or WiFi access points and antennas should be placed around the area in order to ensure connectivity.²⁰⁹ The prices on wireless antennas continue to decrease with additional time. Wireless antennas can be obtained from multiple vendors, a list of which can be found at WiMax Industry.²¹⁰

End-User Devices

Finally, the last components are end-user devices able to connect to the signals transmitted by the antennas, such as VoIP phones, PCs, and other handheld devices.²¹¹ Devices that have previously had software and applications were designed to fit specific user needs and are compatible with the installed infrastructure devices. Computers and telephones are the devices that should be purchased for the applications listed above. However, computers are not terribly energy efficient. According to Wayan Vota of Inveneo, renewable energy sources such as solar power are very expensive and can run \$15-20 per installed watt. Given that a traditional computer draws 150W,

²⁰⁷ Arthur, Cole. “ICT Village Working Paper IWC 2009.” (Awaiting publication). 2009.

²⁰⁸ “iXem Record 2007.” iXem Labs. 1 Mar. 2009 <http://www.ixem.polito.it/research/record_2007/index_e.htm>.

²⁰⁹ “iXem Record 2007.” iXem Labs. 1 Mar. 2009 <http://www.ixem.polito.it/research/record_2007/index_e.htm>.

²¹⁰ “WiMax Hardware.” WiMax Industry. 23 Mar. 2009 <<http://www.WiMax-industry.com/eq/WiMaxhardwarevendors.htm>>.

²¹¹ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXT/DEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

the cost of provisioning the computer is the equivalent of \$3,000 on the high end.²¹² Thus, it is paramount to look for an energy-efficient computing device.

Computers

Computers are also an extremely useful end-user device, because they have multiple capabilities for web-based conferencing, browsing, and other internet-based applications. Computers can be installed as kiosks, standalone, or networked together in a telecenter. They can be donated or purchased and then leased to entrepreneurs.

Relatively low-cost, low-energy, alternatively-powered, durable individual laptop computers designed by Massachusetts Institute of Technology can be obtained from One Laptop Per Child (OLPC).²¹³ On the other hand, recycled computers and associated hardware components are cheap and plentiful, though they can be unreliable. The project director of the Khanya Project, in the Western Cape region of South Africa stated:

Refurbished (used) computers do not do justice to the project. Used computers have already reached a point where it is no longer cost-effective for an organization to maintain the equipment, and by giving such equipment to a poor school, where little technical expertise is available, one can expect break-downs, delays, and lack of funding to repair, all of which can lead to disillusionment with the use of technology.²¹⁴

The California-based company NComputing currently works with the UN on the UN's Infopoverty conference, and supplies a 100W computing system containing a computer with

²¹² Vota, Wayan. Telephone Interview. 9 February 2009.

²¹³ "Vision: Mission." One Laptop Per Child. 15 Mar. 2009 < <http://laptop.org/en/vision/mission/index.shtml>>.

²¹⁴ "Khanya Annual Report for the Period March 2007 - April 2008." Khanya. 25 Apr. 2009 <http://www.khanya.co.za/projectinfo/docs/khanya_annual_rep_2008.pdf>.

multiple monitors and keyboards. The concept is to “share” one computer among many users, with each user able to control their own computing environment through a virtual desktop. Each monitor and keyboard is hooked to the computer, and different models of the X-series can support to 11 users at about \$200.²¹⁵ With regular computers with cathode-ray tubes (CRT) or liquid crystal display (LCD) monitors, each typically requiring 150-200W, the energy savings with Ncomputing’s virtual desktops are significant. NComputing’s competitors, such as Pano Logic, have been focused on business markets instead of developing markets with their “shared” computing concepts.²¹⁶ Thus, it makes sense to partner with NComputing, a company familiar with the issues in developing countries such as South Africa and Macedonia when seeking to include shared computing in the VIKA kit.

Telephones

Community phones can be extremely successful. For example, Vodacom Community Services in South Africa sells Community Services franchise to operate cellular lines from inside converted shipping containers for a cost of \$3,450 USD, where five phone lines call for \$0.11/minute, taking advantage of Vodacom’s cellular network. Implicit in the Vodacom example is the ability to take advantage of existing networks, making the cost of provisioning hardware constrained to handsets and possibly a switch. However, for other options such as satellite phone or VoIP, the VIKA may have to incorporate more than just a handset, as pre-existing networks are not presumed to exist.

²¹⁵ Deger, Renee & Rand, David. “NComputing Builds on Ultra Low-Cost Computing Success With New X-series Desktop Virtualization Kit.” Reuters. 14 Apr. 2009 <<http://www.reuters.com/article/pressRelease/idUS108491+14-Apr-2009+MW20090414>>.

²¹⁶ “Purpose-built for Virtualization.” Pano Logic. 20 May 2009 <http://www.panologic.com/sites/all/files/downloads/brochures/PanoLogic_Product_Brochure_Aug_2009.pdf>.

In general, although proprietary telephones may be cheaper, it is a better idea in the interest of replacement cost to use non-proprietary analog or IP phones that can interface with any system. Phones can be either Federal Communications Committee (FCC)-approved (for use in the U.S.), or non-FCC approved, which can drop the price or extend the distance that a phone can operate. Paired with a full-PBX phone system such as the Talkswitch 284VS Phone System, which allows two traditional phone lines and four VoIP lines, with eight extensions for any non-proprietary analog or IP phone at \$1,135.25 USD, limited connectivity can be provided for a small rural village.²¹⁷ Motorola sells a \$30 USD mobile handset in India that gives instructions in audio rather than text, and has a standby time of two weeks.²¹⁸

The Sustainable Village offers an FCC-approved remote phone tested from one half mile to eight miles (under clear line of sight and external antenna) for \$479 to 1,448 USD, with additional handsets at \$239 USD.²¹⁹ WiFi-based VoIP phones can cost from \$109.95 USD for a D-Link DPH-541 or \$254.83 for a full-fledged Nokia E51, which offers both quad-band GSM/3G, Edge and GPRS support as well as WiFi VoIP.²²⁰ If building a system from individual components is too time consuming, or unfeasible, entire systems can be purchased pre-created at \$1,733.95 USD with the PBX + PSTN gateway + phones for the D-Link DVX-2000MS-5 VoiceCenter IP Phone System with a 5-phone kit, or \$2,197.95 USD for a 10-phone kit.^{221 222} While the above system has a PSTN gateway, other types of connections, such as connecting legacy telephones,

²¹⁷ “Nokia E51 UNLOCKED.” VoIPSupply. 10 Mar. 2009 <<http://www.voipsupply.com/nokia-e51-gsm-wifi-voip-smart-phone>>.

²¹⁸ Hammond, Allen, et al. “The Next Four Billion: Market Size and Business Strategy at the Base of the Pyramid.” World Resources Institute. 20 Apr. 2009 <<http://www.wri.org/publication/the-next-4-billion>>.

²¹⁹ “The Sustainable Village: Communications.” The Sustainable Village Complete Catalog. 10 Mar. 2009 <<http://www.thesustainablevillage.com/products/catalogs/vol1no1/SustainableVillage-Catalog.pdf>>.

²²⁰ “Nokia E51 UNLOCKED.” VoIPSupply. 10 Mar. 2009 <<http://www.voipsupply.com/nokia-e51-gsm-wifi-voip-smart-phone>>.

²²¹ “D-Link DVX-2000MS-5.” VoIPSupply. 10 Mar. 2009 <<http://www.voipsupply.com/d-link-dvx-2000ms-5>>.

²²² “D-Link DVX-2000MS-10” VoIPSupply. 10 Mar. 2009 <<http://www.voipsupply.com/d-link-dvx-2000ms-10>>.

or T1/E1 lines will require different types of gateways and must be researched prior to deploying within the country.

Software and applications

Of course, software is equally important to the end users, given the high rates of illiteracy and lack of language support for native languages. African Virtual University uses sponsored software through the Microsoft Academic Volume Licensing agreement, which reduces the costs of acquiring, upgrading, and managing software for multiple computers, while other projects such as the Jhai Foundation, Laos, uses open-source software in local languages, and n-Logue, India, uses locally-developed software created specifically for its terminals by local software firms, mitigating the need for translation.²²³

Additional Considerations

Regulatory Environment and Roadblocks

According to the World Trade Organization (WTO), telecommunications are a service worth over \$ 1.5 trillion USD in revenue, and this lucrative sector has traditionally been subject to provider monopoly.²²⁴ Many developing countries have restrictive telecommunications policies and regulatory frameworks, or worse yet, no regulatory authority at all. Especially where countries have a “public utility model” instead of a market-based strategy, countries frequently

²²³ “IT Access for Everyone – Global Benchmarking Study.” World Economic Forum. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

²²⁴ “Sector by Sector Telecommunications Services.” World Trade Organization. 28 Mar. 2009 <http://www.wto.org/english/tratop_e/serv_e/serv_sectors_e.htm>.

find their services provided by a private monopoly, which in turn is controlled by a regulatory agency.²²⁵

Because members of the “regulatory agency with the necessary expertise will probably come from the industry and rules which ‘protect’ consumers invariably require some restriction or disincentive to free entry into the industry,” regulators can be ultimately more sympathetic to industry viewpoints.²²⁶ Thus, historically, regulatory bodies have been prone to “agency capture,” where regulators fail to be independent to political authorities and market players for various reasons.²²⁷ This leads to a lack of pro-competitive policies, a result recognized by noted economist Kenneth Galbraith, who states that “[R]egulatory bodies, like the people who comprise them, have a marked life cycle. In youth, they are vigorous, aggressive, evangelistic, and even intolerant. Later they mellow, and in old age... they become... either an arm of the industry they are regulating or senile.”²²⁸ While economic entry pressures incumbents to “reduce prices and deploy new technology,” singular markets prone to agency capture invites “competitors to continue manipulating regulators to buffer their own failures in the marketplace.”²²⁹ Examples are littered throughout the world of monopolistic industries, generally in telecommunications, including the U.S.’s AT&T, the United Kingdom’s British Telecom, and

²²⁵ Miller, Robert. “Denationalising British Telecom: One Step in the Right Direction.” *Journal of Economic Affairs* 3.1 (1982): 56-58.

²²⁶ Miller, Robert. “Denationalising British Telecom: One Step in the Right Direction.” *Journal of Economic Affairs* 3.1 (1982): 56-58.

²²⁷ Chen, Jim. “The Legal Process and Political Economy of Telecommunications Reform.” *97 Columbia Law Review* 835 (1997): 867-68.

²²⁸ Chen, Jim. “The Legal Process and Political Economy of Telecommunications Reform.” *97 Columbia Law Review* 835 (1997): 835-36.

²²⁹ Chen, Jim. “The Legal Process and Political Economy of Telecommunications Reform.” *97 Columbia Law Review* 835 (1997): 866.

Mexico's Telmex, each of which has had a string of anti-competitive abuses on their own domestic telecommunications markets.²³⁰

Real-life effects of restrictive telecommunications regulations can range from simple lack of competition and failure to build regional infrastructure to outright banning and confiscation of equipment or fines in some countries, with non-transparent, closed decision-making by regulatory agencies.²³¹ For example, when USAID arrived in Macedonia in 2004, Macedonia Connects director Glenn Strachan said: "So we get to Macedonia, the prices are incredibly high, we have a predatory [monopoly legacy] provider who is driving all the alternate ISPs out of business. It was illegal to bring any international traffic in and out of the country."²³² However, no infrastructure building could take place until "we changed the regulatory environment, so we worked initially on passing new legislation."²³³

As the following quote illustrates, there are often regulatory roadblocks. In January of 2005, the new telecom laws passed, permitting alternative broadband solutions, but:

The telecom didn't cooperate... at all. The telecom about a week later announced that it would be providing free [broadband] connectivity to all the schools in Macedonia. It was basically a counter-shot at us, trying to derail our activity. [...] During the rollout process, the telecom went out, identified themselves as us

²³⁰ Argüello, Ricardo & Lozano, María Clara. "Agricultural Sector and Competition Policy in Colombia." Universidad del Rosario: Facultad de Economía. 22 May 2009 <<http://www.urosario.edu.co/economia/documentos/pdf/dt28.pdf>>.

²³¹ "Orange Farm – ICASA" [dabba telecom](http://dabba.co.za). 29 Apr. 2009 <<http://dabba.co.za>>.

²³² Orne, Peter. "Tackling a Teleco, Connecting Rural Macedonia." [Wireless Government](http://www.wirelessgovernment.com). 13 Mar. 2009. <<http://glennstrachancv.blogspot.com/2009/02/tackling-telco-connecting-rural.html>>.

²³³ Orne, Peter. "Tackling a Teleco, Connecting Rural Macedonia." [Wireless Government](http://www.wirelessgovernment.com). 13 Mar. 2009. <<http://glennstrachancv.blogspot.com/2009/02/tackling-telco-connecting-rural.html>>.

and installed DSL services to the urban schools and signed them up for two- and three-year contracts, and it was ignorance on the part of the schools... we had to get the prime minister to step in and communicate with the telco, which was 48% owned by the government, that this was an illegal practice and that they should cease and desist.²³⁴

Nor is this an isolated example. More recently, the innovative, fledgling, small-scale telecommunications company, Dabba, sought to provide internet and mobile VoIP to poor and underserved regions of Africa.²³⁵ Despite “legally providing services with type-approved equipment” and possessing a valid electronic communications network services license,²³⁶ Dabba had their equipment at the Orange Farm township suddenly confiscated without notice by the state telecom regulator in Feb. 2009.²³⁷ The Independent Communications Authority of South Africa (ICASA), citing “interference” problems, removed not just the radios but “the poles and cables too,” due to a complaint by Telekom, South Africa’s incumbent telecommunications operator, which escalated into a seizure.^{238 239 240} When questioned in March 2009, ICASA inspectors stated that Dabba was providing service without a license and used unapproved equipment.²⁴¹ Because the decision to seize Dabba’s private equipment was made behind closed-doors and without notice, this example shows the hazards of having a strong incumbent provider

²³⁴ Orne, Peter. “Tackling a Teleco, Connecting Rural Macedonia.” Wireless Government. 13 Mar. 2009. <<http://glennstrachancv.blogspot.com/2009/02/tackling-telco-connecting-rural.html>>.

²³⁵ “Orange Farm – ICASA” dabba telecom. 29 Apr. 2009 <<http://dabba.co.za>>.

²³⁶ Furber, Paul & Jones, Candice. “ICASA’s Orange Farm seizure illegal?” ITWeb-News. 23 Mar. 2009 <<http://www.hellkom.co.za/news/local/7038-ICASA-s-Orange-Farm-seizure-illegal---.htm>>.

²³⁷ “Orange Farm – ICASA” dabba telecom. 29 Apr. 2009 <<http://dabba.co.za>>.

²³⁸ Furber, Paul & Jones, Candice. “ICASA’s Orange Farm seizure illegal?” ITWeb-News. 23 Mar. 2009 <<http://www.hellkom.co.za/news/local/7038-ICASA-s-Orange-Farm-seizure-illegal---.htm>>.

²³⁹ “Orange Farm – ICASA” dabba telecom. 29 Apr. 2009 <<http://dabba.co.za>>.

²⁴⁰ “Local Loop Unbundling waiting game.” MyBroadband.co.za News. 29 Apr. 2009. <<http://mybroadband.co.za/news/Telecoms/7860.html>>.

utilizing the police power of the state regulatory agency, or capitalizing on an ineffective regulatory agency, in actions against competing telecommunications providers.

Thus, in a case where VoIP would be offered, either as a standalone service or part of internet provisioning, it must be recognized as a sensitive sector (telephony) which might infringe upon the local telecommunications provider. It is absolutely in the best interest of the VIKA project to review the telecommunications legal framework of the country that the VIKA would be deployed to, as the aforementioned examples are not isolated, and incumbent malfeasance can be carried out both physically and economically.

While the regulatory policies of the countries are being reviewed, it is also important to recognize that countries are generally parties to multiple international organizations and agreements, and finding access may be facilitated through these memberships. Examples include the WTO, the UN, and its associated entities such as the International Telecommunications Union (ITU), and the World Summit on the Information Society (WSIS).

For countries that are members of the WTO and have signed the multilateral General Agreement on Trade and Services (GATS), the Basic Telecoms Agreement (BTA), or the associated Reference Paper, that country is generally subject to telecommunications-liberalizing trade rules unless the country has chosen to be unbound with regard to certain sectoral requirements.^{242 243}

^{244 245} Also, countries may have signed commitments with the WSIS's Geneva Declaration of

²⁴² "General Agreements on Trade in Services." World Trade Organization. 28 Mar. 2009

<http://www.wto.org/english/tratop_e/serv_e/gatsintr_e.htm>.

²⁴³ "Sector by Sector Telecommunications Services." World Trade Organization. 28 Mar. 2009

<http://www.wto.org/english/tratop_e/serv_e/serv_sectors_e.htm>.

²⁴⁴ "Negotiating group on basic telecommunications." World Trade Organization. 3 Mar. 2009

<http://www.wto.org/english/tratop_e/serv_e/telecom_e/telecom_e.htm>.

²⁴⁵ "Guide to reading the GATS schedules of specific commitments and the list of article II (MFN) exemptions." World Trade Organization. 3 Mar. 2009 <http://www.wto.org/english/tratop_e/serv_e/guide1_e.htm>.

Principles and Plan of Action.²⁴⁶ Finally, outside of North America, countries “give the ITU a lot more credence than the United States” and geographically small entities with common borders will be much more likely to harmonize, and ITU technologies may be “more codified into other countries’ laws than [the U.S.]”²⁴⁷ ²⁴⁸ All of these may help with enforcement and diplomatic requests for market access when running into regulatory problems. As long as there is sufficient political impetus to pursue a solution diplomatically, or to lodge a complaint with the country, the UN, the ITU, or the WTO, these are the internationally accepted methods in which to open up market access and enforce their commitments.

Additional recommendations on the policy side are to develop a rural telecom access plan, possibly in the form of a Universal Service fund, expand fiber and national backbones within the country, and license 2.5G and 3G for voice and more data capacity.²⁴⁹

Best Practices

Alcatel-Lucent, a top telecommunications provider, has identified “four pillars” of public initiatives and policies for broadband penetration: (1) Legal and regulatory policies to encourage broadband uptake, leverage public demand aggregation and foster innovation; (2) Adequate and relevant local content and applications; (3) Broadband user awareness and literacy; and, (4) Services affordability and accessibility.²⁵⁰

²⁴⁶ “Declaration of Principles: Building the Information Society – A Global Challenge in the New Millennium.” World Summit on the Information Society. 27 Mar. 2009 <<http://www.itu.int/wsis/docs/geneva/official/dop.html>>.

²⁴⁷ Campbell, Fred. Telephone Interview. 3 Mar. 2009.

²⁴⁸ Campbell, Fred. Telephone Interview. 3 Mar. 2009.

²⁴⁹ Belt, Juan, et al. “Expanding Rural Access: Seeking a Rural Community Approach.” NextBillion.net. 17 Apr. 2009 <<http://www.nextbillion.net/archive/files/Expanding%20Rural%20Access-PPT-20Feb07.pdf>>.

²⁵⁰ “Public Policies Toward Broadband.” Alcatel-Lucent. 14 Apr. 2009 <http://www1.alcatel-lucent.com/tmp_Static/broadbandforall/publicpolicy.jhtml>

Meanwhile, the ITAFE identified nine key lessons from their global research: (1) Focus relentlessly on end-user needs; (2) Build strong consortium that holistically incorporates each of the “must-have” elements; (3) Create robust business model for each partner; (4) Focus on niche market; (5) Capitalize on entrepreneurialism; (6) Attack cost structure and financing from multiple angles; (7) Focus on tackling a specific issue at the outset with a view to expanding scope once the program is up and running; (8) Establish sufficient set-up funding and core investment relations to ensure pilot project(s) will be fully funded; (9) Build strong government relations when operating in a vertical [industry] which is heavily influenced by government policy but do not rely solely on government support for a project’s success.²⁵¹

The UN Development Programme (UNDP) identified community-based targeted action to “localize” the effort. They did so with the overall need to “account for local needs and priorities, [garner] political commitment and local ownership, and strategically [utilize] the most appropriate level of government in order to achieve the goals nationally and globally.”²⁵² The method in which they do this is by (1) institutionalizing participation in local development processes; (2) strengthening communities’ capacity for collective action; (3) developing a community-based information system; (4) building up a cadre of change agents and developing their capacity in critical technical areas, and; (5) enhancing an enabling policy environment that supports community development at multiple levels within communities, the project, and the local government.²⁵³

²⁵¹ “IT Access for Everyone – Global Benchmarking Study.” World Economic Forum. 11 Apr. 2009. <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

²⁵² “Millennium Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach.” Millennium Villages. 3 Mar. 2009. <Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach>.

²⁵³ “Millennium Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach.” Millennium Villages. 3 Mar. 2009. <Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach>.

Finally, USAID has also compiled a list of best practices: (1) Plan for sustainability and scalability at the outset; (2) Beware of “pilots”; (3) Choose appropriate technologies; (4) Consider power requirements and maintenance costs; (5) Use local companies and competition; (6) Try not to “re-invent the wheel;” (7) Share costs and risks via public-private partnerships; (8) Look for ways to share access to telecommunications; and (9) Consider the telecommunications enabling environment.²⁵⁴

The easiest ways to reach many people at once have tended to be in four areas: information centers, training centers, e-governance, and e-kiosks.²⁵⁵ The Millennium Village approach breaks the ICT barrier down into two “interventions,” the short-term intervention and the long-term intervention.

In the short term, the Millennium Village seeks to provide crucial ICT such as internet (through VSATs), mobile telephones, and VoIP to Millennium Villages Project and cluster offices, “as well as other key local health centers;” work with local operators to improve cell-phone based voice coverage; increase local access to equipment and services for publicly accessible telephones, internet connectivity in key community institutions, and community radio, and finally, to facilitate linkages between sectors to bring key benefits right away, such as “communications for health delivery systems, emergency transport, accurate weather, and price information.”²⁵⁶

²⁵⁴ Payne, Judith E. “E-Commerce Readiness for SMEs in Developing Countries: A Guide for Development Professionals.” LearnLink: Academy for Educational Development. 12 Apr. 2009. <http://learnlink.aed.org/Publications/Concept_Papers/ecommerce_readiness.pdf>.

²⁵⁵ “Millennium Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach.” Millennium Villages. 3 Mar. 2009. <Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach>.

²⁵⁶ “Millennium Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach.” Millennium Villages. 3 Mar. 2009. <Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach>.

In the medium-and-long-term timeframe, they seek to “facilitate training in ICT ownership and management to ensure that communications micro-projects become self-sustaining;” support empowerment by ensuring community, government, and NGO participation, and work with the infrastructure sector to implement internet service, telephone service, community radio, and computers.²⁵⁷ Common sense dictates that the infrastructure must be built before focusing on the provisioning of services, but a focal point – such as a health center, can be provided for prior to establishing community-wide ICT. Within the first year, preliminary infrastructure assessments and community-participation assessments must be done to determine network infrastructure needs and improvements, and then establishing data services and e-mail connectivity at a community center, as well as establishing contact with district and national officials to determine regulations and policies pertaining to internet and telephony.²⁵⁸

Combining all of this together requires a multi-pronged “holistic” approach, from a legal side, as well as a hands-on physical and socioeconomic approach. As repeatedly shown, the three most important factors are targeting community need, securing funding through partnerships, and focusing on regulatory environments.

Potential Collaborators

Because collaborations and partnerships are so important in retaining knowledge and funding, this is a sample list of potential partners with the requisite ICT experience, ranging from private, public, to government entities. In alphabetical order:

²⁵⁷ “Millennium Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach.” [Millennium Villages](#). 3 Mar. 2009. < Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach>.

²⁵⁸ “Millennium Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach.” [Millennium Villages](#). 3 Mar. 2009. < Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach>.

Airspan

Supplier of WiMax and Wi-Fi products.

Alcatel-Lucent

Telecommunications company, part of the Broadband for All initiative.²⁵⁹

AMD

Primarily a computer processor manufacturer, part of the 50x15 initiative.²⁶⁰

Arid Lands Information Network (ALIN)

Africa-specific network of community development workers, membership consists of 2000 workers from different NGOs and community-based organization.²⁶¹

Cisco

Provides Networking Academy Program, which “aims to bridge growing ICT skills shortages in the [gulf] region by providing a curriculum tailored to industry’s needs,” running in “high schools, colleges, universities, technical and military schools, community-based organizations and government organizations” to teach students how to design and implement networks, preparing them for careers in “network design and

²⁵⁹ “Public Policies Toward Broadband.” Alcatel-Lucent. 14 Apr. 2009

<http://www1.alcatel-lucent.com/tmp_Static/broadbandforall/publicpolicy.jhtml

²⁶⁰ “Advanced Micro Devices (AMD).” AMD. 9 Feb. 2009 <<http://50x15.amd.com/en-us/>>.

²⁶¹ “About Us.” Arid Lands Information Network. 17 Apr. 09 < <http://www.alin.or.ke/index.php?page=About-Us>>.

administration, technical support, programming, software engineering, database development and administration,” as well as end-user devices and hardware.²⁶²

CUWiN

Coalition of wireless developers and community volunteers committed to providing low-cost, do-it-yourself, community-controlled alternatives to contemporary broadband models.²⁶³

Dabba

Small start-up telecommunications company in South Africa, providing local calls over Wi-Fi network, and linked to the larger national network.²⁶⁴

Global System Mobile Association

Global trade association for mobile operators; currently assisting Sri Lanka by providing technical knowhow for Sri Lanka’s “green” mobile base stations that use solar and wind turbines.²⁶⁵ Additional subcommittee, the GSMA Development Fund, “facilitates the delivery of mobile offerings to people living on less than US\$2 per day,”²⁶⁶ including the “Mobile Money for the Unbanked (MMU) programme,” which works with mobile operators, banks, microfinance institutions, government and development organizations to support 20 projects in developing countries with the goal of reaching 20 million

²⁶² “Cisco grows base of Networking Academies by 73% in 2006.” I4donline.net News. 24 Apr 2009 <<http://i4donline.net/news/news-details.asp?catid=3&newsid=6229>>.

²⁶³ “CUWiN” Community Wireless Solutions. 11 May 2009 <<http://www.cuwin.net/>>.

²⁶⁴ “Telecoms for villages.” Economist.com. 2 Jun. 2009 <http://www.economist.com/business/displaystory.cfm?story_id=11751167>.

²⁶⁵ Anderson, Tatum. “Green Mobile Network for Rural Sri Lanka Under Trial.” SciDev.Net. 18 Mar. 2009 <<http://www.scidev.net/en/news/green-mobile-network-for-rural-sri-lanka-under-tri.html>>.

²⁶⁶ Schwartz, Michael. “Mobile World Congress will celebrate four billion connections – GSMA.” Developing Telecoms, 18 Feb. 2009 <<http://www.developingtelecoms.com/content/view/1668/123/>>.

previously unbanked people with reliable, affordable mobile financial services by 2012.²⁶⁷

IMAGINE Africa

University of Michigan engineering department seeking satellite solutions to assist in broadband internet and VoIP programs in Africa.²⁶⁸

International Institute for Communication and Development (IICD)

Non-profit foundation that specializes in information and communication technology (ICT) as a tool for development; active with the Infopoverty World Conference.²⁶⁹

Inmarsat

Global coverage through 11 operating satellites; existing contract with distributors, renegotiations each year.²⁷⁰

Intelsat

World's largest fixed-satellite service provider with current existing capacity over Africa.²⁷¹

²⁶⁷ "GSMA and Gates Foundation Partner to Expand Availability of Financial Services through Mobile Phones." Bill & Melinda Gates Foundation. 17 Feb. 2009 <<http://www.gatesfoundation.org/press-releases/Pages/gsma-financial-services-through-mobile-phones-090217.aspx>>.

²⁶⁸ "IMAGINE Africa." Isoc-ny: Wikipedia. 24 Mar. 2009 <http://www.isoc-ny.org/wiki/IMAGINE_Africa>.

²⁶⁹ "Approach." IICD: About. 18 Mar. 2009 <<http://www.iicd.org/approach>>.

²⁷⁰ "About the Inmarsat Network." Remote Satellite Systems. 2 May 2009. <<http://www.remotesatellite.com/networks/inmarsat/about-inmarsat.php>>.

²⁷¹ "Coverage Maps (html)." Intelsat. 4 Apr. 2009 <<http://www.intelsat.com/flash/coverage-maps/covmaphome.htm>>.

Intel

Intel's World Ahead program provides technical leadership and facilitates the project as well as the design of the wireless network, WiMax training, and documenting the project so that it can be applied at similar locations.²⁷²

Inveneo

Provides technology solutions to remote villages through non-governmental organizations (NGOs) and through commercial or government-owned organizations.²⁷³

IPSTAR

High-speed, 2-way broadband Internet via the *IPSTAR* Satellite throughout Asia-Pacific. IPSTAR provides connectivity to USAID projects such as the Ta Van village in Vietnam.²⁷⁴

International Telecommunications Union (ITU) & the World Summit on the Information Society (WSIS)

The ITU and its arm, WSIS develop and foster a clear statement of political will, and take concrete steps to establish the foundations for an Information Society for all, reflecting all the different interests at stake. International approach to implementing and negotiating information needs.²⁷⁵

²⁷² "Wireless Internet Links Highland Community to the World." *Airspan*. 28 Mar. 2009 <http://download.intel.com/intel/worldahead/pdf/VietnamViMax.pdf?iid=worldahead_home+body_vietnam>.

²⁷³ "Our Story." *Inveneo*. 12 Feb. 2009 <<http://www.inveneo.org/>>.

²⁷⁴ Nordhausen, Bernd. "WiMax with IPSTAR Backhaul Links Remote Community in Vietnam to the World." *Last-Mile Online Newsletter*. 28 Mar. 2009 <http://www.ipstar.com/lastmile/november-december/en/ipstar_solutions.html>.

²⁷⁵ "Basic Information: About WSIS." *World Summit on the Information Society*. 26 Feb. 2009 <<http://www.itu.int/wsis/basic/about.html>>.

NComputing

Delivering low-cost and low-energy multi-user, single-platform computing solutions; part of the Infopoverty conference.²⁷⁶

Organisation for Economic Co-Operation and Development (OECD)

Provides reports and analysis on technology outlooks, indicators, statistics, and policy guidance on a wide range of global ICT problems.²⁷⁷

Space Systems Loral (SSL)

Produced IPSTAR and has recently booked more commercial satellite orders than any other manufacturer for many applications: “FSS, mobile telephony, digital audio radio service (DARS) and direct-to-home service providers.”²⁷⁸

UN Millennium Villages

The Millennium Villages seek to end extreme poverty by working with the poorest of the poor, village by village throughout Africa, in partnership with governments and other committed stakeholders, providing affordable and science-based solutions to help people lift themselves out of extreme poverty, and working towards the UN’s Millennium Development Goals (MDGs).²⁷⁹

²⁷⁶ Deger, Renee & Rand, David. “NComputing Builds on Ultra Low-Cost Computing Success With New X-series Desktop Virtualization Kit.” Reuters. 14 Apr. 2009 <<http://www.reuters.com/article/pressRelease/idUS108491+14-Apr-2009+MW20090414>>.

²⁷⁷ “About.” Organisation for Economic Co-operation and Development. 13 May 2009 <http://www.oecd.org/topic/0,3373,en_2649_37441_1_1_1_1_37441,00.html>.

²⁷⁸ “Space Systems/Loral Expands North American and Asian Marketing and Sales Teams.” Space Systems Loral. 22 Apr. 2009 <<http://www.ssloral.com/html/pressreleases/pr20051109.html>>.

²⁷⁹ UN Millennium Villages. <http://www.unmillenniumproject.org/>

United Nations Development Program

UNDP is the UN's global development network, an organization advocating for change and connecting countries to knowledge, experience and resources to help people build a better life. On the ground in 166 countries, working with those countries on their own solutions to global and national development challenges.²⁸⁰

United States Agency for International Development (USAID)

Already experienced with rolling out nationwide telecommunications in three completely distinct environments, Mongolia, Vietnam, and Sri Lanka.²⁸¹ Worked with Ta Van village in Hoang Lien Son mountain range.²⁸²

World Bank

\$50 million USD ICT initiative in Nigeria towards “infrastructure development, connectivity, skills development and capacity building for Nigeria,” with a seven-month earlier \$424 million for the development of eastern and southern African communication infrastructure.²⁸³

World Bank GICT

The Global Information and Communication Technologies Department (GICT) is a joint department of the World Bank and the International Finance Corporation (IFC). Bringing

²⁸⁰ “About UNDP.” UNDP. 28 Mar. 2009 <<http://www.undp.org/>>.

²⁸¹ Owen, Darrell. “Achieving Rural ICT Access... Providing the Connectivity.” USAID Presentation. 15 May 2009 <http://siteresources.worldbank.org/EXT/DEVELOPMENT/Resources/20080226_Darrell_AchievingRural_ICT_Access-v1.ppt?resourceurlname=20080226_Darrell_AchievingRural_ICT_Access-v1.ppt>.

²⁸² USAID. <http://www.usaid.gov/>

²⁸³ Malakata, Michael. “World Bank shifts focus to West African telecom.” The Industry Standard. 29 Apr. 2009 <<http://www.thestandard.com/news/2009/04/29/world-bank-shifts-focus-west-african-telecom>>.

together IFC's experience in private sector investment transactions and the World Bank's expertise in policy and regulatory matters, GICT promotes access to information and communication technologies in developing countries. GICT serves as the World Bank Group's department for research, policy, investments and other programs related to ICTs, main expertise, coordinator of relations and partnerships with donors, and capital organizers.²⁸⁴

World Trade Organization

Negotiating forum for liberalizing trade, settling trade disputes, and operating a system of trade rules. Specifically to ICTs, it enforces trade agreements relating to telecommunications markets.²⁸⁵

Preliminary Recommendations

Along with the Millennium Villages, this report recognizes the key ICT target should “provide institutional access to ICT while developing affordable, sustainable telephone, email [sic] and Internet services at the community level.”²⁸⁶ First and foremost, the three prongs to building an effective telecommunications infrastructure is (1) contemplating and setting-up the central-shared network, (2) extending the services provided within the central-shared network to the village's community-based network, and (3) focusing on the regulatory environment.

²⁸⁴ “About GICT: Who We Are.” The World Bank. 28 Mar. 2009

<<http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/0,,contentMDK:20687836~menuPK:282840~pagePK:210058~piPK:210062~theSitePK:282823,00.html>>.

²⁸⁵ “Telecommunications Services.” World Trade Organization. 3 Mar. 2009

<http://www.wto.org/english/tratop_e/serv_e/telecom_e/telecom_e.htm>.

²⁸⁶ “Millennium Villages Handbook: A Practitioner's Guide to the Millennium Villages Approach.” Millennium Villages. 3 Mar. 2009. <Villages Handbook: A Practitioner's Guide to the Millennium Villages Approach>.

Because the provisioning and building of a telecommunications infrastructure is prohibitively expensive, the U.S. military should not seek to provide the central-shared services (satellite, PSTN, content, billing, cellular tower) to villages. For example, the military should not seek to host or operate internet or voice-provisioning services on its satellites. Instead, it should seek to be a simple subsidizer of service provisioning, akin to USAID's initial funding of Macedonian internet connectivity.

Also, because the U.S. military is not primarily a hardware manufacturer, it would be wise to develop a public-private partnership with companies possessing the necessary subject matter expertise and manufacturing facilities, such as Intel or NComputing, to acquire inexpensive hardware for packaging within a VIKA. However, military specialists in equipment site evaluations and telecommunications hardware may well be useful during the initial evaluation of the terrain, environment, and technical requirements of any telecommunications-related VIKA technology. Military expertise may also come in during a rapid technical setup and deployment, as well as the transportation of the VIKA's associated component parts. The best practices listed above should be a starting guideline for any ICT-related venture. As shown through this report, telecommunications is not a one-size-fits-all venture. Because a network can be built in many ways to accommodate different needs, this section of the paper is meant to highlight many of the innovative products, concepts, and best practices when considering what to include in the VIKA.

VIKA HARDWARE SELECTOR

The VHS is a notional computer program that was created as an objective method for determining the appropriate hardware for specific regions. The importance of having a hardware selector is to provide users with the ability to quickly discern what hardware is needed in diverse villages, and could be especially useful when a situation requires immediate attention, for instance, a natural disaster. Hardware that could provide potable water, energy, and telecommunications are the only types of hardware being considered at this point. The purpose of this section is to explain how the VHS would work, how it would be used, and suggestions for broader usability and future developments. It is important to keep in mind that the VHS is notional as it is in its earliest developmental stages.

In its current notional form, the VHS has been designed to be utilized by an individual with little or no training and no knowledge or experience in providing aid packages. It is necessary, however, that the user knows the type of terrain, climate, and water source of a specific region because the VHS computes those factors in order to provide hardware recommendations. Specifically, these three factors were discussed by the customers and are necessary to consider when choosing appropriate hardware solutions. In addition, the VHS could consider hardware that is already available in a region. For example, if a region already has an adequate system that provides some form of telecommunications, the VHS would not offer a recommendation for telecommunications, upon selecting the option that would exclude telecommunications from being recommended. See Figure 18 for an example of the selection screen for the notional VIKa Hardware Selector.

VIKA Hardware Selector

Terrain	Climate	Water
Mountainous	Mixed	Lake

Other Specifications:

Population size (increments of 500):

Resources currently available at destination (check box if applicable):
 Electricity Potable Water Telecommunications

Calculate

ACTION NEEDED
 Input relevant criteria, then click **CALCULATE** for hardware recommendation

Figure 18: Notional example of the VIKA Hardware Selector's selection screen

To understand how the VHS could actually be developed, it is important to understand the theoretical process underlying the VHS which is in the form of an algorithm conceptualized by the research team. This conceptual algorithm relies on assigning a numerical value to each item or specification that could be entered into a selection screen. Essentially, as an item in the selection screen is chosen, its assigned numerical value could be permuted or combined with the assigned numerical values of additionally chosen items. Figure 19 is an example of the numerical values that could be assigned to each item that could be selected. The following is an example using a region by rural Southwest Kabul in Afghanistan in order to better illustrate how the VHS could use this algorithm to eventually provide recommendations for hardware solutions.

Terrain ²⁸⁷	Climate ²⁸⁸	Water source
Rugged = 1	Moist Tropical = 13	River = 19
Jungle = 2	Humid = 14	Lake = 20
Sand desert = 3	Cold = 15	Ocean = 21
Rock desert = 4	Dry = 16	None = 22
Plains = 5	Continental = 17	
Tundra = 6	Mixed = 18	
Ice sheets = 7		
Hills = 8		
Mountains = 9		
High Mountains = 10		
Swamp = 11		
Bog = 12		

Figure 19: Example of the numerical values that could be assigned to each possible selected item

²⁸⁷ "Terrain Types." Bloginja. 27 Feb 2009 <http://bloginja.com/doc/aime-doc/bldr_tutorial/webtutorial/terrain.html>.

²⁸⁸ "World Climate Zones." Blue Planet Biomes. 2 Mar. 2009 <<http://www.blueplanetbiomes.org/climate.htm>>.

A typical region by Southwest Kabul could be characterized as rugged terrain, mixed climate, and having a source of river water.²⁸⁹ As shown in Figure 20, after inserting those specifications into the selection screen of the VHS, it could then process the information using the framework provided by the team’s conceptual algorithm. If the numerical values assigned to each item are such that rugged terrain is 1, mixed climate is 18, and river water source is 19, then the permutation would be {1,18,19}. Conceptually, each permutation could be associated with a specific combination of hardware that could vary based on information entered into the selection screen and the needs of a community.

Terrain	Climate	Water
Mountainous	Mixed	River

Other Specifications:

Population size (increments of 500):

Resources currently available at destination (check box if applicable):

Electricity Potable Water Telecommunications

Recommended hardware package ID:

Figure 20: Selected items based on typical characteristics of a rural region near Southwest Kabul.

As a method of more simply referring to the hardware that the VHS could recommend, a unique package ID could be associated with each permutation created by the VHS. For instance, remembering “package C1” could be easier to reference than a relatively long, complicated

²⁸⁹ “Afghanistan-Geographic.” [AfghanMehan](http://afghanmehan.com/Geography/Geography.htm), 25 Jul. 2009 <<http://afghanmehan.com/Geography/Geography.htm>>.

number such as “11819.” Such a long, complicated number could likely increase the probability of a miscommunication because the longer the string of numbers or letters, the more difficult it is to remember.²⁹⁰ In terms of the specifications of a typical rural village by Southwest Kabul, the conceptual algorithm would yield the permutation {1,18,19}, as mentioned earlier. Notionally, if the permutation {1,18,19} could arbitrarily translate to “package C1,” then in package C1 could include the hardware most appropriate for providing potable water, energy, and telecommunications. More specifically, package C1 could include PurWater Systems, AeroCams, and GSM mobile phones for the exact purpose of providing potable water, energy, and telecommunications, respectively, in a rural region near Southwest Kabul, as presented in Figure 21.

²⁹⁰ Anderson, John, Reder, Lynne, & LeBiere, Christian. “Working Memory: Activation Limitations on Retrieval.” Cognitive Psychology 30.7 (1996): 221-256.

Package ID: C1	
Location: Rural Southwest Kabul	
Specifications:	
Terrain: Rugged	Population: 1,000
Climate: Mixed	Exclusions: No
Water: River	
Recommended hardware for:	
Potable water: Portable PurWater System	
Energy: AeroCam (wind)	
Telecommunications: GSM mobile phones	

Figure 21: Hypothetical example of the hardware that could be most appropriate for providing potable water, energy, and telecommunications in a rural region near Southwest Kabul.

Part of the development of the VHS would necessitate a team of individuals familiar with sustainable hardware that would provide access to potable water, energy and telecommunications. This is necessary because after evaluating every possible permutation that the VHS algorithm could generate, the hardware combination that corresponds with each specific permutation would need to be programmed into the VHS. The next step would require a simple alpha-numeric ID be attached to each permutation as it would be the method by which the software could provide the hardware recommendation to the user.

Although the previous example only considered a region's terrain, water source, and climate, other factors such as population size and infrastructure that already exists are also shown in Figures 18 and 19. Additional factors that could be included in the selection screen with respect to the conceptual algorithm are cost restraints, agriculture of the village, livestock needs,

nourishment, health needs, waste management, and weather. As mentioned earlier, it is important to understand the VIKA hardware selector is only being presented as a notional idea. With further development, the VHS could eventually lead to broader usability for natural disaster and economic relief, as well as to aid military members stationed in countries outside the U.S.

SOCIO-CULTURAL CONSIDERATIONS

When discussing and researching the development of the VIKA with experts, one pervasive theme was apparent: in order to implement a successful kit such as the VIKA, it is necessary to examine the exact relevance of the kit to the specific culture in which it should be used. The discipline that most closely examines these specific cultural concerns is anthropology. The American Anthropological Association (AAA) defines anthropology as “the study of humankind.”²⁹¹ Consequently, anthropology is a broad term, and thus can be broken down into several other sub-disciplines such as linguistic anthropology, cultural anthropology, archaeology, and biological anthropology.

Culture is defined as the “entire database of knowledge, values, and traditional ways of viewing the world” that is transmitted from generation to generation by means of words, concepts, and symbols.²⁹² Arguably, based on the definition of culture, cultural anthropology is the most relevant field to the overall scope and purpose of the VIKA because it addresses the unique concerns that vary from culture to culture. Moreover, cultural anthropology is the most studied sub-discipline in anthropology. Those who make up the vast research in cultural anthropology use many social science methodologies, with the ethnographic approach being the primary mode of research.

²⁹¹ “About AAA: What is Anthropology?” American Anthropological Association. 18 Mar. 2009 <<http://www.aaanet.org/about/WhatIsAnthropology.cfm>>.

²⁹² “About AAA: Cultural Anthropology.” American Anthropological Association. 18 Mar. 2009 <<http://www.aaanet.org/about/WhatIsAnthropology.cfm>>.

By definition, ethnography is, “a firsthand description of a living culture based on personal observation.”²⁹³ Ethnography generally takes place while an anthropologist is conducting his or her fieldwork, and the findings are often written and published for the purposes of further research and analysis. An important element of ethnography is participant observation which, “places the ethnographer at the scene where a combination of direct observation and interviewing provides evidence from which ethnographic accounts are constructed.”²⁹⁴

The research team proposes using the ethnographic method, participant observation, and other social science methodologies to enhance the PMESII framework of analysis. After providing a PMESII analysis for three case study nations, the proceeding section, CROPS, presents a new framework for analysis which seeks to enhance the social element of PMESII to create a more thorough description of a nation-state. The new framework will be fully discussed, including what the acronym stands for, what each portion entails, and an example analysis with a corresponding table.

²⁹³ Harris, Marvin & Johnson, Orna. Cultural Anthropology. Prentice Hall, 2007.

²⁹⁴ Harris, Marvin & Johnson, Orna. Cultural Anthropology. Prentice Hall, 2007.

PMESII CONSIDERATIONS

Overview

Traditionally, the accepted framework for analysis of a nation-state is described using the acronym PMESII. The acronym translates to Political, Military, Economic, Social, Infrastructure, and Information systems, and all sections are to be considered for a thorough analysis of any state.²⁹⁵ This framework is particularly useful when examining the center of gravity (COG) of a state, or the area from which the state draws the greatest amount of its power. For kinetic and non-kinetic military operations, it is vitally important for the U.S. to understand adversaries as well as allies on a specific and detailed level which a PMESII analysis is intended to provide.²⁹⁶

The purpose of the VIKA, however, is not necessarily a military operation, but rather a deterrence approach to nation-building and economic development. Regardless, the use of PMESII is still crucial and shall be used when discussing three main case studies. The purpose of the case studies is to illustrate the variability of the kit given its use in differing states with starkly diverse situations. When employing PMESII, it is possible to take into consideration those aspects which the military deems central to many operations. Specifically, PMESII will be used regarding Afghanistan, the Marshall Islands, and Uganda in order to examine the feasibility and efficacy of deploying a VIKA, and serve as an example of how the VIKA can be used in many circumstances. The customer requested the Marshall Islands be included in the case studies, while the team selected Afghanistan and Uganda due to their varying culture, politics,

²⁹⁵ Arnold, Kris A. "PMESII and the Non-State Actor: Questioning the Relevance." DTIC. 2 May 2009. <<http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA450021&Location=U2&doc=GetTRDoc.pdf>>.

²⁹⁶ Arnold, Kris A. "PMESII and the Non-State Actor: Questioning the Relevance." DTIC. 2 May 2009. <<http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA450021&Location=U2&doc=GetTRDoc.pdf>>.

and geography. A table illustrating the PMESII analysis can also be found at the end of this section (see Figure 22).

Afghanistan

The Islamic Republic of Afghanistan, commonly shortened to Afghanistan, became fully independent of British rule on August 19, 1919. The country has been in consistent economic strife and political upheaval ever since its independence. After World War II, Afghanistan strengthened ties with the Soviet Union, conditions in the country were diminishing, and a new leader stepped in with hopes of repairing this country. Since then, leader after leader has struggled with the divided and corrupt government structure. A new constitution and government leadership was emplaced in 2004 and visible changes have been made.²⁹⁷

Political

The constitutional government of Afghanistan is organized similarly to the U.S., consisting of executive, legislative, and judicial branches. The year 2004 brought many changes to this unstable state with a new constitution and election of President Hamid Karzai in October.²⁹⁸ The new formation brings equality to the government with a specific number of seats in the 249-member Wolesi Jirga (People's Council), designated to women, the handicapped, and members of a semi-nomadic population. These changes have been substantial for this country, but there

²⁹⁷ "Country Profile: Afghanistan." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

²⁹⁸ Qazi, Abdullah. "Afghanistan: Branches of Government." Afghanistan Online. 25 Apr. 2009 <<http://www.afghanweb.com/politics/government.html>>.

are still forms of corruption within this structure, especially for control over provincial and local governments.²⁹⁹

Military

Since 2004, Afghanistan has worked diligently on establishing a credible armed force, known as the Afghan National Army (ANA), as well as a national police force for domestic security. As of 2008, the U.S. has trained 35,000 Afghani soldiers, with the hopes of increasing the army to 120,000 by 2013. The major national security problem is the estimated 10,000-member warlord-commanded militia organization. There has been substantial progress in the disarmament of these organizations with plans for integrating the people back into society.³⁰⁰

Economic

After continual conflict for nearly two decades, the remnants of a war-ridden state remained one of the poorest in the world. An agricultural economy, dominating 80% of the workforce, lacks resources or infrastructure to perform its main functions. Foreign recovery teams and military personnel have stepped in over the past three years to begin to restore some of the physical infrastructure and security in Afghanistan. A main concern is the importance of the “black economy” that thrives with the production of Opium in Afghanistan. Excluding this illegal production the March 21, 2006 to March 20, 2007 fiscal year estimated GDP of \$8.8 billion USD or \$270 USD per capita. After the economic downfall of the late nineties, which brought

²⁹⁹ “Country Profile: Afghanistan.” Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

³⁰⁰ “Country Profile: Afghanistan.” Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

inflation rates of 100% and above, the economy has experienced steady growth that continues today.³⁰¹

Social

In 2008, the estimated population was 32.7 million, with 75% of the population residing in rural areas. As once stable areas become unstable, shifts in population continue to occur.

Afghanistan's population is very young, with nearly 45% under the age of fifteen. It is also very diverse with seven main ethnic groups, Pashtun comprising of 42%, and speaking over thirty languages with the official languages Dari and Pashtu. Although some improvements were being made on education and literacy, in 1979 the Soviet invasion destroyed the education system. Most recently, an estimated 57% of men and 87% of women are illiterate. Health has always been a grave concern and with military unrest, the health of the nation has suffered. Lacking sanitation and means of potable water, there is a need for new technologies to improve the quality of life.³⁰²

Infrastructure

Afghanistan is in the "rebuild" process with infrastructure. In 2006 the London Conference on Afghanistan pledged \$10.4 billion USD for economic infrastructure reconstruction for the following three years. After nearly two decades of war, severe damage left the roadways and

³⁰¹ "Country Profile: Afghanistan ." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

³⁰² "Country Profile: Afghanistan ." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

airports unusable. The lacking infrastructure and railways is harming the current economy by deterring possible regional commerce.³⁰³

Information Systems

After the introduction of mobile phones, the development of landline services came to a halt in major cities with access to phone networks.³⁰⁴ By 2006, Afghanistan estimated 3.2 million active cell phone subscribers. Internet use has grown substantially in the past eight years, but the unpredictability of power supply hinders the usage. In larger cities, internet cafes are more widely available for public use.³⁰⁵

Marshall Islands

Political

The Republic of the Marshall Islands, commonly referred to as the Marshall Islands is comprised of over 1,200 islands, located in the central Pacific Ocean. The Marshall Islands are an Administrative State, which elects a President by a 33-member unicameral parliament called the Nitijela. A secondary body, the Council of Chiefs, or Iroji, serves as a consultative body.³⁰⁶ Their primary task is the preservation of traditional laws and customs, which is of the utmost importance to the inhabitants of the Marshall Islands, for reasons which will be discussed under the social aspects of PMESII.

³⁰³ "Country Profile: Afghanistan ." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

³⁰⁴ CIA World Fact Book. Skyhorse Publishing: NY, 2008.

³⁰⁵ "Country Profile: Afghanistan ." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

³⁰⁶ "Marshall Islands." Encyclopædia Britannica. 20 May 2009 <<http://search.eb.com.leo.lib.unomaha.edu/eb/article-9117363>>.

Military

The Marshall Islands fell under U.S. occupation during World War II, which led to its being made part of the UN Trust Territory of the Pacific Islands in 1947.³⁰⁷ The U.S. was given jurisdiction over the Marshall Islands at that same time. This lasted until 1979 when the Marshallese people ratified a constitution creating the independent Republic of the Marshall Islands, withdrawing itself from the status of Trust Territory. Given its vulnerability and global strategic interests, however, the Marshallese Parliament signed the Compact of Free Association with the U.S. in 1983, establishing that the U.S. would provide defense, security, and financial assistance.³⁰⁸ Therefore, the Marshall Islands has no official military of its own. In exchange for military services provided, the U.S. is permitted to lease an area of the Kwajalein Atoll for missile testing.

Economic

The economy of the Marshall Islands relies heavily on U.S. subsidies and aid. Specifically, the Compact of Free Association allows for the U.S. to lease land used for missile testing. Other much less lucrative revenue streams come from the outermost islands through subsistence farming, pig and poultry farming, and fishing. Principal exports include coconuts, breadfruits, and taro which also contribute minimally to the economy.³⁰⁹

³⁰⁷ "Marshall Islands." *Encyclopædia Britannica*. 20 May 2009 <<http://search.eb.com.leo.lib.unomaha.edu/eb/article-9117363>>.

³⁰⁸ "Marshall Islands: Country History and Economic Development." *Encyclopedia of the Nations*. 10 Apr. 2009 <<http://www.nationsencyclopedia.com/economies/Asia-and-the-Pacific/Marshall-Islands-COUNTRY-HISTORY-AND-ECONOMIC-DEVELOPMENT.html>>.

³⁰⁹ "Marshall Islands." *Encyclopædia Britannica*. 20 May 2009 <<http://search.eb.com.leo.lib.unomaha.edu/eb/article-9117363>>.

Social

Traditions and customs are very important to most of the inhabitants of the Marshall Islands. One proof positive of this is the establishment of the aforementioned consulting body, the Council of Chiefs. The native inhabitants to the Marshall Islands were Micronesians thought to be practicing the Lapita, or early Polynesian culture.³¹⁰ While this original culture was jeopardized by waves of European navigators and explorers coming into the Micronesian region, the Lapitan culture survived fairly intact. The arrival of American Christian missionaries during the 1850s proved successful as the current population of Marshallese people is predominantly Christian. The dual-practice of Micronesian traditions and Christian traditions, however, is a common practice.³¹¹

Infrastructure

Currently, the Marshall Islands has no railway system. However, there are numerous ports and paved road and highway systems. As an island nation, the port system is the most important resource, and so most of the transportation funding goes towards upkeep and renewal. The quality of roadway infrastructure lessens the further out in the island chain one travels. The main cities have paved roads, but other areas of the islands use coral and sand roads.³¹²

Primary energy consumption in the Marshall Islands consists of diesel fuel. Typically, smaller domestic needs are met with kerosene stoves or wood burning ovens. A constant and stable supply of clean water is not available, but there are numerous projects in the area, such as the

³¹⁰ "Marshall Islands." *Encyclopædia Britannica*. 20 May 2009 <<http://search.eb.com.leo.lib.unomaha.edu/eb/article-9117363>>.

³¹¹ "Marshall Islands." *Encyclopædia Britannica*. 20 May 2009 <<http://search.eb.com.leo.lib.unomaha.edu/eb/article-9117363>>.

³¹² "Marshall Islands: Infrastructure, Power, and Communications." *Encyclopedia of the Nations*. 10 Apr. 2009 <<http://www.nationsencyclopedia.com/economies/Asia-and-the-Pacific/Marshall-Islands-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html>>.

Community Lifelines Programme by the South Pacific Applied Geoscience Commission, attempting to improve conditions.³¹³

Information Systems

As of July 2003, the Marshall Islands became its own internet service provider (ISP). This was possible because of a presence of the nation's strong centralized telecommunications organization, the National Telecommunications Authority. However, at the time of the ISP's creation, service was limited to the capital city of Majuro.³¹⁴ All other internet access was provided by IT&E from Guam. Current updates to internet service progress is largely unavailable, but it was speculated by the National Telecommunications Authority that providing service outside of the capital city or main island was not economically feasible due to a very small customer base of just over 1,000.³¹⁵

Under the Compact of Free Agreement with the United States, the Marshall Islands have the right to conduct foreign affairs in any means they see fit, but have requested that the U.S. take responsibility for telecommunications.³¹⁶ Also stated in the same document, the U.S. should provide telecommunications services, "in accordance with the provisions of the laws and

³¹³ "Marshall Islands: Infrastructure, Power, and Communications." *Encyclopedia of the Nations*. 10 Apr. 2009 <<http://www.nationsencyclopedia.com/economies/Asia-and-the-Pacific/Marshall-Islands-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html>>.

³¹⁴ "Marshall Islands: Infrastructure, Power, and Communications." *Encyclopedia of the Nations*. 10 Apr. 2009 <<http://www.nationsencyclopedia.com/economies/Asia-and-the-Pacific/Marshall-Islands-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html>>.

³¹⁵ "Marshall Islands National Telecommunications Authority Gets Its Own Internet Link-Up." *Yokwe Online*. 10 Apr. 2009 <<http://www.yokwe.net/index.php?name=News&file=article&sid=501>>.

³¹⁶ "The Compact of Free Association: Agreement Regarding the Provision of Telecommunication Services by the Government of the United States to the Marshall Islands and the Federated States of Micronesia Concluded Pursuant to Section 131 of the Compact of Free Association." 2004.

regulations of the United States which the Government of the United States determines are applicable to the Marshall Islands or the Federated States of Micronesia at such time.”³¹⁷

Uganda

Political

Previously a British protectorate until 1962, Uganda has struggled through many years of depressive leadership which has destroyed the security and faith of the people in the local government.³¹⁸ In January of 1986, the National Resistance Movement (NRM), not a political party, but coined by leadership as a movement, came to power with hopes of breaking this unhealthy cycle that perpetuates destruction. Political tension was high and in the late 1960’s government harassment of the citizens, imprisonment, violence, and torture were becoming a common way to settle political disputes.³¹⁹ The NRM instituted a Ten-Point Program tracing the problems back to the previous leaders and their decision making which inhibited development. The Ten-Point Program was a lofty goal and with staff support lacking for the NRM, it was not attained, but also has not been abandoned. Museveni, the first elected president currently in his second term, has made progress and the NRM is continually working towards a “no party” government while receiving opposition from elites who favor a multi-party system.³²⁰

³¹⁷ “The Compact of Free Association: Agreement Regarding the Provision of Telecommunication Services by the Government of the United States to the Marshall Islands and the Federated States of Micronesia Concluded Pursuant to Section 131 of the Compact of Free Association.” 2004.

³¹⁸ “Government and Politics.” Library of Congress Country Studies: Uganda. 10 Feb. 2009 <[³¹⁹ “Government and Politics.” Library of Congress Country Studies: Uganda. 10 Feb. 2009 <\[³²⁰ “Country Watch. Uganda: Political Conditions.” Country Watch. May 18, 2009 <\\[>\\]\\(http://search.countrywatch.com.cuhsl.creighton.edu/cw_searchdocument.aspx?DocNumParam=51\\).\]\(http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+ug0009\)>.</p>
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Military

Ugandan Peoples' Defense Force (UPDF) includes the following military branches: Army, Marine Unit, and Air Wing. Ugandans are eligible to enlist if they are over the age of 18, or have parental consent at the age of 14.³²¹ The Tuvalu Police Force is the primary means for law enforcement.³²²

Economic

Once heavily endowed with an abundance of human and natural resources, Uganda's political and economic structures have not taken advantage of the possibilities for development. The primary cash crops Uganda thrives off of, coffee and cotton, have kept the economy afloat, although most of the people survive off of subsistence farming.³²³ With a gross national income of \$880 USD, the economy's focus on agricultural commodities has endured the hardships of fluctuating prices and demand.³²⁴ The NRM has proven to be beneficial to the economy by creating a more stable ground for the nation to begin to diversify agricultural exports.

Social

One of the most populated countries in Africa, approximately 30 million people inhabit Uganda, and it is constantly growing at a rate of 5.7%.³²⁵ As of October 2006, the Baganda, Banyankole and Basoga are the largest ethnic groups in Uganda, with approximately 99% of the population

³²¹ CIA World Fact Book. Skyhorse Publishing: NY, 2008.

³²² CIA World Fact Book. Skyhorse Publishing: NY, 2008.

³²³ Clark, Nancy. "Chapter 3 - The Economy." Library of Congress Country Studies: Uganda. 10 Feb. 2009 <[http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+ug0072\)>](http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0072)>).

³²⁴ "Countries: Uganda." World Health Organization. 18 May 2009 <www.who.int/countries/uga/en/>.

³²⁵ "Country Watch. Uganda: Political Conditions." Country Watch. May 18, 2009 <http://search.countrywatch.com.cuhsl.creighton.edu/cw_searchdocument.aspx?DocNumParam=51>.

of African descent and 1% European or Asian.³²⁶ The official language of Uganda is English being taught in schools and used in the court of law, but as a tribal region there are many unofficial languages spoken throughout the country.³²⁷ Although throughout the years, the country has become more religiously diverse, Catholicism and Protestantism remain the major religions holding 42% of the population each.³²⁸ This relatively young populace, averaging fifteen years old, struggle with Acquired Immune Deficiency Syndrome (AIDS), which has slowed the development of the country after it began to recover from the corrupt government and civil war.^{329 330} Another issue Ugandans have been facing is the educated population eager to abandon tradition and modernize their society. This strife is causing hardships within the government, which is trying to create a balance between these opposing forces.³³¹

Infrastructure

A primary cause of the lacking resources and communication is due to the inefficient means of transporting goods, people, and information. Uganda's roadways cover approximately 27,000 km (16,800 miles), of which only 6.6% (1100 miles) are paved. Since 1987, there have been many projects to open and connect new roadways with neighboring countries. Additional funds have been established to rejuvenate the state owned Uganda Railways Corporation (URC) stretching its reach to 1,241 km (771 miles).³³² Uganda's major airport, Entebbe International Airport, is located approximately 35 km (22 miles) from the capital of Kampala. There are an additional 28

³²⁶ Wakabi, Wairagala. "Country Profile: Uganda." *New Internationalist* 394 (2006): 36.

³²⁷ *CIA World Fact Book*. Skyhorse Publishing: NY, 2008

³²⁸ *CIA World Fact Book*. Skyhorse Publishing: NY, 2008

³²⁹ *CIA World Fact Book*. Skyhorse Publishing: NY, 2008

³³⁰ Byrnes, Rita M. "Chapter 2 - The Society and Its Environment." *Library of Congress Country Studies: Uganda*. 10 Feb. 2009 <[http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+ug0025\)>](http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0025)>).

³³¹ Byrnes, Rita M. "Chapter 2 - The Society and Its Environment." *Library of Congress Country Studies: Uganda*. 10 Feb. 2009 <[http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+ug0025\)>](http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0025)>).

³³² "Uganda: Infrastructure, power, and communications." *Encyclopedia of the Nations*. 19 May 2009 <<http://www.nationsencyclopedia.com/economies/Africa/Uganda-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html>>.

airports throughout the country, many of which are unpaved. Due to the fact the country is landlocked, Uganda relies heavily on its neighboring countries, Kenya and Tanzania, for their port services.³³³

Information Systems

As of 2000, Uganda Telecomm Limited (UTL) and Mobile Telephone Network Uganda (MTN) were the two national telecommunications operations in the country. With the growing interest in internet, an additional 12 internet service providers have been licensed to provide internet, although in early 2001, only four were in existence.³³⁴ There is an obvious growth in information technology in Uganda which encourages development.

³³³ “Uganda: Infrastructure, power, and communications.” Encyclopedia of the Nations. 19 May 2009 <<http://www.nationsencyclopedia.com/economies/Africa/Uganda-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html>>.

³³⁴ “Uganda: Infrastructure, power, and communications.” Encyclopedia of the Nations. 19 May 2009 <<http://www.nationsencyclopedia.com/economies/Africa/Uganda-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html>>.

	Afghanistan	Marshall Islands	Uganda
Political	Lacking rule of law with weak centralized government body	Democracy: President and unicameral Parliament	Democracy: President, Cabinet and unicameral Parliament
Military	Absence of internal security or military forces	Under U.S. Protection per Compact of Free Association (1983)	Uganda People's Defense Forces: air force, marine, and army contingents
Economic	Dominated by natural gas and opium exports; Relies on foreign aid	Relies heavily on U.S. subsidies and aid	Bank of Uganda (est. 1966) serves as main financier; Relies heavily on tourism and trade
Social	Multiple ethnicities, religions, and languages	Lapita culture mixed with Christianity	Strong tribal and religious affiliations; over 30 languages
Infrastructure	Heavy reliance on roads; lacks railway	No railway; numerous ports and paved roads	Over 16,000 miles of often unpaved road; railway access
Information Systems	One of least developed globally; improving gradually with cellular service	Scattered but efficient access to telephone and cellular	Prevalent cellular systems, scattered internet access

Figure 22: PMESII table for Afghanistan, Uganda, and Marshall Islands

A NEW FRAMEWORK: CROPS

Overview

The PMESII framework for analysis is useful and vital for assessing any nation-state, and the successful implementation of a VIKA relies heavily on the social aspect of PMESII which is vague, especially given the dynamic nature of any society. In fact, one of the most widely accepted attributes of society is that, no matter which society one is discussing, it is in a constant battle between change and stability.³³⁵ In order for a society to remain intact and recognizable, there must be few changes occurring at a time, and change in its entirety must transpire slowly. Regardless of minimal and slow change, however, there is a constant and pervasive influx of outside influences entering and altering any society.³³⁶ All of this makes societal analysis difficult, and an analysis that was accurate one year ago may be inaccurate at the present time and in the following years.

In order to better examine and analyze society, the research team proposes the use of a new framework that applies specifically to the many different facets of society. The acronym CROPS refers to Culture, Religion, Organizational patterns, Perceptions of the U.S., and Societal markers. Using a CROPS analysis makes societal examination more concrete and specific. In addition, research may find that between CROPS analyses, only one or two factors may change, but each is important to consider for numerous reasons.

³³⁵ Basirico, Cashion, et al. Understanding Sociology. Horizon Textbook Publishing (2ed), 2007.

³³⁶ Basirico, Cashion, et al. Understanding Sociology. Horizon Textbook Publishing (2ed), 2007.

Since CROPS is a new analytical framework introduced in this paper, each of the five parts needs to be defined and discussed in order to illustrate its utility. It is important to note prior to the description that CROPS is not a replacement for PMESII, but rather an extension of the “S,” or Social aspect of PMESII. Using the two frameworks in conjunction with each other will create a more specific and encompassing description of a nation-state, and the importance of understanding the society into which a VIKA will be deployed cannot be understated.

Culture

Culture is typically defined as, “the total way of life of all of the people in a society.”³³⁷ Cultures are vast and therefore the definition itself is decidedly vague. Specific components of culture include, but are not limited to, codes of manners, ways of dressing, languages spoken, rituals, norms, behaviors, and systems of belief. Culture can also include types of housing, tools, foods, employment practices, perspectives on health and illness, government structures, and etcetera. Any or all of these components can, and at times should, be examined for a full CROPS analysis.³³⁸

Culture is the greatest binding force among people within a society. It is shared among members and transmitted to new members and subsequent generations.³³⁹ Culture is the root of societal values and norms, and so the components of a culture are often emotionally charged. Culture is both evolutionary and historical in its nature. This is to say that members are acted on by their

³³⁷ Jary, David & Jary, Julia. *The Harper Collins Dictionary of Sociology*. Harper Collins Publishers: New York, NY, 1991.

³³⁸ Harris, Marvin & Johnson, Orna. *Cultural Anthropology*. Prentice Hall, 2007.

³³⁹ Macionis, John J. *Society: The Basics*. Prentice Hall Publishers: Upper Saddle River, New Jersey, 2006.

culture and respond to it, so new cultural forms and meanings are generated within the original historical context.³⁴⁰

The importance of considering culture in any analysis of a society is paramount for the success of VIKA implementation. According to the Harper Collins Sociological Dictionary:

It is virtually impossible for any human behavior to reside outside of cultural influences. What initially may appear to be natural features of our lives, for example, sexuality, aging, and death, are all made meaningful by culture and transformed by its influence. Even the consumption of food, so apparently natural, is imbued with cultural meaning and custom.³⁴¹

Due to the fact that culture is significant and emotionally charged, violating any part of it can eliminate the chances of entering that culture and creating a relationship with members. For example, if a researcher or military personnel violates the code of manners or wears offensive dress, even if done unintentionally, members of the culture could react negatively and refuse to help or participate in the VIKA process, thus potentially rendering its services useless. On the other hand, knowing the language(s) spoken in a society tends to make members of that society feel more comfortable with outside influences.³⁴² So in many ways, fully examining a culture before implementing a VIKA can prevent losing the trust and respect of the society, as well as improve relationships between the U.S. and the partner nation-state.

³⁴⁰ Angeloni, Elvio. Classic Edition Sources: Anthropology. McGraw Hill Companies, 2007.

³⁴¹ Jary, David & Jary, Julia. The Harper Collins Dictionary of Sociology. Harper Collins Publishers: New York, NY, 1991.

³⁴² Harris, Marvin & Johnson, Orna. Cultural Anthropology. Prentice Hall, 2007.

Religion

Religion is often considered part of culture, but due to its elevated importance in most societies around the world, it is important to discuss as a separate element of the CROPS framework.

Often, religion is the basis for the values and solidarity of a society, especially in lesser industrialized rural areas around the world, and so it is one of the most pervasive and powerful elements of a society. In fact, the late sociologist, Emile Durkheim, noted, “[religion is] the elimination of the self and the denial of individuality for the purpose of the social group, which is greater than the self.”³⁴³ This collective nature based on religious belief, or the preservation of group over the individual, is fundamental to the success of the VIKA, as many societies could not accept it if a means of collective ownership and benefit was not possible.

Furthermore, religious taboos could also interfere with the successful implementation of a VIKA and so need to be considered in the religion section of CROPS. A poignant example of this issue is the preservation of sacred cows in Calcutta, India. Many thousands of years ago, cattle were slaughtered and consumed regularly in what is now India and much of South Asia. At the same time, many herds were also kept alive as the primary means of fuel (dung) and manual labor (pulling plows). However, as urbanization occurred, it was no longer possible to raise enough cattle to serve the dual purpose of meat and labor/fuel.³⁴⁴

As a result, it was decided that the more important use of the cow was for “traction power” which generally refers to manual labor, but can also include fuel and non-meat food production such as milk. In order to make sure no Hindu ever killed his cattle then, it became religious

³⁴³ Harris, Marvin & Johnson, Orna. Cultural Anthropology. Prentice Hall, 2007.

³⁴⁴ Harris, Marvin & Johnson, Orna. Cultural Anthropology. Prentice Hall, 2007.

doctrine to ban slaughter, leading to the well known sacred cow taboo in modern India and other predominantly Hindu areas of Asia.³⁴⁵ Now, cows' dung is one of the primary fuels in rural India, and likewise, cows are the most preferred method of manual labor. They are able to carry or pull a great deal of weight which is necessary for agriculture. They also serve the purpose of clearing the fields after harvest by eating the remaining vegetation and overgrowth.

The purpose for discussing the cattle taboo in relationship to the VIKA or other development projects is to illustrate the significance of religious belief in different societies. The cattle are central to Hindu belief and serve very important societal functions. Therefore, it is likely that many rural Hindu farming communities would refuse the energy services of a VIKA for their preferred use of the sacred cattle. This could be dealt with in two ways: either use the *a la cart* approach of the VIKA and eliminate the energy portion completely, or provide a technology that does not necessarily replace the use of cow dung for fuel, but rather works alongside it. One such technology is the solar lantern that could provide light, while the dung could still be used for heated cooking as it is now. The perks of having storable energy via solar power could prove to be quite valuable, and eventually the community could make the choice to do away with the use of dung, instead of having an outsider make that choice for them. This would further foster the trust relationship between the U.S. and the partner nation.

While this is only one example of how religious taboos or doctrines could prevent the complete implementation of the VIKA, the point remains the same from society to society. The significance of religion in many parts of the world cannot be overlooked, even when the effort from outsiders is humanitarian or developmental in nature.

³⁴⁵ Harris, Marvin & Johnson, Orna. Cultural Anthropology. Prentice Hall, 2007.

Religion can even influence political leadership. For thousands of years, religious leaders such as shamans and priests held the primary position of power and decision-making in society, and in many rural areas they still do.³⁴⁶ So while it may seem commonplace to abide by a particular political or government structure, this is often not the case in more rural areas with no governmental structure. Instead of a President, Prime Minister, etcetera, a high priest, shaman, or indigenous healer may hold the leadership position and needs to be treated with the greatest respect.³⁴⁷ Failure to do so could result in being shut out of the society completely, as religion is at the core of most societies.³⁴⁸

Aside from the main functions of religion in society, it can have a more heightened function during tumultuous times. This elevated importance is often called revitalization and “occurs when a society is pushed out of a state of equilibrium by various forces, such as climatic or biotic change, epidemic disease, war and conquest, and so on.”³⁴⁹ The importance of understanding revitalization is that it is not always deliberate and detectable. However, if the conditions are present, the odds of revitalization occurring are high, and the VIKA could often be deployed to an area where the conditions are indeed present.

Organizational Patterns

The term “organizational pattern” is a term developed specifically for the CROPS framework. It is intentionally broad and encompasses many structural aspects of society, specifically marriage patterns, kinship, family structures, and living arrangements. All organizational patterns will

³⁴⁶ Angeloni, Elvio. Classic Edition Sources: Anthropology. McGraw Hill Companies, 2007.

³⁴⁷ Winkelman, Michael J. “Shamans and Other ‘Magico-Religious’ Healers: A Cross-Cultural Study of Their Origins, Nature, and Social Transformations.” Ethos 18. 3 (1990).

³⁴⁸ Macdonis, John J. Society: The Basics. Prentice Hall Publishers: Upper Saddle River, New Jersey, 2006.

³⁴⁹ Harris, Marvin & Johnson, Orna. Cultural Anthropology. Prentice Hall, 2007.

vary from society to society, and sometimes even within the same society depending on its geographic size and scope.³⁵⁰

There are typically two accepted patterns of marriage arrangements, monogamy and polygamy. Monogamy, or marriage to only one other individual at a time, is the most commonly practiced arrangement worldwide.³⁵¹ Polygamy, or marriage to multiple individuals at the same time, is the most widely accepted arrangement worldwide, although it is not the most often practiced. In other words, it is culturally acceptable to participate in polygamy in more places than monogamy, but due to many external factors such as cost and spouse-availability, monogamy is the most practiced marriage pattern overall.³⁵²

Confounding a simple explanation of marriage patterns is the fact that there are two subcategories of polygamy. Polygamy itself is an umbrella term for a marriage with two or more spouses, but the number of wives or the number of husbands taken by one individual determines which subcategory of polygamy is being practiced. According to John Macionis, Ph.D., polygyny is by far the more common form of polygamy and it “unites one man and two or more women.”³⁵³ The opposite of polygyny is polyandry which, according to the same sociologist, “unites one woman and two or more men.”³⁵⁴ Furthermore, any of the above defined marriage patterns can be either endogamous or exogamous. An endogamous marriage is one that occurs between people of the same category, culture, race, village, etcetera. An exogamous marriage is one that occurs between people of different categories.

³⁵⁰ Macionis, John J. Society: The Basics. Prentice Hall Publishers: Upper Saddle River, New Jersey, 2006.

³⁵¹ Jary, David & Jary, Julia. The Harper Collins Dictionary of Sociology. Harper Collins Publishers: New York, NY, 1991.

³⁵² Basirico, Cashion, et al. Understanding Sociology. Horizon Textbook Publishing (2ed), 2007.

³⁵³ Macionis, John J. Society: The Basics. Prentice Hall Publishers: Upper Saddle River, New Jersey, 2006.

³⁵⁴ Macionis, John J. Society: The Basics. Prentice Hall Publishers: Upper Saddle River, New Jersey, 2006.

Kinship refers to family ties, and often takes the shape of a kinship chart or family tree diagram. Fortunately, almost all societies have been studied and charted for their kinship and so diagrams are often readily available.³⁵⁵ Ultimately, kinship determines family structures and living arrangements by providing the foundation for who is a relative and to what degree, and therefore who is or is not a potential marriage partner.

Just as there are different patterns of marriage, there are also numerous family structures. The most common are the nuclear family and extended family. A nuclear family is composed of parents and their children while an extended family is composed of parents, children, and the other kin. In the U.S., a typical extended family is made up of many generations including parents, children, aunts, uncles, cousins, and grandparents. However, due to varying definitions of kinship, definitions of family may also vary between societies.³⁵⁶

Kinship can also determine living arrangements or residence patterns, depending on how the family is structured. The three main residence patterns are patrilocality, matrilocality, and neolocality. In a patrilocal society, a newly started family will reside with or near the husband's family, while in a matrilocality society a newly started family will reside with or near the wife's family. A neolocal system allows for a new family to live apart from both sets of parents. Patrilocal and matrilocality patterns are quite common cross culturally, and often result in a more communal structure in which extended families live with or near one another.³⁵⁷

All of these organizational patterns are necessary to examine prior to the implementation of a VIKA, since they all contribute to the physical structure of any given society. A polygamous and

³⁵⁵ Angeloni, Elvio. Classic Edition Sources: Anthropology. McGraw Hill Companies, 2007.

³⁵⁶ Macionis, John J. Society: The Basics. Prentice Hall Publishers: Upper Saddle River, New Jersey, 2006.

³⁵⁷ Macionis, John J. Society: The Basics. Prentice Hall Publishers: Upper Saddle River, New Jersey, 2006.

patriolocal village, like many in Africa, would be organized very differently from a monogamous neolocal society found in the U.S. Determining the exact organizational patterns could help make very important decisions in the choice of technology incorporated into a VIKA. If using the LifeStraw, for example, a society in which people live in separate residences would need individual LifeStraws to meet their needs, whereas a communal society living closely together would get better use from a Family LifeStraw.

Perceptions of the U.S.

The U.S. is perceived differently around the world. In some locations, societies have a very favorable impression, and in others the impression is not so great. Overall, the perceptions of the U.S. across the globe should be thought of in terms of a continuum, ranging from the highest respect and favorability on one end to the lowest respect and disregard on the other. Every society in the world will fall somewhere along this continuum, but finding where each may fall is a difficult and potentially time consuming task. However daunting it may be though, it is equally as important as every other element of the CROPS analysis.

In the context of implementing a VIKA, the perception of the U.S. in the partner nation-state serves one main purpose: deciding whether or not to work through a NGO. If the partner nation-state thinks lowly of the U.S., working with a NGO could give access to the state that would otherwise be restricted. This is because many well known NGOs are politically and religiously neutral. Take for example the organization Médecins Sans Frontières (MSF), also known in English as Doctors Without Borders, which has provided medical care to some of the most destitute populations most recently in Rwanda, Sudan, Chad, Somalia, and the Democratic

Republic of the Congo.³⁵⁸ MSF itself is made up of 19 different partner organizations spanning the entire globe including the U.S., Spain, Australia, Greece, Holland and Switzerland. Most importantly for this example is the fact that, according to its official website, “MSF's work is based on the humanitarian principles of medical ethics and impartiality... [MSF] is committed to bringing quality medical care to people caught in crisis regardless of race, religion, or political affiliation.”³⁵⁹

MSF is just one of many NGOs working all over the world independently of any political, military, or religious agenda. That level of impartiality often makes NGOs more welcome in many societies than a military or religious organization's presence, and the research team heavily encourages working in cooperation with NGOs already on the ground where the VIKA is to be implemented. The previously established relationship between the NGO and the partner nation-state should also benefit the U.S. during VIKA implementation because it could lessen the time frame by eliminating much of the need to establish trust in a non-existent or strained relationship.³⁶⁰ The importance of working with NGOs and IGOS will be further discussed in the IGO/NGO section.

The necessity of measuring the perceptions of the U.S. is absolute, but very difficult for two primary reasons. First, it is a measurement of a subjective construct that will, without a doubt, differ both within and between societies. Second, it is something that does not exist to any great extent in the current literature. So unlike the kinship charts from organizational patterns which

³⁵⁸ Orbinski, James M.D. “An Imperfect Offering: Humanitarian Action for the Twenty-First Century.” Walker Publishing Company: New York, NY, 2008.

³⁵⁹ “About Us: History and Principles.” Doctors Without Borders. 14 Mar. 2009
<<http://doctorswithoutborders.org/aboutus/?ref=main-menu>>.

³⁶⁰ Orbinski, James M.D. “An Imperfect Offering: Humanitarian Action for the Twenty-First Century.” Walker Publishing Company: New York, NY, 2008.

are easy to find for almost every society, the perceptions of the U.S. abroad will need to be researched from the most basic level.

The Human Terrains System (HTS) housed in the U.S. Army is doing work in this area, employing the research methods developed and used by the academic social sciences. According to the official HTS Army website, “The near-term focus of the HTS program is to improve the military’s ability to understand the highly complex local socio-cultural environment in the areas where they are deployed; however, in the long-term, HTS hopes to assist the US government in understanding foreign countries and regions prior to an engagement within that region.”³⁶¹

Specifically, ethnography and interview skills used in field work by sociologists and anthropologists make up the core of the HTS. One of the HTS’s main beliefs is very much in line with the overall purpose of the VIKA: “Achieving national security objectives is dependent on understanding the societies and cultures in which we are engaged.”³⁶² Teams of social scientists embedded with troops are only deployed to Afghanistan and Iraq at this time, but the same framework could be utilized by the U.S. Air Force or any other branch of the military or government sector to measure the perceptions of the U.S. worldwide.

For the purposes of demonstration, a CROPS table has been provided at the end of this section (see Figure 23). However, the perceptions of the U.S. for Afghanistan, the Marshall Islands, and Uganda are notional. That is, the values entered into the table are not based on research, but rather they have been arbitrarily assigned in order to show how a CROPS table would look when completed.

³⁶¹ “Human Terrain System.” Human Terrain System. 15 Mar. 2009 <<http://humanterrainsystem.army.mil/>>.

³⁶² “HTS Mission.” Human Terrain System. 15 Mar. 2009 <<http://humanterrainsystem.army.mil/missionstatement.html>>.

Societal Markers

The final element of a CROPS analysis is that of various societal markers. Societal markers are basic data on numerous factors or qualities of the society being measured. The four main rates that should be considered in every CROPS analysis are birth, death, disease mortality, and literacy rates. Birth and death rates give a society some context. As discussed earlier, societies are dynamic and always changing. One of the most effective means of grasping the level of change is to quite literally examine population change by answering the question, “Is it growing or shrinking at the current time?” A growing population may indicate the need for more economic or political aid in the future, while a shrinking population may require medical care or other aid, depending on the reason for fluctuation.

According to the WHO, disease mortality rates indicate problems in the society, such as little access to potable water, adequate diet, or suitable health care. In other words, if disease mortality rates are high, it points the analysis in a more specific direction than simply knowing if death rates are high. Death rates in the U.S. will spike when the Baby Boomer generation begins to die, but this is not an indication of a disease-related issue. High disease mortality rates, however, do indicate a problem and require deeper analysis.³⁶³

Literacy rates have an immediate and often drastic effect on any society. The societies with the lowest literacy rates also have the least economic growth, gross domestic product (GDP), educational attainment, and political participation, along with the highest disease mortality rates. When offering a potential development package like the VIKA, literacy rates become increasingly important because instructional methods will vary depending on literacy rates. Low

³⁶³ “WHO Statistical Information System.” The World Health Organization. 29 Mar. 2009 <<http://www.who.int/whosis/en/>>.

rates will require instruction manuals consisting of pictures or illustrations, or the use of previously trained personnel on hand to address questions and issues. High literacy rates, which are generally an indication of higher educational standards, will allow for a text-only instruction manual and fewer or no trained personnel on hand.

While these four primary rates should be included in any CROPS analysis, many other rates can be included if deemed necessary or informational. For example, a CROPS analysis for the VIKA project should include rates of rural electrification, and access to clean water and telecommunications.

In order to illustrate its utility, a CROPS analysis was performed in regards to the same states used for the PMESII analysis: Afghanistan, the Marshall Islands, and Uganda. It is important to note that the political, military, economic, infrastructural, and information systems aspects of each case study have already been examined in the PMESII section, and so will only be discussed here as needed. Also recall that this is a preliminary analysis inherently limited by access to current statistics and information. In addition, perceptions of the U.S. have not been included, and an ethnographic assessment is recommended to accurately gauge variation.

Afghanistan CROPS

Culture

The largest ethnic group in Afghanistan is Pashtun, and the second largest is Tajik. Other minority groups include Hazara, Uzbek, Almak, Turkmai, and Baloch. In addition to a wide variety of ethnic groups, there are over 30 different languages commonly spoken in Afghanistan.

Out of the thirty languages, the official languages are Dari and Pashtu, and many people speak more than one.³⁶⁴

Afghans intensely value family, and the roles within the family structure are traditional.³⁶⁵ For instance, men tend to do work that could generate income to support the family, and women tend to stay home and take care of children and tend to other household responsibilities. Honor and reputation are held as extremely important by Afghans. In fact, one's perception of their status in a community in terms of honor and reputation significantly affects behavior in social and non-social contexts, thus being perceived as someone not worthy of being honored or having a desirable reputation is consciously avoided.³⁶⁶ Important responsibilities of the head male in a family is to ensure that the family's honor and reputation are maintained, and to prevent the possibility of fostering a negative reputation or possibly shaming the family.³⁶⁷

Moreover, hospitality and etiquette are viewed as important means by which families can avoid shame and ostracization. Certain nuances such as making eye contact with a person inappropriately, endlessly offering tea, and exchanging business cards can affect whether someone is perceived as honorable and reputable or not.³⁶⁸ It is important to keep in mind that Afghanistan's human population is composed of several different tribes, and each tribe is likely to hold separate unique traditions, behaviors, values, etcetera, and these intricacies can affect the success of dealings in social and non-social situations.³⁶⁹

³⁶⁴ CIA World Fact Book. Skyhorse Publishing: NY, 2008

³⁶⁵ "Afghanistan – Language, Culture, Customs, and Etiquette." Kwintessential. 20 Mar. 2009 <<http://www.kwintessential.co.uk/resources/global-etiquette/afghanistan.html>>.

³⁶⁶ "Afghanistan – Language, Culture, Customs, and Etiquette." Kwintessential. 20 Mar. 2009 <<http://www.kwintessential.co.uk/resources/global-etiquette/afghanistan.html>>.

³⁶⁷ CIA World Fact Book. Skyhorse Publishing: NY, 2008

³⁶⁸ "Afghanistan – Language, Culture, Customs, and Etiquette." Kwintessential. 20 Mar. 2009 <<http://www.kwintessential.co.uk/resources/global-etiquette/afghanistan.html>>.

³⁶⁹ CIA World Fact Book. Skyhorse Publishing: NY, 2008

Religion

Almost all of Afghanistan is Muslim, with the majority being Sunni, and the minority, Shia.³⁷⁰

Due to the Shias' status as a minority in Afghanistan, they tend to face discrimination and are economically disadvantaged.³⁷¹ Approximately 2,000 Jews still exist in Afghanistan, but that number is decreasing.³⁷²

Organizational Patterns

The population of Afghanistan was estimated to be 33.6 million people as of July 2009, with an estimated population increase to 97 million by 2050.³⁷³ Due to the rapid population growth, rates of urbanization are also increasing, with the capital city, Kabul, having reached a population of 1 million people.³⁷⁴ Other large cities include Kandahar, Jalalabad, and Herat.

Due to the numerous ethnic groups scattered throughout Afghanistan, village level organizational patterns vary widely. Typical features in most Afghani villages are a local council of leaders, a subsistence agriculture based local economy, and an area in which to pray.³⁷⁵

The Islamic Constitution and religious law allows for the practice of polygamy, with a maximum of four wives, all of which must be treated equally.³⁷⁶ Regardless, the stigma placed on single or divorced women in Afghanistan often compels women to remain with a husband as a third or

³⁷⁰ CIA World Fact Book. Skyhorse Publishing: NY, 2008

³⁷¹ CIA World Fact Book. Skyhorse Publishing: NY, 2008

³⁷² CIA World Fact Book. Skyhorse Publishing: NY, 2008

³⁷³ CIA World Fact Book. Skyhorse Publishing: NY, 2008

³⁷⁴ CIA World Fact Book. Skyhorse Publishing: NY, 2008

³⁷⁵ Biswas, Soutik. "Day In Afghanistan: Village Life." BBC News. <http://news.bbc.co.uk/2/hi/south_asia/4237756.stm>.

³⁷⁶ "Gender Equality and Social Institutions in Afghanistan." Social Institutions & Gender Index. 5 Apr. 2009 <<http://genderindex.org/country/afghanistan>>.

fourth wife, even when receiving unequal treatment.³⁷⁷ Furthermore, it is estimated that nearly 60% of Afghani girls are married by the age of sixteen.³⁷⁸

Perceptions of the U.S.

As stated previously, the perceptions of the U.S. in Afghanistan vary widely across cultures and geographic area. As a result, this section requires a full ethnographic assessment and will not fall to speculation here.

Societal Markers

Economically, Afghanistan is one of the least developed and poorest nations in the world, with only about one quarter of the population living on more than \$2 USD per day, and an unemployment rate of over 35% in 2005.³⁷⁹ The poor economy is only one issue facing Afghani people on a daily basis, however.

An extensive survey conducted by The Asia Foundation found that, on a national level, over 22% of Afghani people felt the most significant problem was security, closely followed by unemployment, poor economy, and electricity.³⁸⁰ On a local level, the most significant problems cited were unemployment, electricity, safe drinking water, and poverty.³⁸¹

³⁷⁷ "Gender Equality and Social Institutions in Afghanistan." Social Institutions & Gender Index. 5 Apr. 2009 <<http://genderindex.org/country/afghanistan>>.

³⁷⁸ "Gender Equality and Social Institutions in Afghanistan." Social Institutions & Gender Index. 5 Apr. 2009 <<http://genderindex.org/country/afghanistan>>.

³⁷⁹ Morales, Victor. "Poor Afghanistan." Voice of America. 5 Apr. 2009 <<http://www.voanews.com/english/archive/2005-03/2005-03-28-voa53.cfm>>.

³⁸⁰ "A survey of the Afghan people: Afghanistan in 2006." The Asia Foundation. 5 Apr. 2009 <<http://asiafoundation.org/pdf/AG-survey06.pdf>>.

³⁸¹ "A survey of the Afghan people: Afghanistan in 2006." The Asia Foundation. 5 Apr. 2009 <<http://asiafoundation.org/pdf/AG-survey06.pdf>>.

Because of rampant poverty and centuries of war, Afghanistan's health profile is also one of the poorest in the world.³⁸² According to a publication by the Library of Congress Federal Research Division, all medical training programs ceased and most of the country's already scarce medical professionals left between 1980 and 1990. As a result, between one quarter and one half of the nation's entire population has no access to healthcare, including emergency care.³⁸³ The same publication found, "because of poor sanitation and insufficient potable water supply, infectious and parasitic diseases such as malaria and diarrhea are very common. Malnutrition and poor nutrition also are pervasive."³⁸⁴

The educational profile of Afghanistan is equally unfortunate. While the illiteracy rate decreased in the last 4 decades, as of 2006 approximately 57% of all men and 87% of all women remained illiterate.³⁸⁵ The Library of Congress reported:

By 1996 only about 650 schools were functioning. In 1996 the Taliban regime banned education for females. After the overthrow of the Taliban in 2001, the interim government received substantial international aid to restore the education system, but for the next six years the Taliban attacked public schools wherever possible.³⁸⁶

³⁸² "Country Profile: Afghanistan." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

³⁸³ "Country Profile: Afghanistan." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

³⁸⁴ "Country Profile: Afghanistan." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

³⁸⁵ "Country Profile: Afghanistan." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

³⁸⁶ "Country Profile: Afghanistan." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

Thus, consistent education in the last decade has been difficult to accomplish. Even with the opening of over 9000 schools in 2008, rural families continued the tradition of only educating males, so females still face a severe educational deficit.³⁸⁷

Marshall Islands CROPS

Culture

According to the webpage for the embassy of the Marshall Islands, the values central to the Marshallese culture are being friendly and peaceful in all personal interactions, welcoming strangers, dealing with one another in cooperative and mutually beneficial means, and highly valuing the Marshallese history.³⁸⁸ The strong-knit community nature is crucial for survival on the small islands. Welcoming strangers or newcomers from all over the world has also resulted in an expansion of Marshallese culture, openly mixing in German, Japanese, and American cultures.³⁸⁹ Despite the addition of new cultural components, the original Marshallese culture remains strong, and can be seen quite concretely in the structure of the political system discussed in the PMESII section.

The Marshall Islands has two official languages, English and Marshallese, with English being the most commonly spoken among all groups there. The language family which Marshallese belongs to, the Austronesian language family, has approximately 880 dialects, but only two exist in the Marshall Islands: one on the Ralik atoll and one on the Ratak atoll.³⁹⁰ The differences

³⁸⁷ "Country Profile: Afghanistan." Library of Congress: Federal Research Division. 19 Feb. 2009 <<http://lcweb2.loc.gov/frd/cs/profiles/Afghanistan.pdf>>.

³⁸⁸ "Culture." Embassy of the Republic of the Marshall Islands. 10 Apr. 2009 <<http://www.rmiembassyus.org/Culture.htm>>.

³⁸⁹ "Marshall Islands." Encyclopædia Britannica. 20 May 2009 <<http://search.eb.com.leo.lib.unomaha.edu/eb/article-9117363>>.

³⁹⁰ "Republic of the Marshall Islands." Australian Government: Department of Foreign Affairs and Trade. 10 Apr. 2009 <http://www.dfat.gov.au/geo/marshall_islands/>.

between the two dialects are minimal, however, and a speaker of one generally has no translational problems with the other.

One of the most widely practiced past times in the Marshall Islands is that of traditional arts and crafts. Items constructed generally include jewelry, fans, purses, coasters and woven baskets, and are always made of local natural resources. Ship building is also a main facet of Marshallese culture dating back over a thousand years.³⁹¹

Religion

The main religion in the Marshall Islands is Protestantism, with the largest Church in the island nation being the United Church of Christ. The embassy also states that there are numerous other denominations of Christianity represented, including a strong presence of the Catholic Church. Due to the high levels of Christianity in the islands, the embassy states that, “Sundays are set aside for rest and relaxation.”³⁹² One of the hallmark features of religion in the Marshall Islands is their inherent ability to mesh Christian belief with Polynesian tradition.³⁹³

Organizational Patterns

Marshallese kinship mirrors that of Hawaiian natives which features far fewer classifications of relatives than that of the familiar U.S. kinship pattern. To be more specific, cousins are classified as siblings along with brothers and sisters. Alexander Spoher stated in the *Southwest Journal of Anthropology*:

³⁹¹ “Culture.” [Embassy of the Republic of the Marshall Islands](http://www.rmiembassyus.org/Culture.htm). 10 Apr. 2009 <<http://www.rmiembassyus.org/Culture.htm>>.

³⁹² “Culture.” [Embassy of the Republic of the Marshall Islands](http://www.rmiembassyus.org/Culture.htm). 10 Apr. 2009 <<http://www.rmiembassyus.org/Culture.htm>>.

³⁹³ “Marshall Islands.” [Encyclopædia Britannica](http://search.eb.com.leo.lib.unomaha.edu/eb/article-9117363). 20 May 2009 <<http://search.eb.com.leo.lib.unomaha.edu/eb/article-9117363>>.

The mother's sister, father's sister, and wives of the father's brother and mother's brother are all classed with the mother. The father's brother and the husband's of the father's sister and the mother's sister are grouped with the father. The mother's brother is given a separate designation.³⁹⁴

While it may seem complex, the basic idea is that there is relatively little distinction between uncles and fathers, aunts and mothers, and cousins and siblings. This is further evidence of the communal nature of the Marshallese people. In addition, the strong presence of Christianity in the Marshall Islands resulted in monogamy as the primary marriage pattern.³⁹⁵

Perceptions of the U.S.

As mentioned in the introductory section to CROPS, the perception of the U.S. requires a more in-depth analysis than what current literature provides. An ethnographic assessment conducted by trained social scientists is highly recommended for the completion of this section. For the purposes of illustrating the CROPS table in the next section, however, it will be stated here that the Marshallese citizens view the U.S. favorably. This should not, under any circumstance, be interpreted as fact.

Societal Markers

The average life expectancy of a Marshall Islander is approximately 62 years, with an adult mortality rate of 327 males and 275 females per 1,000. In addition, the under five years old

³⁹⁴ Spoher, Alexander. "The Generation Type Kinship System in the Marshall and Gilbert Islands." Southwestern Journal of Anthropology 5.2 (1949).

³⁹⁵ Pollock, Nancy J. "Rethinking Marriage and Gender Relations Using Evidence from the Pacific." Gender and Development 11.2 (2003).

mortality rate is an average of 59 per 1,000.³⁹⁶ The highest percentage of deaths in children under age five, at 47%, is due to neonatal complications. At approximately 15% each are diarrheal diseases and pneumonia. Ischemic heart disease and cerebrovascular disease are the highest ranked killer of adults at approximately 12% each.³⁹⁷

Approximately 67% of the Marshall Islands is urbanized.³⁹⁸ However, according to the SOPAC (South Pacific Applied Geoscience Commission) Community Lifelines Program for the Marshall Islands, “There are a number of critical issues that have been identified... through national and regional mechanisms.”³⁹⁹ Similar to the VIKA project, the SOPAC program seeks to improve energy, water, and telecommunication access in order to jump start social and economic development. Problems identified in those three areas mainly deal with access to clean water, or the efficient use of the water that is available. Other problems include a dependence on imported fossil fuels in an area where renewable energy resources are readily available.⁴⁰⁰ In addition, there is a drastic need to more educational emphasis on training in science, mathematics, and technological skills. The effects of all of these shortcomings are worse on the outer island communities.⁴⁰¹

Literacy rates for the Marshall Islands are low or at risk, but there has been improvement. The most recent data available from 1999 showed that an average of 60% of all Marshall Islander children fell below the recognized literacy standard. Children in private schools typically had a

³⁹⁶ “WHO Statistical Information System.” The World Health Organization, 29 Mar. 2009 <<http://www.who.int/whosis/en/>>.

³⁹⁷ “Mortality Country Fact Sheet 2006: Marshall Islands.” World Health Organization, 29 Mar. 2009 <http://www.who.int/whosis/mort/profiles/mort_wpro_mhl_marshallislands.pdf>.

³⁹⁸ “Marshall Islands: Statistics.” Unite for Children, 5 Apr. 2009 <http://www.unicef.org/infobycountry/marshallislands_statistics.html>.

³⁹⁹ “Community Lifelines Program.” SOPAC, 12 Mar. 2009 <<http://www.sopac.org/Community+Lifelines>>.

⁴⁰⁰ “Republic of the Marshall Islands.” Australian Government: Department of Foreign Affairs and Trade, 10 Apr. 2009 <http://www.dfat.gov.au/geo/marshall_islands/>.

⁴⁰¹ “Community Lifelines Program.” SOPAC, 12 Mar. 2009 <<http://www.sopac.org/Community+Lifelines>>.

higher literacy rate, with 40% of privately educated school children falling below the literacy standard. Nearly 80% of public school children fell below the standard.⁴⁰²

Uganda CROPS

Culture

From region to region, culture in Uganda varies significantly. Such a phenomenon of cultural variation is perhaps largely due, but not limited to, the many different groups of people that migrated there throughout the past centuries, the political division between the north and the south, and the various spoken languages that substantially differ from Northwest Uganda compared to Southeast Uganda.⁴⁰³ For example, although English is the primary language used for commerce, government, and education, most Ugandans speak at least one other African language.⁴⁰⁴ In fact, two-thirds of Ugandans spoke Bantu during the time the country was gaining independence from Great Britain in 1962.⁴⁰⁵

Although it is the case that the caste system describes the social strata in some African countries, as in Nigeria, it is not the case, however, in Uganda. Instead, Ugandans are separated by a pervasive, high degree of social inequality.⁴⁰⁶ For instance, the richest Ugandans tend to live closely near the capital city Kampala, are educated, and speak English, whereas the poorest Ugandans tend to live in rural villages and have little access to education and healthcare.⁴⁰⁷ As

⁴⁰² Marshall Islands: Part II – Analytic Sections.” *The EFA 2000 Assessment: Country Reports*. 5 Apr. 2009 <http://www.unesco.org/education/wef/countryreports/marshalls/rapport_2.html>.

⁴⁰³ “Culture of Uganda.” *Everyculture.com*. 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴⁰⁴ “Culture of Uganda.” *Everyculture.com*. 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴⁰⁵ “Culture of Uganda.” *Everyculture.com*. 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴⁰⁶ Dike, Victor. “The ‘Caste System’ in Nigeria, Democratization and Culture: Socio-political and Civil Rights implications.” *Africa Economic Analysis*. 5 Apr. 2009 <<http://www.africaeconomicanalysis.org/articles/gen/castehtm.html>>.

⁴⁰⁷ “Culture of Uganda.” *Everyculture.com*. 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

for gender differences, men tend to be the primary financial providers and hold higher paying and higher power positions, however it is possible for a woman to be as equally powerful as a man.⁴⁰⁸ For example, women are legally permitted to own land and challenge decisions made by men.⁴⁰⁹ Although gender equality does exist, it is typical for women to rely on the financial support of men who are closest in kin, which is usually their husband, brother, or father.⁴¹⁰

Certain societal detriments that recently have affected Uganda are the Lord's Resistance Army (LRA), Sudanese Guerillas, and AIDS.⁴¹¹ Essentially, the LRA is a Christian group that rapes, tortures, and maims large groups of people, particularly children who they will enslave to work towards their mission of establishing a government based on the biblical Ten Commandments.⁴¹² In addition, the LRA is closely linked to Sudanese Guerillas.⁴¹³ AIDS is common throughout Uganda, as it is in most Southern African countries, and tends to be most pervasive in poor, rural communities where people do not either have access to healthcare or cannot afford it. Recent changes in and attitudes towards safer-sex practices have brought about a decrease in the number of incidences related to HIV/AIDS.⁴¹⁴

As mentioned earlier in the introduction it is important to be completely aware of behaviors and customs that are perceived as offensive, especially when in a non-native land, because this could affect the overall success of an outcome. For instance, when going into a foreign land to work with a native people, it would be a bad idea to do something they typically perceive as offensive

⁴⁰⁸ "Culture of Uganda." [Everyculture.com](http://www.everyculture.com/To-Z/Uganda.html). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴⁰⁹ "Culture of Uganda." [Everyculture.com](http://www.everyculture.com/To-Z/Uganda.html). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴¹⁰ "Culture of Uganda." [Everyculture.com](http://www.everyculture.com/To-Z/Uganda.html). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴¹¹ "The Lord's Resistance Army (LRA)." [GlobalSecurity.org](http://www.globalsecurity.org/military/world/para/lra.htm). 10 May 2009

<<http://www.globalsecurity.org/military/world/para/lra.htm>>.

⁴¹² "The Lord's Resistance Army (LRA)." [GlobalSecurity.org](http://www.globalsecurity.org/military/world/para/lra.htm). 10 May 2009

<<http://www.globalsecurity.org/military/world/para/lra.htm>>.

⁴¹³ "The Lord's Resistance Army (LRA)." [GlobalSecurity.org](http://www.globalsecurity.org/military/world/para/lra.htm). 10 May 2009

<<http://www.globalsecurity.org/military/world/para/lra.htm>>.

⁴¹⁴ "Changing Attitudes in Uganda." [UN Volunteers](http://www.unv.org/en/what-we-do/thematic-areas/human-rights/doc/changing-attitudes-in-uganda.html). 12 May 2009 <<http://www.unv.org/en/what-we-do/thematic-areas/human-rights/doc/changing-attitudes-in-uganda.html>>.

because then they might be less cooperative or open to negotiation. This is especially important if such actions are necessary to the success of a mission. The notion of suppressing offensive behavior, or attempting to adapt to local customs in order to become more approachable to the native people, might seem intuitive or overly simplified, but what one might perceive as small or unimportant could easily be perceived as just the opposite to another. Fortunately, such cultural differences could be ameliorated by use of a thorough, ethnographic assessment.

Despite any specific reasons for traveling throughout Uganda, while there it is quite inevitable that some form of interaction with the native people will occur, and therefore being aware of typical social norms is important.⁴¹⁵ For instance, during a meal it is customary to sit at the floor on a mat, to refrain from leaning on the left arm, and to completely extend one's legs to stretch.⁴¹⁶ However, not all customs are different from those of the U.S. In fact, a typical hand shake and casual, western dress are part of the social norms in Uganda, yet in more rural communities it is much more common to see people wearing traditional, African clothing.⁴¹⁷ In addition, individuals who are perceived as westerners to the native people, are considered wealthy, and are usually referred to as "muzungos."⁴¹⁸ Consequently muzungos tends to be charged more for goods and services, even when bartering.⁴¹⁹

Religion

Uganda is composed of different religious affiliations, such that one-third of Uganda's inhabitants are Roman Catholic, one-third Protestant, and the remaining third is a mixture of

⁴¹⁵ "Culture of Uganda." [Everyculture.com](http://www.everyculture.com/To-Z/Uganda.html). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴¹⁶ "Culture of Uganda." [Everyculture.com](http://www.everyculture.com/To-Z/Uganda.html). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴¹⁷ "Culture of Uganda." [Everyculture.com](http://www.everyculture.com/To-Z/Uganda.html). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴¹⁸ "Caleb in Uganda." [Blogspot](http://calebinuganda.blogspot.com/2008/09/ugandan-norms.html). 16 Apr. 2009 <<http://calebinuganda.blogspot.com/2008/09/ugandan-norms.html>>.

⁴¹⁹ "Caleb in Uganda." [Blogspot](http://calebinuganda.blogspot.com/2008/09/ugandan-norms.html). 16 Apr. 2009 <<http://calebinuganda.blogspot.com/2008/09/ugandan-norms.html>>.

Islam, African tribal religions, and spiritualities centered on spirits, spiritual possession, and witchcraft.⁴²⁰ The followers of each religion usually have a specific way of indicating their affiliation whether intentional or not. For instance, Muslims in Uganda typically travel to Mecca whenever they have the opportunity, and followers of African tribal religions tend to keep shrines devoted to spirits and gods in many different locations.⁴²¹

It is commonly believed that religion tends to answer the question of the afterlife for many believers. Similarly, many Ugandans believe that death is usually attributed to witchcraft or a spiritual hoax.⁴²² Although many people in Uganda share the same belief on the afterlife, it is not necessarily the case on other matters.⁴²³ In fact, with the existence of several religions and spiritual affiliations, inter-religious conflict usually is quite pervasive. In some cases, religion is important because the leaders of local religious institutions or groups tend to settle disputes, such as the allocation of resources.

Organizational Patterns

As mentioned before, at least two-thirds of the Ugandan population practices Christianity. With regard to marriage, the religious composition connotes monogamy as the primary marriage pattern. Indeed, surveys support that monogamy is becoming the norm. “Between 1989 and 1995, the proportions of women and men, both unmarried and married, who had had multiple sexual partners declined.”⁴²⁴ However, “Family prosperity in rural areas [still] involves the

⁴²⁰ “Culture of Uganda.” [Everyculture.com](http://www.everyculture.com). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴²¹ “Culture of Uganda.” [Everyculture.com](http://www.everyculture.com). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴²² “Culture of Uganda.” [Everyculture.com](http://www.everyculture.com). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴²³ “Culture of Uganda.” [Everyculture.com](http://www.everyculture.com). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴²⁴ Bankole, Akinrinola, Darroch Jacqueline, & Singh, Susheela. “A, B, and C in Uganda: The Roles of Abstinence Monogamy and Condom Use in HIV Decline.” [The Allan Guttmacher Institute](http://www.policyarchive.org/bitstream/handle/10207/6206/or_abc03.pdf?sequence=1). 8 Jun. 2009 <https://www.policyarchive.org/bitstream/handle/10207/6206/or_abc03.pdf?sequence=1>.

acquisition of wives.”⁴²⁵ Ugandan law does not outlaw polygamy, meaning that polygamy can be considered a secondary marriage pattern because it is slightly less prevalent.⁴²⁶ Also common among some ethnic groups in northern Uganda is exogamy, or the belief that two people of the same clan cannot marry one another, and men generally avoid marriage with a woman of their mother’s clan or that of her close relatives.⁴²⁷

In rural areas, Uganda’s kinship/clan system follows patrilineage, wherein most people trace their lineage back to common male ancestors. Accordingly, in rural areas, extended families are close-knit and sizable, often living close together. “As many as forty people often live in one homestead.”⁴²⁸ Additionally, the homestead consists of several mud huts, including one for the wife, one built by adolescent boys to live in before marriage, in addition to the common family house.⁴²⁹ Clans believing that they are even distantly related locate housing in close proximity to one another. Among the Jie and Karamajong clans in the northeastern part of the country, a set of brothers inherits the family’s livestock (valued very highly among pastoralist peoples) and it is not until the last surviving brother dies that the clan’s animals are bestowed upon the next generation.⁴³⁰ Due to Uganda’s ethnic diversity, it is difficult to generalize organizational patterns for the country. In spite of this, the patterns of these exemplary clans can serve as a starting point for the analysis of these trends.

⁴²⁵ “Culture of Uganda.” [Everyculture.com](http://www.everyculture.com/To-Z/Uganda.html). 8 Jun. 2009 <<http://www.everyculture.com/To-Z/Uganda.html>>.

⁴²⁶ Doherty, Peter. “A Visit to Uganda.” [Catholic Medical Quarterly](http://www.catholicdoctors.org.uk/CMQ/2004/May/visit_to_uganda.htm). 8 Jun. 2009 <http://www.catholicdoctors.org.uk/CMQ/2004/May/visit_to_uganda.htm>.

⁴²⁷ Byrnes, Rita M. “Uganda: Karamojong Cluster.” [Library of Congress Country Studies](http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0042)). 7 May 2009. <[http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+ug0042\)](http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0042))>.

⁴²⁸ Byrnes, Rita M. “Uganda: Karamojong Cluster.” [Library of Congress Country Studies](http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0042)). 7 May 2009. <[http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+ug0042\)](http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0042))>.

⁴²⁹ Byrnes, Rita M. “Uganda: Karamojong Cluster.” [Library of Congress Country Studies](http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0042)). 7 May 2009. <[http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+ug0042\)](http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0042))>.

⁴³⁰ Byrnes, Rita M. “Uganda: Karamojong Cluster.” [Library of Congress Country Studies](http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0042)). 7 May 2009. <[http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+ug0042\)](http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+ug0042))>.

Perceptions of the U.S.

This facet of Ugandan society would be best served by an in-depth personal investigation of sentiments towards the U.S. Current literature does not provide adequate analysis of Ugandans' perceptions of the U.S. As a side note, the Central Intelligence Agency (CIA) World Factbook identifies 10 distinct ethnicities comprising 70.4% of the nation's 31,367,972 people.⁴³¹ The other 29.6% represent other smaller ethnicities. Given the other political, economic, religious, and social dynamics of a society, it is likely that sentiment towards the U.S. varies across the country.

Societal Markers

HIV/AIDS is interrupting the typical Ugandan family order. The epidemic is leaving village elders to fend for themselves and younger generations. In a piece done by National Public Radio on AIDS in Uganda, Deborah Kaijuka, the head of the Uganda Reach the Aged Association, said, "People in Africa, they're insurance is their children. It is assumed that they [family elders] will sit back and relax once they've finished their parenting role."⁴³² Since AIDS is causing deaths in younger generations, elders in families must support grandchildren. It had previously been the norm that the younger generations would care for the elders.

Since 1976, the age dependency ratio (the number of people younger than 15 and older than 64 years of age in proportion to working age people 15 to 64 years old) has indicated there are more

⁴³¹ CIA World Fact Book. Skyhorse Publishing: NY, 2008

⁴³² "AIDS Deaths Disrupt Family Relationships in Uganda." National Public Radio. 8 Jun. 2009 <<http://www.npr.org/templates/story/story.php?storyId=5074670>>.

dependents than people in the work force.⁴³³ Fertility, birth, and death rates do not suggest that Ugandan workers will be able to better provide for the increasing number of dependents over time. In 2008, it is estimated that 6.81 children are born per woman.⁴³⁴ There are 48.15 births and only 12.32 deaths for every 1,000 people in the population.⁴³⁵ These numbers indicate that strategic public health measures could drastically improve the median age (15 years in 2008) and life expectancy at birth (48 for males, 51 years for females).^{436 437} Literacy rates for male and females differ significantly (76.8% for males and 57.7% for females).⁴³⁸ This highlights Uganda's system of patrilineage. Females, because they are often relegated to doing household chores and agricultural work, are often precluded from pursuing education.

Moreover, imports cripple Uganda's economy, as the country imported a total amount of goods and services greater than that of its annual budget in 2008 (\$2.803 billion imported versus a budget of \$2.506 billion).⁴³⁹ Accordingly, public debt consumes 20.6% of GDP in 2008.⁴⁴⁰ Access to improved water sources improved gradually over time (roughly 64% of the population had access to at least 20 liters of water per person per day from a source such as a household connection, public standpipe, borehole, etc. within one kilometer of one's dwelling).⁴⁴¹ These factors indicate that Uganda, though it has made improvements, needs development on many societal fronts: public health, economic, and infrastructural.

⁴³³ "Age Dependency Ratio (Dependents to Working-Age Population)." World Bank World Development Indicators Database (WDI). Creighton University Reinert Alumni Memorial Library. Omaha, NE.

⁴³⁴ CIA World Fact Book. Skyhorse Publishing: NY, 2008.

⁴³⁵ CIA World Fact Book. Skyhorse Publishing: NY, 2008.

⁴³⁶ CIA World Fact Book. Skyhorse Publishing: NY, 2008.

⁴³⁷ "Country Health System Fact Sheet 2006: Uganda." World Health Organization. 8 Jun. 2009.

<http://www.afro.who.int/home/countries/fact_sheets/uganda.pdf>.

⁴³⁸ CIA World Fact Book. Skyhorse Publishing: NY, 2008.

⁴³⁹ CIA World Fact Book. Skyhorse Publishing: NY, 2008.

⁴⁴⁰ CIA World Fact Book. "Uganda." Skyhorse Publishing: NY, 2008.

⁴⁴¹ "Improved Water Source (Percent of Population with Access)." World Bank World Development Indicators Database (WDI). Creighton University Reinert Alumni Memorial Library. Omaha, NE.

	Afghanistan	Marshall Islands	Uganda
Culture	Largely Pashtun and Tajik; over 30 languages spoken; hospitality and etiquette norms are strong	Strong community bonds; Strong Marshallese culture with German, Japanese, and American cultures mixed in	Over 30 languages spoken; gender inequality exists although women have more rights when compared to other African states
Religion	Vast majority Muslim - Sunni and Shia	Mainly Protestant; other: Christianity, Polynesian traditions remain	1/3 Roman Catholic; 1/3 Protestant; other - Islam, and local religious traditions
Organizational Patterns	Vary widely by culture and geographic region; polygamy allowed	Hawaiian/Polynesian kinship traditions; monogamy is primary marriage pattern	Polygamy allowed but monogamy more common; Patrilineal clan kinship
Perceptions of U.S.*	Unfavorable*	Favorable*	Neutral*
Societal Markers	Poor health care; high illiteracy; low rates of education, especially for females	67% urban; low access to clean water; relatively high life expectancy; low or at risk literacy rates	High HIV/AIDS rate as well as other diseases; low life expectancy; average 6 children per woman

Figure 23: CROPS TABLE

* Perceptions of the U.S. provided on this table are notional and not based on prior research. They are provided in order to illustrate how a CROPS table would look when an assessment was completed.

ECONOMIC CONSIDERATIONS

The Solow Growth Model and the VIKA

A primary issue in the economic consideration of a VIKA is the relatively low amount of disposable income held by the rural populations the VIKA would target. The question looms: “Can the U.S. receive any repayment for the initial investment of a VIKA from such poor populations?” After talking with Kristie Briggs, Ph.D., an international economics expert at Creighton University, the VIKA team came to the realization that a repayment method is not ideal and would be impractical in the real world under these conditions.⁴⁴² The cost of a VIKA should be at most \$40,000, as prescribed by the VIKA project’s customers. Per globalissues.org, “At least 80% of the world’s population lives on less than \$10 a day.”⁴⁴³ Hypothetically, given that a VIKA would most likely be targeted at part of that 80%, this means the VIKA requires enormous community commitment to finance. The likelihood of a community having the ability to pay any substantial part of its disposable income to finance access to these basic resources must in theory be slim.

Nonetheless, in principle, the VIKA proposes to create an opportunity for economic development. Accordingly, it is necessary to establish how the VIKA could facilitate development. If it can be considered that the VIKA technology is appropriate for a community, then theoretical models exist to prove that such technological growth enhances output and productivity.

⁴⁴² Briggs, Kristie. Personal Interview. 24 Apr. 2009.

⁴⁴³ Shah, Anup. “Poverty Facts and Stats.” [Globalissues.org](http://www.globalissues.org). 2 June 2009 <<http://www.globalissues.org/article/26/poverty-facts-and-stats>>.

A classic model of economic growth is Robert Solow's Growth Model. Solow posits that an economy can be represented by a production function. In this model, Solow proposes that the amount of capital and labor in the economy determines the nature of the production function:

$$Y = f(K,L)$$

Solow terms his production function in terms of output and capital per labor. If one divides each term in the function above by L, one would arrive at:

$$Y/L = f(K/L,L/L)$$

Since L/L is equal to one and the Y/L and K/L terms are commonly expressed as lower case variables, the function can be simplified to:

$$y = f(k)$$

Because the Solow Growth Model presupposes diminishing marginal productivity, the level of overall output per laborer will decrease as the amount of capital per laborer increases over time.

The law of diminishing marginal returns states that "if one input in the production of a commodity is increased while all other inputs are held fixed, a point will eventually be reached at which additions of the input yield progressively smaller, or diminishing, increases in output."⁴⁴⁴

Thus the graphical depiction of the level of production, according to Solow, in an economy appears as pictured in Figure 24.

⁴⁴⁴ "Diminishing returns." *Encyclopedia Britannica*. 19 May 2009
<<http://www.britannica.com/EBchecked/topic/163723/diminishing-returns>>.

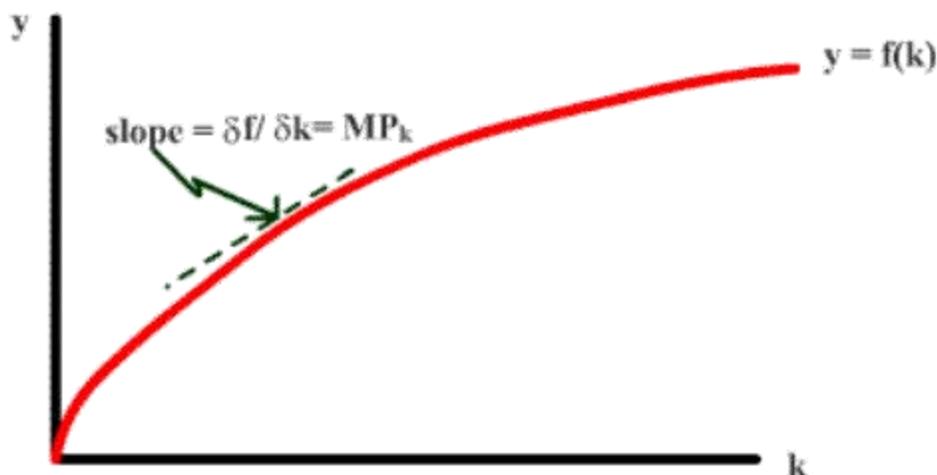


Figure 24: Solow Growth Model⁴⁴⁵

With every economy, there is supply and demand. The production function represents the supply in the economy. On the other hand, the demand function posits that the total amount of output in an economy is either consumed or saved (or invested):

$$y = c + i ; \text{ where } y = Y/L, c = C/L, i = I/L$$

Not all of the economy's output translates to savings. Figure 25 shows that because some consumption is necessary in the economy, the graphical depiction of the savings curve positions the savings function below the overall production function. The savings curve, like the production function, exhibits the same diminishing returns as the production curve because generally at increasing levels of output or income, people maintain a relatively consistent rate of savings. Hence, the graph would look like:

⁴⁴⁵ "Solow Growth Model." Iowa State University Department of Economics. 18 May 2009
<<http://www.econ.iastate.edu/classes/econ302/Alexander/Spring2006/SOLOW/SOLOWGROWTHMODEL.htm>>.

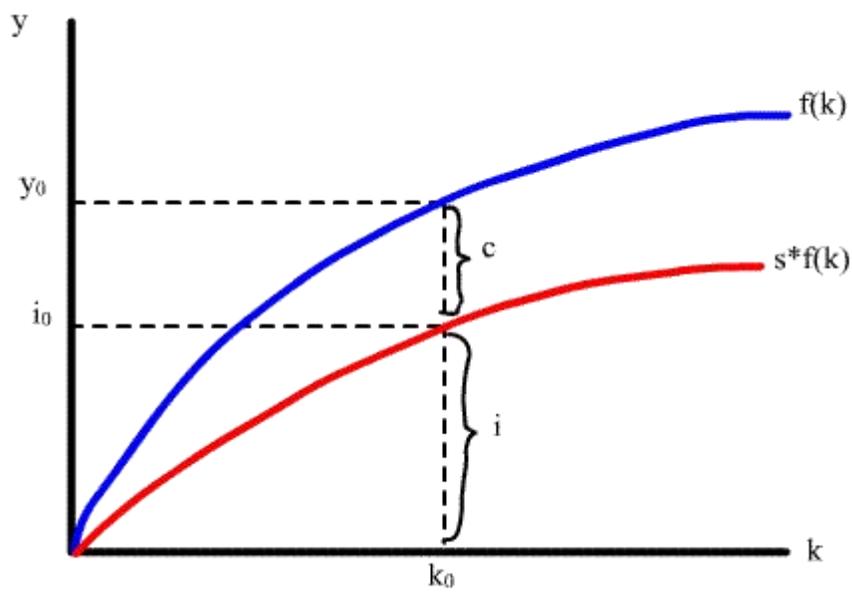


Figure 25: Solow Growth Model⁴⁴⁶

Another key component to consider is that over time, a certain amount of the capital stock wears out. One rate of depreciation exists for an economy, yielding the following depiction. Figure 26 depicts the production function is in red, the savings function is in blue, and the depreciation function is in pink.

⁴⁴⁶ "Solow Growth Model." Iowa State University Department of Economics. 18 May 2009
 <<http://www.econ.iastate.edu/classes/econ302/Alexander/Spring2006/SOLOW/SOLOWGROWTHMODEL.htm>>.

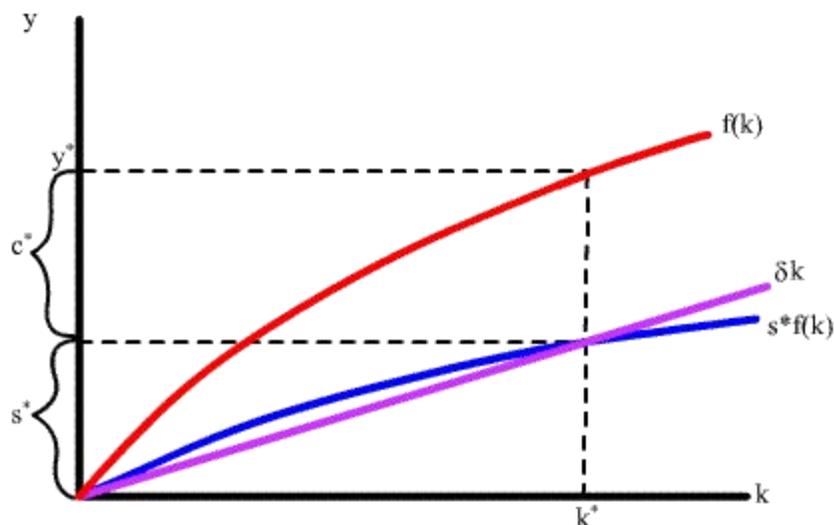


Figure 26: Solow Growth Model⁴⁴⁷

Inherent in this model is the concept of the steady state. The steady state in the previous graph is the point at which the depreciation curve intersects with the savings curve. This means no new capital stock is added to the economy over time because the amount of capital per laborer worn out is equal to the amount of capital per laborer contributed each period. The concept of the steady state may resonate with U.S. Department of Defense mentality that some destitute economies require significant initial investment to transcend the posited steady state. “Is there any way to keep growing? It turns out that there is – through improved technology... If that improvement permits faster investment growth, output per worker can continue to grow.”⁴⁴⁸ In the context of the Solow Growth Model, a VIKA serves as the appropriate technology to stimulate labor efficiency.

⁴⁴⁷ “Solow Growth Model.” Iowa State University Department of Economics. 18 May 2009

<<http://www.econ.iastate.edu/classes/econ302/Alexander/Spring2006/SOLOW/SOLOWGROWTHMODEL.htm>>.

⁴⁴⁸ Lynn, Stuart R. Economic Development: Theory and Practice for a Divided World. Prentice Hall: Upper Saddle River, New Jersey, 2003.

One example of increases in labor efficiency is in water collection methods. In Africa especially, limited access to water means that people of rural communities have to traverse great distances to obtain water. In a recent project in Ethiopia, “Women, who are responsible for taking care of their families, had to endure the hardship of travelling six to seven hours to the Dijo River, the only source of water during the dry season.”⁴⁴⁹ The community implemented a more accessible water system and charged users a flat fee for the water. The success of the system, as indicated by the growth of revenue from selling water at points closer to the population, denotes that the community achieved a measure of labor efficiency.

Within the context of the Solow Model, the technological innovation leads the economy to a state depicted in Figure 27.

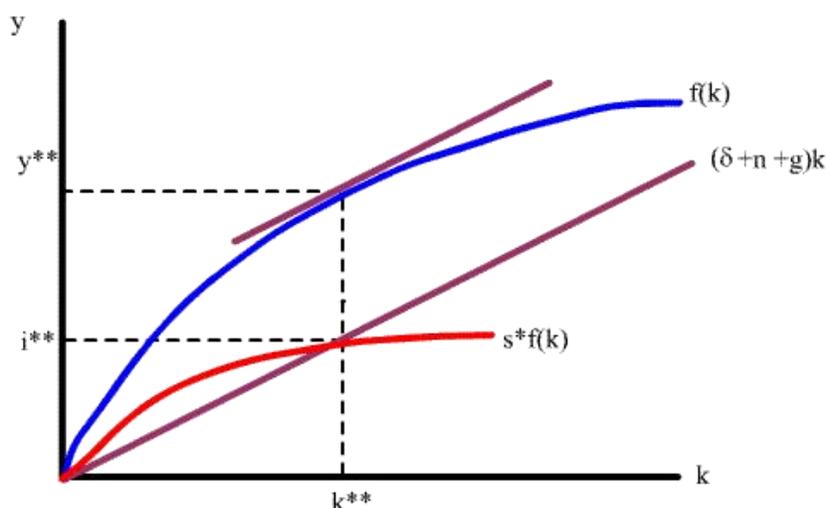


Figure 27: Solow Growth Model⁴⁵⁰

⁴⁴⁹ Michael, Helen A. & Gebra, Martha. “DWWDA: From water fetching towards managing.” 25th WEDC Conference, 1999. Integrated Development for Water Supply and Sanitation. Addis Ababa, Ethiopia, 1999.

⁴⁵⁰ “Solow Growth Model.” Iowa State University Department of Economics. 18 May 2009

<<http://www.econ.iastate.edu/classes/econ302/Alexander/Spring2006/SOLOW/SOLOWGROWTHMODEL.htm>>.

The economy has its steady state at a point where depreciation of capital stock, population growth, and technological innovation is equal to the amount of investment to the capital stock in a specified time period. Due to the influx of VIKA technology and factoring in the likelihood of population growth, productivity would increase. Community members would have more free time to pursue entrepreneurial activities, employment, or education. They would also have access to healthier water, more information via radio, telephone, or internet, and could potentially employ more electricity for educational purposes.

In short, the appropriate VIKA for a community, insofar as it would be a technological innovation, theoretically would enhance productivity. Productivity could potentially lead to an improved quality of life initially and if the appropriate conditions exist thereafter (e.g., availability of jobs, access to financial markets, and opportunity for education or vocational training, etc.) growth in income, human capital, and financial deepening could proceed from such innovation and heightened quality of life.

One prerequisite for growth to proceed in a fuller fashion is the maturation of financial markets. In development language, this would mean financial deepening, or, “An increase in the proportion of transactions that are accomplished through money, rather than subsistence consumption and barter.”⁴⁵¹ Indeed, some barter economies still exist that employ a means for exchange circumventing conventional currency. Following a recent article, a barter economy still thrives in Bolivia. Some of the locales waterlocked by Lake Titicaca in Bolivia, resident Leonardo Esteban says, are places where, “... ‘Very little money changes hands, and we continue trading fish for potatoes...the amount of food that can be held in two hands is the measure used

⁴⁵¹ Lynn, Stuart R. Economic Development: Theory and Practice for a Divided World. Prentice Hall: Upper Saddle River, New Jersey, 2003.

to negotiate the barter”⁴⁵² According to this tenet, places outside the scope of the financial system can still find ways to transfer value to one another. However, a currency and stable financial system enable more efficient transactions and access to the resources to undertake certain activities.

Areas the VIKA is targeting for this research project are Sub-Saharan Africa, South Asia, and islands in the Pacific. Ratios of money supply to total output exist in the World Bank’s World Development Indicators database to document how developed a region or country’s financial systems are. Figure 28, a graph of money and quasi-money as percentages of GDP, demonstrates how widely used money has been in these regions and the U.S. over time.⁴⁵³

⁴⁵² Chávez, Franz. “Bolivia: Aymara Traders Mix Tradition and Modern-Day Savvy.” Inter Press Service News Agency. 25 May 2009 <<http://ipsnews.net/news.asp?idnews=45162>>.

⁴⁵³ “Money and Quasi Money (M2) as Percentage of GDP.” World Bank World Development Indicators Database (WDI). Creighton University Reinert Alumni Memorial Library. Omaha, NE.

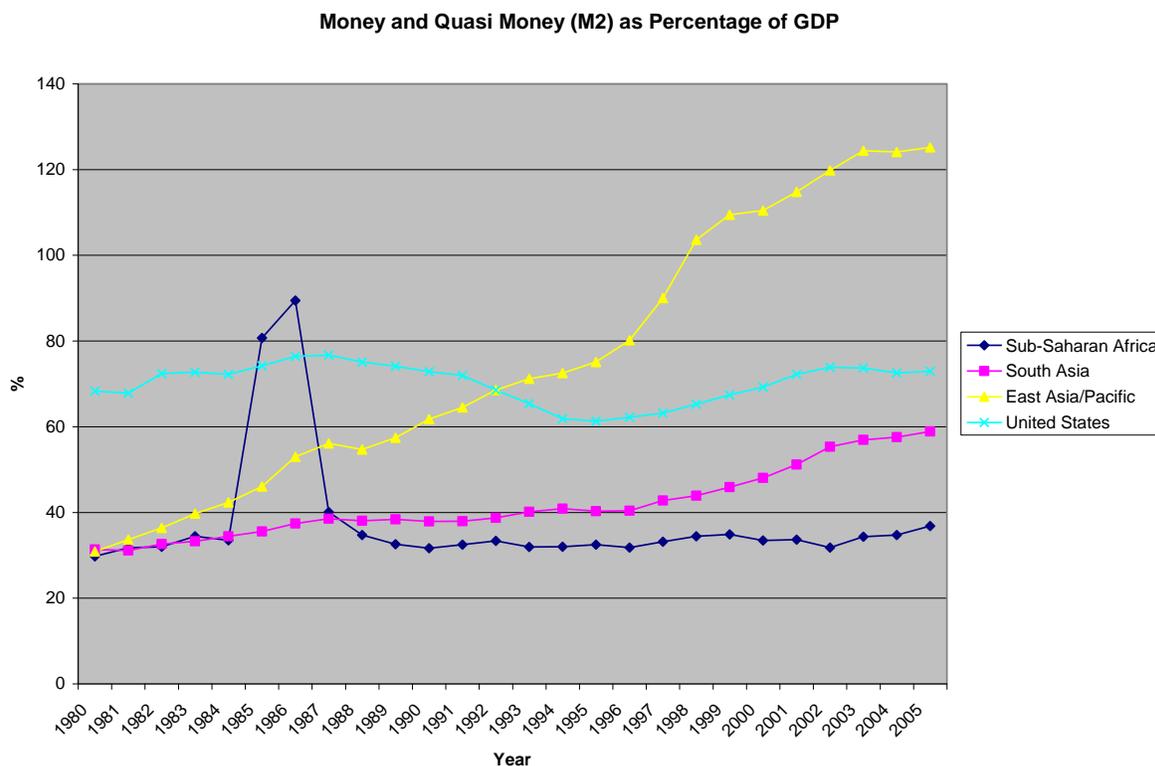


Figure 28: Money and Quasi Money (M2) as percentage of GDP

Easily visible are the trends in South Asia and East Asia (pink and yellow lines) that trend steadily upward over time. This indicates that citizens in these areas have gradually made greater use of money (currency, check deposits, traveler’s checks, savings, time deposits, and money market mutual funds) to complete transactions. However, Sub-Saharan Africa’s financial development has not followed the same progress as the other areas. Compared to how frequently U.S. citizens use money to complete transactions, these regions (except East Asia) generally have less developed financial systems and use money less often, at least in rural areas, to complete transactions.

At appropriate intervals, microfinance should be considered as a means to further an economy’s financial system. “These [microfinance] institutions make loans to borrowers who seek relatively

small amounts and who may be viewed as too risky by larger conventional lenders... The MFI [microfinance institution] clientele typically lacks either credit histories, or collateral, or both.”⁴⁵⁴

By enabling access to basic lines of credit for entrepreneurial ventures, a greater number of citizens can develop credit histories, collateral, and skills. These characteristics denote upward social and financial mobility.

The foremost example of success in microfinance is the Grameen Bank in Bangladesh. The VIKA team recommends that any microfinance institution be modeled off the successes experienced in Bangladesh. Supported by NGOs and the national government, about 95 % of Grameen’s two million members are women.⁴⁵⁵ The recipients of loan monies are channeled into small groups that hold each other accountable for paying their loans back. Future consideration for loans originates from being in good standing with regard to previous loans taken out with the bank. The normal interest rate for these loans is 16% and repayment schedules allow weekly installments. One survey, “...Credits the [Grameen] bank’s success to a culture of discipline and responsibility that is fostered within the groups and training and oversight of bank employees.”⁴⁵⁶ Microcredit seems to work well in part because of the risk of social ostracism for failing to repay the principal borrowed.

The VIKA’s ethnographic assessment team would provide for the most efficient integration of a basic microfinance system. The customers of the VIKA project desire full payback for the VIKA system. The targeted cost of the hardware of the system was initially identified as \$40,000 USD.

⁴⁵⁴ Caudill, Steven B, Gropper, Daniel M, & Hartarska, Valentina. “Which Microfinance Institutions Are Becoming More Cost Effective With Time? Evidence from a Mixture Model.” *Journal of Money, Credit and Banking*. 3 Jun. 2009 <<http://web.ebscohost.com.cuhs1.creighton.edu/bsi/pdf?vid=3&hid=9&sid=3c7ef316-2f86-404c-a69e-c2ef448c2ea7%40sessionmgr9>>.

⁴⁵⁵ Lynn, Stuart R. *Economic Development: Theory and Practice for a Divided World*. Prentice Hall: Upper Saddle River, New Jersey, 2003.

⁴⁵⁶ Lynn, Stuart R. *Economic Development: Theory and Practice for a Divided World*. Prentice Hall: Upper Saddle River, New Jersey, 2003.

The repayment structure may follow the notional VIKA repayment plan diagram shown in Figure 29.

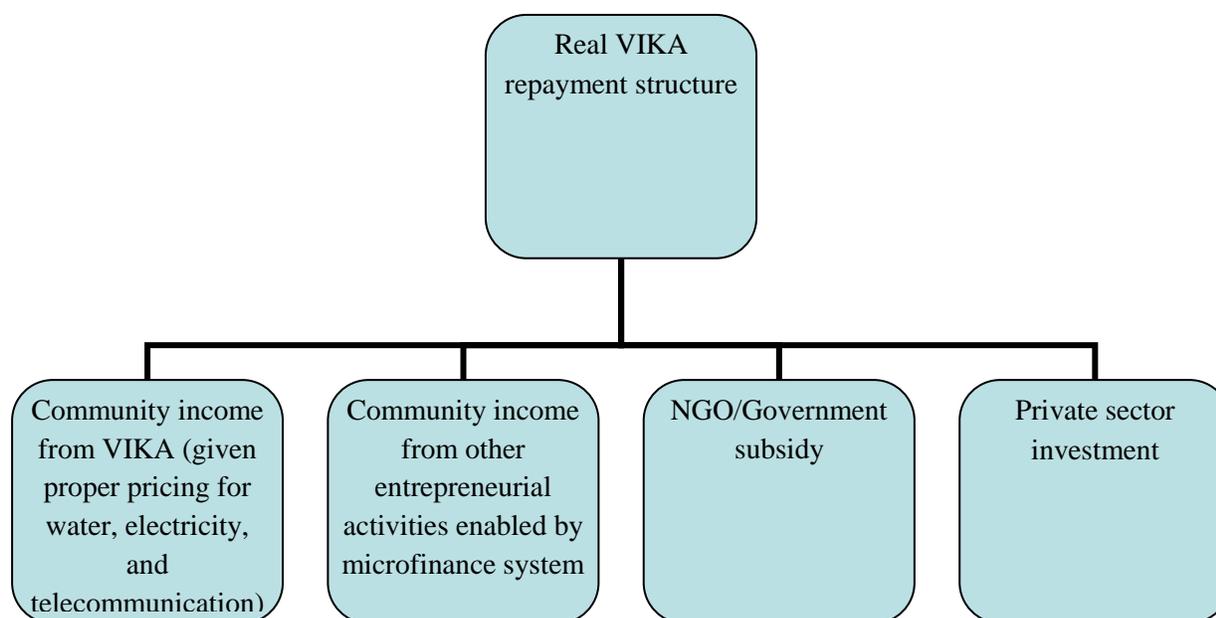


Figure 29: Notional VIKA repayment plan

Based on the premise that there is a high probability that many of the VIKA users would make less than \$10 USD per day, the assumption can be made that trying to ascertain full payback would be futile.⁴⁵⁷ In order to facilitate the process of the community taking financial ownership, not merely psychological ownership, over a VIKA, microfinance is essential. Such a system could help pool community resources to begin repayment for a VIKA and allot localities access to credit for other entrepreneurial activities whose income could supplement the ability to repay the principle borrowed. If a community places a significant investment towards the VIKA, then the community would theoretically have an incentive structure to maintain and protect a VIKA.

⁴⁵⁷ Shah, Anup. "Poverty Facts and Stats." [Globalissues.org](http://www.globalissues.org/article/26/poverty-facts-and-stats). 2 June 2009 <<http://www.globalissues.org/article/26/poverty-facts-and-stats>>.

Small group organizational structure may be beneficial in limiting free riders. Inevitably, people who do not undertake any of the costs associated with a VIKA could derive benefit from the public health improvements of a VIKA (e.g., less hazardous electrical generation at the household level, uncontaminated water, and etcetera). Organizing the community into small groups of borrowers may ensure better maintenance and management of a VIKA. The Grameen bank is one example of a microfinance organization, in which:

Groups of five prospective borrowers are formed; in the first stage, only two of them are eligible for, and receive, a loan. The group is observed for a month to see if the members are conforming to the rules of the bank. Only if the first two borrowers begin to repay the principal plus interest over a period of six weeks, do the other members of the group become eligible themselves for a loan. Because of these restrictions, there is substantial group pressure to keep individual records clear. In this sense, the collective responsibility of the group serves as the collateral on the loan.⁴⁵⁸

The Grameen Bank creates an atmosphere encouraging collective responsibility for individual action. If all members of a given locality can be incorporated into such a system, then few members could actually bypass placing some minimal investment in the system. The VIKA system, if it proves to be a more efficient way for people to obtain life's essentials, could attract migrant users not from the targeted village. A strategy, such as a small, baseline membership fee to obtain the VIKA's services, would need to be in place to ensure that these migrant users are

⁴⁵⁸ "Credit Delivery System." Grameen Bank: Banking for the Poor, 29 Apr. 2009.
<http://www.grameeninfo.org/index.php?option=com_content&task=view&id=24&Itemid=127>.

incorporated into the village repayment structure. Above all, measures can be taken to limit free riding.

Furthermore, the people may finance a VIKA and then still have to bear the burden of paying for water, electricity, and information access from a VIKA. Free vouchers for initial service could win greater acceptance and loyalty from the people who may be reluctant to pay for services from a VIKA system when there may already be ways, although perhaps strenuous and inefficient, to obtain basic services.⁴⁵⁹ In order to smooth the tension of paying the upfront and ongoing service cost, it would be best that the VIKA serves dire needs identified by the community. At the opportunity to accrue cash for some employment, the people of a village could want access to credit largely for activities that follow their own self-interests and not necessarily that of a VIKA. The VIKA system could realistically, by no choice of the local people, be an imposition of the U.S., simply because an area may be of strategic interest to the U.S. In earnest, the ethnographic assessment to determine a comprehensive VIKA system tailored to the village's needs must indeed only proceed with VIKA implementation if the general consensus of the community demands a VIKA.

On a practical level, community investment can occur from how the system is managed. A community decision-making panel would be efficacious. In a recent information and communication technology project in Mali, an NGO partnered with existing institutions (radio stations, Mayor's office, or etcetera) to jumpstart Community Learning and Information Centers (CLIC). The CLICs employed Consultative Committees that made important strategic and directional decisions for the CLIC. They were comprised of prominent members of the local

⁴⁵⁹ Tetelman, Mike. Personal Interview. 20 February 2009.

community, including local business leaders and individuals in public policy. Partly attributable to this community involvement, the CLICs achieved 25,000 single purchases of services at 13 separate CLICs in Mali between May 2004 and July 2005.⁴⁶⁰

An example of less human-intensive system management that reinforces community investment is the electronic bailiff units (EBUs) implemented in South Africa by affiliates of the Watery Program of the Alliance to Save Energy. According to Mike Rabe, who runs the Watery Program in South Africa, these systems function well on microcredit:

[These systems] work on credit...the EBU will only dispense water when there is credit on the token [a cheap, electronic token where users can purchase water credits from local vendors who then load the credits onto the token]...As water is being dispensed, credit on the token is automatically reduced according to the applicable tariff...⁴⁶¹

The result of this system was that over a course of three years, the South African community's acceptance rate of this system improved from 3% to 100%.⁴⁶² Such an efficient pricing strategy granted by this electronic hardware could potentially facilitate the means to develop a competitive market for water and ensure that each community member is paying a fair price for his or her water usage.

One of the potential threats during VIKa implementation is the creation of new markets or the disruption of established markets. A senior member of the Department of State, who spent time in development projects in Iraq, provided the following example. In one area of Iraq, U.S. parties

⁴⁶⁰ "Establishing Community Learning and Information Centers (CLICs) in Underserved Malian Communities." [Dot-com-alliance.org](http://www.dot-com-alliance.org/resourceptrdb/uploads/partnerfile/upload/338/Mali_CLICs_Final_Report.pdf). 30 Mar. 2009 <http://www.dot-com-alliance.org/resourceptrdb/uploads/partnerfile/upload/338/Mali_CLICs_Final_Report.pdf>.

⁴⁶¹ Rabe, Mike. Personal Interview. 30 Jan. 2009.

⁴⁶² Filippov, Alexander. Personal Interview. 19 Feb. 2009.

took the diligence to drill new wells to draw water from; however, without realizing that local sheikhs controlled the existing wells, U.S. forces experienced more attacks on resources. The sheikhs, perturbed by the competition from new wells, had subsequently influenced more attacks on U.S. forces. Once U.S. forces realized this was the case, they took steps to reconcile the situation.⁴⁶³ The relationship building and assessment for a VIKA should include careful analysis of who controls which resources, especially water, electricity, and telecommunications, if any of these infrastructures exist in the area. Anticipation of any conflict resulting from infringements on these existing power structures should be anticipated and circumvented.

To an even greater extent, how new markets may develop, either formally or informally, should be extrapolated upon. For example, a project in rural Nepal started in the 1960s, installed two water-driven turbines. Doing so provided a sustainable source of electricity, improved productivity in running mills that process agricultural products, and reduced usage of wood for fuel. The new market for electricity enabled income-producing activity and greater efficiency within the community.⁴⁶⁴ Having electricity and water can create labor markets (as some employment opportunities can originate from a VIKA, especially if it is managed locally) unfamiliar to the local community. If water credits become commonplace in the event that an electronic bailiff unit is installed, there could be a secondary market for trading water credits. These kinds of considerations are imperative to be factored into the ethnographic assessment. Otherwise, a VIKA could have wide-ranging ramifications if a VIKA upsets the community's idea of value (e.g., perceived unfair pricing, thriving black markets for water, electricity, and

⁴⁶³ Epstein, Stephen. Personal Interview. 20 February 2009.

⁴⁶⁴ Lynn, Stuart R. Economic Development: Theory and Practice for a Divided World. Prentice Hall: Upper Saddle River, New Jersey, 2003.

telecommunications, opportunity for theft of valuable VIKA hardware, and monopolistic competition).

Economically, it can be seen that appropriate technology leads to economic growth, the development of financial markets are imperative, community investment and autonomy is key, and consideration of new and existing market structures before VIKA implementation is prudent. The analysis and institution of these economic facets of community life should prepare an area for VIKA integration and success. The economic success of a VIKA denotes greater productivity, a more efficient allocation of resources than what already exists in the community, and an improved quality of life for VIKA users.

POLITICAL CONSIDERATIONS

Overview

Paying particular attention to the political makeup of potential partner nation-states is crucial for VIKA success. The design of government institutions and the relationships among them can directly impact the effectiveness and stamina of development and growth. As an example, “ in monarchies, military juntas, and many autocracies...only a small portion of the population has a chance of becoming influential in politics of gaining access to the benefits that involvement in politics can bring..”⁴⁶⁵ When power is concentrated in the hands of only few political leaders, citizens are discouraged from political participation, trust in the government, and cannot rely on the government to make quality public policies.

This is because governments that have small winning coalitions increase the likelihood of moral hazard, and corruption, which greatly degrades government accountability. A corrupt government with little to no checks on its powers has huge impacts on economic development. Political leaders are not obligated to make sound economic and social policies, due to a variety of institutional reasons.

A lack of quality policies results because leaders choose to use resources for personal gains and interests instead of responsibly allocating state resources towards public goods. These poor decisions go unchecked by society, which further diminishes the power of the populace in checking the government and maintaining democracy.⁴⁶⁶ Conversely, nation-states with lively

⁴⁶⁵ De Mesquita, Bruce, et al. “Political Competition and Economic Growth.” *Journal of Democracy* 12.1 (2001).

⁴⁶⁶ De Mesquita, Bruce, et al. “Political Competition and Economic Growth.” *Journal of Democracy* 12.1 (2001).

democracies often experience stronger growth, because its citizenry has a larger influence on political outcomes, which increases stability and investment. “Prosperity for the average citizen seems closely tied to democracy, and poverty to autocracy.”⁴⁶⁷

It is, therefore, paramount to understand that certain nation-states are not conducive to immediate and drastic economic development because of the nature of their governments. This has huge impacts for the potential effectiveness of the VIKA: in most of the partner nation-states there is a problematic cyclical relationship among the necessary components for development. For example, an underserved nation-state that seeks to develop a quality education system, first needs to educate its leaders and citizens to commence the process. It is often the case that these partner nation-states do not provide environments that sustain “national security, property rights, individual liberties, rule of law, public health, education and other social services.”⁴⁶⁸

Additionally, these nation-states do not have the institutional or capital means to efficiently achieve these qualities, both at the national and local levels.

Facing these political deficits, the VIKA implementation process could take into account the many different governmental issues that affect potential partner nation-states. The technology in the VIKA hardware selector creates the “opportunity” for development, but true growth beyond the VIKA requires bigger steps. “Physical progress like roads and schools do not provide villagers with a means of solving their own basic problems.”⁴⁶⁹ Therefore, to foster stability, the political environments into which the VIKA should be placed, must be handled with deliberate and mindful caution. Issues such as property rights, existing leadership positions, and the

⁴⁶⁷ De Mesquita, Bruce, et al. “Political Competition and Economic Growth.” *Journal of Democracy* 12.1 (2001).

⁴⁶⁸ De Mesquita, Bruce, et al. “Political Competition and Economic Growth.” *Journal of Democracy* 12.1 (2001).

⁴⁶⁹ Owens, Edgar & Shaw, Robert. *Development Reconsidered: Bridging the Gap Between Government and People*. Lexington Books: Lexington, MA, 1972.

networking of responsibility among national, regional, and local governments could all be considered to maximize the potential for development with the VIKA.

Property Rights

Secure property rights are one of the most recognized preconditions for development.⁴⁷⁰ When protected, property rights stimulate innovation, savings, and investment. Unfortunately, most of the nation-states that have need for a VIKA will most likely have minimally protected property rights as a result of many issues. Crime is a major force that detracts from the security of property rights. It is important to recognize that not only does crime discourage innovation, savings, and investment, but it also could directly pose a threat to the longevity of VIKA technology. Afghanistan is an excellent case-study example, in which crime, particularly theft, hinders communities' adequate use of technology and prospects for development.

Another threat to property rights is corruption and bias in the government. Nation-states that have insufficient police forces leave citizens unprotected from violence, theft, or fraud.

Similarly, judicial branches that rule with influence from personal relationships or political goals also undermine the fair application of law to legal issues, and make just protection of property unlikely. This leaves the facets of property rights, such as business contracts and personal investments, extremely vulnerable to the pervading corruption in government bodies.

Inadequate legal tools and corrupt government bodies contribute to the increased sense of uncertainty for a nation-states' people and their assets. Unfortunately, this threat to property rights is detrimental to the likelihood of growth occurring. Instability makes the cost of investing

⁴⁷⁰ North, Douglass C. Institutions, Institutional Change and Economic Performance. Cambridge University Press: New York, 1990.

and developing too high, for the low and risky returns. VIKA implementation must consider that a legally protected citizenry will greatly stimulate savings, investment, and productivity to contribute to development.⁴⁷¹

Relationships with the Village

One of the biggest misperceptions regarding development projects is that significant growth occurs in a single village without connecting it to the regional and national levels. However, a VIKA village must strive to build ties with other villages, as well as the regional and national governments, in order to make important political, social, and economic gains. “The atoms, that is the villages, cannot be modernized individually. Rather, part of the modernization process is linking them with the outside world- socially, politically, and economically.”⁴⁷² This insight has serious implications for the VIKA project in relation to the customers’ interaction with the village, as well as the village’s relationship with its own government and national government.

Regarding the customer’s relationship to the village, it is crucial to consider the importance of the village’s input on the implementation of the VIKA. Although it is essential that the customer plays an active role with the VIKA implementation to help, train, and suggest different strategies, a VIKA village may not be as successful in development if it does not have a sense of legitimate control over its own decisions and innovation.⁴⁷³ If the village plays a leading role in developing means for change and introducing the technology to the citizens, this may help tailor the VIKA to the specific, expressed needs and qualities of the village.

⁴⁷¹ North, Douglass C. Institutions, Institutional Change and Economic Performance. Cambridge University Press: New York, 1990.

⁴⁷² Owens, Edgar & Shaw, Robert. Development Reconsidered: Bridging the Gap Between Government and People. Lexington Books: Lexington, MA, 1972.

⁴⁷³ Owens, Edgar & Shaw, Robert. Development Reconsidered: Bridging the Gap Between Government and People. Lexington Books: Lexington, MA, 1972.

Acknowledging the village's legitimate power in the implementation of the VIKA may increase the likelihood that the citizens incorporate its technology into their daily lives, and induce the chances of development. However, this success also relies on a symbiotic relationship with the customer, which acknowledges that the village may need to make structural and logistical adjustments with outside assistance. It is important to help guide the village as a mentor to build the community instead of directing it. The villages clearly need to make important changes to stimulate growth, such as establishing problem-solving bodies and competitive leadership positions. But the community members need to come to understand and demand these conclusions on their own, before working together with the outside agents for change.

The agents of the customer could also help to set minimum performance standards of the recipient villages of the VIKA that should help the local officials regulate the use of the technology, and prevent abuses of power. For example, agents could help the village to coordinate a system of auditing, control water access, and determine a potential repayment system. It is paramount to remember the various cultural and economic considerations of each village when helping to implement a political and regulatory body. This should help to make the new system applicable to the norms of the village, but also introduce a newer system that has the necessary components to stimulate development.⁴⁷⁴

One of the biggest challenges to development is that citizens within many potential partner nation-states do not have the means for expressing and instigating demands for change. Citizens of villages need to be empowered both within their village and in the broader scope of the nation-state to stimulate development. First, the importance of a local problem-solving system

⁴⁷⁴ Owens, Edgar & Shaw, Robert. Development Reconsidered: Bridging the Gap Between Government and People. Lexington Books: Lexington, MA, 1972.

cannot be overlooked. In the village, the people need to participate in a system that may allow them to design their own solutions, solve technological issues, and demand new social and economic change, relative to their own societies. If the village does not have basic collective action tools, it will not independently participate, thrive, or develop politically, economically, or socially.

Also, the citizens of a VIKA village should have a participatory relationship with the national government. This capacity is essential for boosting the people's confidence in the central government, igniting a sense of national identity, and invigorating local innovation, which could lead to greater stability.⁴⁷⁵ When citizens are able to effectively organize demands at the national and grass-roots level, it may pressure the government to increase its commitment to democracy, good governance, and human rights. The ability to organize and have a reasonable influence on a nation-states' policies is important for government accountability and development because it serves as "counterweights to state power and alternative mechanisms to the state and markets for meeting people's needs."⁴⁷⁶

However, the capacity for participation and organization is predicated on the notion that there is a preexisting relationship among the local, regional, and national governments. However, this is most often not the case. In many underserved nation-states, there are massive disconnects among the relationships of the national, regional, and local governments. Many rural populations are so

⁴⁷⁵ Owens, Edgar & Shaw, Robert. Development Reconsidered: Bridging the Gap Between Government and People. Lexington Books: Lexington, MA, 1972.

⁴⁷⁶ Gellar, Sheldon. Democracy in Senegal: Tocquevillian Analytics in Africa. Palgrave Macmillan: New York, NY, 2005.

far removed from urban political centers that they receive no public goods, financial assistance, or logistical training to even allow for development.⁴⁷⁷

Many issues contribute to these poor national, regional, and local relationships, but they largely stem from a concept called the “policy deficit.” Nation-states that experience the policy deficit, often the ones which suffer the most from underdevelopment, face problems such as the inability to raise and allocate resources, the inability to develop adequate policy, and inefficiency in managing public projects.⁴⁷⁸ For development, villages could be involved in relationships with their national governments, which would oversee their local policy, fund village projects, but also acknowledge the importance of the independent participation and development of the village. This relies on establishing systematic linkages among the different government levels, which realistically divide the responsibilities among national, regional and local governments, such as collecting taxes and providing education.

“The art of organizing people lies in allowing decisions to be made at the appropriate level: national, regional, and local. Thus, allowing the diverse needs of smaller communities to be embraced within a broader and uniform national policy.”⁴⁷⁹ This requires a delicate balance of both being considerate of existing leadership positions and power structures, tailoring policy to local demands, receiving funding, and boosting government performance and initiative for public goods.

⁴⁷⁷ Owens, Edgar & Shaw, Robert. Development Reconsidered: Bridging the Gap Between Government and People. Lexington Books: Lexington, MA, 1972.

⁴⁷⁸ Hyden, Goran. African Politics in Comparative Perspective. Cambridge University Press: New York, NY, 2006.

⁴⁷⁹ Owens, Edgar & Shaw, Robert. Development Reconsidered: Bridging the Gap Between Government and People. Lexington Books: Lexington, MA, 1972.

Strategies

The VIKA project has many opportunities for political growth in partner nation-states. Combined with the advantages of sustainable technology, political considerations offer excellent chances for stimulating development and stability in village areas, and their national governments. Many organizations, which specialize in political development, could offer further important insight and assistance in these areas.

The VIKA project could team up with NGOs to assist the local and national governments to strategize methods for boosting grass-roots relationships, and addressing many policy and logistical issues such as budgeting, taxes, and accountability. It is important that the VIKA implementation recognize the cultural norms within the village's power hierarchy and decision-making bodies, while working as a guide for new political changes.

To facilitate a smooth transition, perhaps the VIKA implementation could include logistical training for community leaders in a legitimate governing body at the local level. Training could foster local ownership, leadership, and regulation, which increase the villages' capacity to independently solve collective choice issues and address economic and political concerns. Empowerment of the village and its leaders to competitively and actively participate in the village and at the national level could be a vital component for stimulating development in the VIKA villages.

LOGISTICS AND SUPPLY CHAIN

Training

Training and support prior to and during the deployment of the VIKA is essential. To be effective, training should be comprised of two facets: management of U.S. personnel, and local training. For the most part, U.S. training would be applied to U.S. technical and management personnel, whereas local training would focus on the population of users and operators to develop technical capabilities.

A training program would be essential to educate U.S. personnel on PMESII, CROPS, and other means of effective diplomatic implementation methods. These aspects are vital when considering if a VIKA may be accepted and efficient in a particular village. PMESII would be utilized for the initial evaluation of a village in its capability to encompass a VIKA. The CROPS assessment, a further analysis of the socio-cultural aspects of a society, would determine specific and individual concerns of how a VIKA would be successfully implemented into a village with an emphasis on the specific needs of that community. It is becoming ever more important that these factors are examined if any development project is to be successful. The training program would allow individuals to understand the importance of CROPS and how to use it when observing an underserved village.

Along with PMESII and CROPS, diplomatic implementation is necessary to increase the likelihood of success. Despite the opportunity for increased standard of living a VIKA would provide, the individuals assisting in the implementation process are still guests in the host country and society. For the efforts to be useful it is imperative to familiarize and adjust to the

socio-cultural norms and rituals of the village. This means diplomatically engaging with the village; not offending them by being ignorant of their customs, or insulting their current way of life. Many villages welcome any improvement, but not if the provider is offending or belittling them.⁴⁸⁰ A training program would allow the U.S. to educate personnel in these fields so they may be the initial village contact. This would offer the ability to gain trust and build relationships with a society in order to find out what they need or want, and what should be done for them to accept it. This may also require training local villagers on how to set-up, use, and maintain technologies that should be implemented as part of a VIKA.

Local Training and Support

Because solutions are customized to the local market and must be adopted by the population, local operators are the key to the success of any VIKA initiative. The required skills to maintain, configure, and repair technology contribute to the VIKA's long-term sustainability.⁴⁸¹ Thus, who deals with the VIKA is just as important as deploying the hardware solutions.

Assuming incentives for entrepreneurs are in place, recruiting main operators of equipment should be the priority. For example, n-Logue, an ICT initiative in India, has one of its local partners recruit its kiosk operators from the pool of graduates from India's technical institutes. Those operators are put through training and business advisory services, and have continued

⁴⁸⁰ Daweet. Personal Interview. 17 Apr. 2009.

⁴⁸¹ "IT Access for Everyone Initiative." World Economic Forum. 11 Feb. 2009
<<http://www.weforum.org/en/initiatives/itafe/index.htm>>.

access to additional support from the local connectivity service providers who “maintain access centers... and collect revenues.”⁴⁸²

The next topic concerns the types of training that are available to those community-operators. Will training be best taken face-to-face or remote? If there are available and technically proficient personnel on the ground that can communicate with the local operator, face-to-face is the best choice, as it offers real-time communication and higher efficiency in transferring information. However, if there is not on-the-ground availability, remote training reduces the need for staff and is more cost-effective in the form of self-help software or internet-based training courses; nevertheless, in regions where users are not technically proficient, or require initial help in deploying VIKa components, remote training will probably not be initially available.⁴⁸³ The problem with ongoing remote support is that it fails to build local capacity, ownership, and self-sustainability, until knowledge transfer takes place at the local level.⁴⁸⁴

The best solutions developed thus far include: conditioning the provision of technology on undergoing required training to configure and maintain the equipment, and transferring skills to other operators; flexible training over a variety of methods, such as workshops, TV-based distance learning, and virtual campuses; tracking and identifying operators who are having difficulties marketing or collecting payments, and providing support and help on a weekly face-to-face basis and providing a direct customer service facility.⁴⁸⁵ Initially providing quality support and training, and passing those skills onto local populations through face-to-face training

⁴⁸² “IT Access for Everyone – Global Benchmarking Study.” World Economic Forum. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

⁴⁸³ “IT Access for Everyone – Global Benchmarking Study.” World Economic Forum. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

⁴⁸⁴ “IT Access for Everyone – Global Benchmarking Study.” World Economic Forum. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

⁴⁸⁵ “IT Access for Everyone – Global Benchmarking Study.” World Economic Forum. 11 Apr. 2009 <http://www.weforum.org/pdf/Initiatives/Global_Digital_Inclusion_Benchmarking_Study_Jan05.pdf>.

appears to be the most effective methods of disseminating those skills to the local population, and should be provided accordingly.

Diplomatic Relations

The University of Southern California's Center on Public Diplomacy defines public diplomacy, as follows:

The transparent means by which a sovereign country communicates with publics in other countries aimed at informing and influencing audiences overseas for the purpose of promoting the national interest and advancing its foreign policy goals.⁴⁸⁶

Unquestionably, the VIKA program would entail multiple interfaces with the host government, NGOs, and the end user. With impending interactions along the VIKA supply chain with these organizations, relevant parties designated by a VIKA program must negotiate with the host government to efficiently offer the VIKA under the auspices of the U.S. government or people. Likewise, it needs to be assessed, if an NGO leads the implementation effort, how the U.S. can maximize the efficacy of the kit in terms of embedding enhanced perceptions of the U.S. at each level of society encountered in the VIKA supply chain.

In a speech at the 2009 Munich Conference on Security Policy, U.S. Vice President Joe Biden iterated the U.S.'s emphasis on diplomacy as a means to defend America's values and security.

Addressing the many foreign policy entanglements, Biden stated:

⁴⁸⁶ "What is Public Diplomacy?" University of Southern California. 9 Jun. 2009
<http://uscpublicdiplomacy.com/index.php/about/what_is_pd>.

Meeting these and other challenges of the new century takes more than defense and diplomacy; it also takes development. Poor societies and dysfunctional states...can become breeding grounds for extremism, conflict, and disease. Nondemocratic nations frustrate the rightful aspirations of their citizens and fuel resentment.⁴⁸⁷

Biden highlights defense, diplomacy, and development as means to advance U.S. national interests. Of strategic and national interest to the U.S. are the promotion of economic, political, and social stability and the prevention of terroristic and anti-U.S. sentiment, especially in a post-September 11th world. VIKA, insofar as it is a formidable component of the diplomatic toolbox seeking to accomplish the goals of foreign policy, can aid development and shape base-level perceptions of the U.S.

Representatives of the Department of State in the targeted country must manage the negotiations with the host government. Coordination among the embassies and consulates in the host government should facilitate the process of gaining legal approval to import a VIKA. Ideally, negotiations will allot the U.S. to import the VIKA duty-free and with minimal complications through customs.⁴⁸⁸ The embassy would then transfer the kit to the implementers, whether NGOs or organizers branching out from a U.S. consulate.

NGOs are vital to VIKA implementation. All the same, the U.S. still wishes to benefit from increasingly positive shifts in how other populations interpret the U.S. image. If NGOs are the primary implementers of a VIKA, how will this method of management support enhanced

⁴⁸⁷ Kellerhals Jr., Merle D. "Biden Lays Out U.S. Foreign Policy Goals, Approaches." [America.gov](http://www.america.gov). 9 Jun. 2009. <<http://www.america.gov/st/peacesec-english/2009/February/20090128091910dmslahrellek0.7426264.html>>.

⁴⁸⁸ Baldinger, Pamela. Personal Interview. 28 May 2009.

perceptions among the local peoples? Transforming the VIKA into an official diplomatic tool of the U.S. could mean simply branding the VIKA with an emblem like that of USAID that communicates the kit is from the American people.

In the end, it is ideal that VIKA users inextricably identify the VIKA as a genuine U.S. investment in the society's capacity to determine its own well-being. In theory, if local peoples make this association, then more positive sentiments towards the U.S. should come about.

There are processes in place in the Department of State to measure public opinion. Polling efforts to research changes in U.S. perceptions in VIKA areas could be magnified for more acute measurements of progress on this strategic goal. Though the Department of State's budget is already constrained, pressures to increase funding for the Department of State come from major reports such as the Defense Science Board Task Force on Strategic Communication. This study recommended that funding for the Department of State's public diplomacy activities be tripled, meaning that increased efforts on opinion research could be soon enabled.⁴⁸⁹

The VIKA ethnographic assessment team is another measure of assurance that the sentiment towards the U.S. remains positive. Participant observation is a specific means for getting an accurate vision of what the community is truly lacking. Greg Mortenson, executive director of the non-profit Central Asia Institute, performed such an ethnographic assessment when he stumbled into a rural village in Pakistan after a failed attempt to climb a large Himalayan mountain. Upon seeing that the village shared a teacher with a neighboring village and the deficiency of educational resources, Mortenson said, "I felt like my heart was being torn out.

⁴⁸⁹ Vitto, Vincent. "Report of the Defense Science Board Task Force on Strategic Communication." Office of the Under Secretary of Defense For Acquisition, Technology, and Logistics. 9 June 2009. <http://www.acq.osd.mil/dsb/reports/2004-09-Strategic_Communication.pdf>.

There was a fierceness in their [Pakistani villagers] desire to learn, despite how mightily everything was stacked against them...I knew I had to do something.”⁴⁹⁰ By being a part of this society for a short time, Mortenson was able to identify a serious demand in the community. In addition, he developed a working relationship with the community that improved his access to serve the demand. VIKA team members on the ground can work to build relationships by becoming a part of the normal course of life in the community. As representatives of the U.S., they can work to erode negative perceptions. Doing so can ease VIKA integration and assist people in associating that a VIKA is directly from the U.S. and not a gift of an NGO or a host government.

Above all, diplomacy will be important from the national-level to the local level. Attention to how a VIKA communicates information about the U.S. at each level should in turn yield valuable data on how much impact a VIKA has in generating positive U.S. sentiment. The project customers want the strategic goal of the VIKA to be deterrence via stability, economic development, and generating an overall more positive U.S. sentiment. Water, energy, and telecommunications could help areas stabilize and develop economically, politically, and socially. As a diplomatic package, coupled with an assessment team and sponsored by Department of State consulates and embassies, it could also influence attitudes towards the U.S. Positive perceptions could contribute to deterrence, as fewer people in these rural areas would be fueled by dissatisfaction with the U.S. to engage in violent action against the interests of the U.S. These communicative, diplomatic activities along the VIKA supply chain serve to advance national interests and support successful VIKA implementation.

⁴⁹⁰ Mortenson, Greg & Relin, David. Three Cups of Tea. Penguin Group: New York, 2006.

Transportation

Information related to transportation was shared with the team during a conference call with Rick Boyle, Vice President of Maersk Line Limited.⁴⁹¹ Maersk Line Limited supports military and humanitarian missions by transporting cargo on its many types of ship. Currently, Maersk Line Limited is the largest U.S. flag fleet in international trade.⁴⁹² For the purpose of this section, the types of maritime transportation that will be presented are break bulk vessels and shipping container. In addition, alternate methods of transportation outside of maritime travel will be discussed as well as the potential to work with other organizations, the stabilization of cargo, the reuse of containers, and additional considerations.

The three types of economic transportation commonly used for transporting humanitarian aid are break bulk vessels and shipping containers (by means of maritime transport), and helicopters. Break bulk vessels are typically used to transport extremely large items such as trucks, and to transport food or grains. Disadvantages to using break bulk vessels include the following; they tend to be costly; deliver only to coastal regions; are less stabilized and “loosely” packaged cargo might move around (could cause damage); are more vulnerable to theft than other forms of transportation; and they are required to move a high volume of cargo in order to actually be economical. In comparison, the average size of a shipping container is 20 to 40 feet and looks similar to the back of a semi-truck. An advantage to using shipping containers is they make it possible to move cargo to inland locations. As for non-maritime transportation, the helicopter is

⁴⁹¹ Boyle, Rick. Personal Interview. 12 Mar. 2009.

⁴⁹² “Home: U.S. Flag Transportation Services.” Maersk Line, Limited. 13 May 2009
<www.maersklinelimited.com/transportation>.

generally used to transport smaller, more immediately used aid, such as tents, blankets, and medicine.

In order to most efficiently and economically transport humanitarian aid, it is often useful and even encouraged to work with other organizations. One notable organization known for its work transporting humanitarian aid is USAID. To obtain a close estimate of shipping costs, it can be helpful to reference USAID's website; after a bid has been accepted, that is where the costs are published. A specific example of USAID's work is the Denton Program, which is a program that ships, on average, 300 tons of aid yearly. Unfortunately, the Denton's Program's schedule is quite rigid, and therefore their ships cannot always go where aid is immediately needed. In general, the use of NGOs is encouraged as they often have the capabilities to handle and transport the aid to remote destinations once it has reached the general location via ships.

Other important considerations that will likely vary significantly depending on the region where aid is needed are laws and regulations, the use of ports, the size, weight, and scope of the effort to transport aid, the road systems, local environments, and product stability. It is necessary that these aspects be researched extensively prior to the dispersal of aid because they do contribute greatly to the overall success of transporting humanitarian aid.

Laws and regulations generally affect the type of aid that can go into a specific country or region. For instance, one detriment to not having a clear understanding of prohibited items is that organizations providing humanitarian aid risk spending large amounts of money on aid that cannot be legally or safely used. In terms of laws and regulations, it is also important to keep in mind that aid is often subject to customs; however, in some cases certain types of aid may be given preferential treatment. In addition, the U.S. Coast Guard prohibits the shipment of

dangerous chemicals near food and the placement of two or more items that are ignitable or combustible when placed near each other.⁴⁹³ The Intergovernmental Maritime Consultative Organization (IMCO) provides a list of specific laws and regulations regarding the legal and safe transportation of goods.

Similarly, the use of non-U.S. ports is important to consider because the U.S. does not own or have access to every port around the world. Also, because certain shipping organizations have contracts with specific ports, it is usually best to choose the shipping organization that has the best relationship with the port closest to the region where aid is needed. Such an approach can reduce travel time and other fees, which can significantly affect the cost of transportation, as well as increasing the likelihood of potentially establishing trust and familiarity.⁴⁹⁴

More obvious considerations that can affect the cost of transporting humanitarian aid are size and weight of the cargo. First, the use of break bulk vessels, shipping containers, and helicopters will depend on the size and weight of cargo, as well as the time frame in which the aid is needed. As mentioned earlier, certain means of transportation are more costly than others, and vary in the time it takes them to arrive at a destination. Before choosing a specific means of transportation, it is important to research the size and scope of the projects they usually do. For example, Maersk Line Limited handles cargo as small as three shipping containers and as large as 500 shipping containers with an average weight of 18,000 metric tons to 25,000 metric tons, and a maximum of 45,000 metric tons. Also, costs can depend on a number of factors, and depending on the organization, costs are usually kept confidential.

⁴⁹³ Swerczek, Tony. Personal Interview. 12 Mar. 2009.

⁴⁹⁴ Luhmann, Niklas. "Familiarity, Confidence, Trust: Problems and Alternatives." [SIECI.PJWSTK](http://sieci.pjwstk.edu.pl/media/bibl/%5BLuhmann%5D_%5BFamiliarity%20Confidence%5D_%5BTrust%5D_%5B1988%5D.pdf). 15 May. 2009
<http://sieci.pjwstk.edu.pl/media/bibl/%5BLuhmann%5D_%5BFamiliarity%20Confidence%5D_%5BTrust%5D_%5B1988%5D.pdf>.

Moving the cargo from a ship to a remote destination can create additional problems. For instance, dense forests, underdeveloped roads, and the non-existence or lack of roads can make it seem nearly impossible to get humanitarian aid to its destination. A solution to this in the past has been to put cargo in smaller containers which can sometimes be more easily moved by trucks, local transportation systems, carried by foot, and etcetera. However, no matter what medium is chosen to transport humanitarian aid, it is important that package stabilization be taken into account. Knowing product information such as fragility can be useful when deciding on its packaging and its placement. In general, shipping across ocean is reliable, but it is important to keep in mind that it is usually quite turbulent. Materials that are packaged and placed appropriately in all methods of transportation are more likely to arrive to their destination with little or no damage. In order to decrease the chances of unexpected costs by having to replace damaged or stolen materials, it is encouraged to purchase some form of insurance.

Finally, there are various populations of individuals who are accustomed to using the very last bit of a raw or produced material, which to others might be considered waste. For example, it is common for packaging material to be used for other reasons than which it was intended, such as building material.⁴⁹⁵ As a result, consider using packaging materials and containers that can be used by the community after its purpose of transportation.

The specific type of transportation used to move any kind of aid is a function of size, weight, and scope of project. These criteria in addition to any third party involvement will contribute significantly to the final cost. Always keep in mind that security, safety, distribution, and each region's specific laws and regulations can significantly affect how transportation is carried out.

⁴⁹⁵ Epstein, Steven. Personal Interview. 20 Feb. 2009.

COLLABORATION WITH IGOs AND NGOs

As discussed briefly in the CROPS section of this paper, it is important to partner with NGOs and IGOs for various reasons. NGOs working in all areas of the world deal with issues ranging from disease and poverty to war and genocide, and are often the first line of aid for citizens in dire need of assistance, particularly in nations where economic development is slow or stalled.⁴⁹⁶ NGOs that are neutral in terms of religion, politics, or any other agenda are particularly useful because they are typically viewed as entering a foreign state free of ulterior motives.⁴⁹⁷

Many NGOs also have long-term relationships established with the nations in which they provide assistance,⁴⁹⁸ particularly with the current government of that nation. Although there are some examples of NGOs being forced out of a country by the government leaders, such as Doctors without Borders (MSF) from the Sudan in March of 2009, there are many more instances in which the NGO is a welcome partner.⁴⁹⁹ MSF itself sees great successes and acceptance in several countries other than Sudan.⁵⁰⁰ Partners in health functions in some of the poorest nations in the world, and the Bill and Melinda Gates Foundation has become one of the most effective benefactors of global aid in our modern history, just to name a few.^{501 502} In order to best demonstrate the usefulness of cooperating with NGOs when implementing a VIKA, the work of these three organizations will be examined more thoroughly.

⁴⁹⁶ Orbinski, James M.D. "An Imperfect Offering: Humanitarian Action for the Twenty-First Century." Walker Publishing Company: New York, NY, 2008.

⁴⁹⁷ "About MSF." Doctors Without Borders. 14 Mar. 2009 <<http://www.msf.org/msfinternational/aboutmsf/>>.

⁴⁹⁸ "About MSF." Doctors Without Borders. 14 Mar. 2009 <<http://www.msf.org/msfinternational/aboutmsf/>>.

⁴⁹⁹ Gottlieb, Sebastian. "Doctors Without Borders kicked out of Sudan" Radio Nederland Wereldomroep. 2 Apr. 2009 <<http://www.rnw.nl/internationaljustice/icc/Sudan/090311-msf-sudan>>.

⁵⁰⁰ "About MSF." Doctors Without Borders. 14 Mar. 2009 <<http://www.msf.org/msfinternational/aboutmsf/>>.

⁵⁰¹ Kidder, Tracy. Mountains Beyond Mountains. Random House: New York, NY, 2003.

⁵⁰² "Global Success Stories." The Bill and Melinda Gates Foundation. 11 April 2009 <<http://www.gatesfoundation.org/Pages/home.aspx>>.

MSF has been doing humanitarian aid work since 1971. Now on the ground in over 70 countries, it has one of the greatest success rates of any similar organization, but has also dealt with numerous political problems with development in underserved countries.⁵⁰³ For example, even as a politically and religiously neutral organization, founder James Orbinski stated that, “I learned that even for the neutral and impartial humanitarian, politics matters, and matters a lot.”⁵⁰⁴ As a result of often convoluted and misguided politics, the organization was most recently banned from providing aid in the Sudan after an arrest warrant for President Omar al-Bashir was issued in March of 2009.⁵⁰⁵

Despite having to leave the millions of Sudanese citizens behind, MSF retains its presence elsewhere in Africa. In the most recent edition of an MSF publication, *Alert Quarterly*, an article appeared on Somalian refugees in Yemen. According to the article entitled “Yemen: Refugees Risk Everything to Leave Somalia,” more than 7,000 people escaped by boat from Somalia to the coast of Yemen in 2007 alone, reporting that there were often over 100 people packed on a craft made for less than 30. The same article states that, “The number of arrivals in January 2009 was 20 percent higher than at the same time last year.”⁵⁰⁶ In response to the need for medical care and other services, MSF now has contacts along the coast of Yemen who notify medical practitioners when new refugees arrive.

⁵⁰³ “About MSF: The MSF Role in Emergency Medical Aid.” *Doctors Without Borders*. 14 Mar. 2009. <http://www.msf.org/msfinternational/invoke.cfm?objectid=130CB2BA-E018-0C72-097046C7C42A8573&component=toolkit.indexArticle&method=full_html>.

⁵⁰⁴ Orbinski, James M.D. “An Imperfect Offering: Humanitarian Action for the Twenty-First Century.” Walker Publishing Company: New York, NY, 2008.

⁵⁰⁵ Gottlieb, Sebastian. “Doctors Without Borders kicked out of Sudan” *Radio Nederland Wereldroep*. 2 Apr. 2009. <<http://www.rnw.nl/internationaljustice/icc/Sudan/090311-msf-sudan>>.

⁵⁰⁶ “Yemen: Refugees Risk Everything to Leave Somalia.” *Alert Quarterly*. 9 Mar. 2009. <<http://doctorswithoutborders.org/publications/alert/articlefull.cfm?id=3483&cat=alert-article>>.

A second medically-oriented NGO, Partners in Health (PIH), is a non-profit NGO founded by Dr. Paul Farmer in Haiti in 1987, and that has since spread to eight other sites in Haiti and five additional countries around the world.⁵⁰⁷ With a strong foundational emphasis on research, education, and training programs, the main goal of the organization is to provide free, quality health care to the most destitute populations on Earth. PIH also partners with the Program for Infectious Disease and Social Change from the Department of Global Health and Social Medicine at the Harvard Medical School, the Division of Global Health and Equity at the Brigham and Women's Hospital, and the François-Xavier Bagnoud Center for Health and Human Rights at the Harvard School of Public Health.⁵⁰⁸

The initial, or flagship project, of PIH still exists today in Zamni Lasanti, Haiti. According to the organization's official website, the project in Haiti is, "the oldest, largest, most ambitious, and most replicated [project]...featuring a 104-bed, full-service hospital with two operating rooms, adult and pediatric inpatient wards, an infectious disease center, an outpatient clinic, a women's health clinic, ophthalmology and general medicine clinics, a laboratory, a pharmaceutical warehouse, a Red Cross blood bank, radiographic services, and a dozen schools."⁵⁰⁹ Similar facilities now exist in Peru, Russia, Rwanda, Lesotho, Malawi, and the U.S.

While PIH is a controversial organization with a history of pressuring anyone from drug manufacturers to lobbyists and beyond,⁵¹⁰ its contributions to humanity cannot go underestimated. Aside from providing healthcare and other basic human services, PIH functions

⁵⁰⁷ "History." Parterns in Health. 23 Apr. 2009 <<http://www.pih.org/who/history.html>>.

⁵⁰⁸ "History." Parterns in Health. 23 Apr. 2009 <<http://www.pih.org/who/history.html>>.

⁵⁰⁹ "Haiti." Parterns in Health. 23 Apr. 2009 <<http://www.pih.org/who/history.html>>.

⁵¹⁰ "Haiti." Parterns in Health. 23 Apr. 2009 <<http://www.pih.org/who/history.html>>.

on the premise that there must be a paradigm shift in global relations. Creator Dr. Paul Farmer stated:

Fifty years ago, the door to greater involvement was opened by Article 25 of the Universal Declaration of Human Rights, which underlined social and economic rights: ‘Everyone has the right to a standard of living adequate for the health and well-being of himself and his family, including food, clothing, housing, and medical care and necessary social services...’⁵¹¹

This emphasis on basic human rights, including those that a VIKA could provide, approached from a stance of political and religious neutrality makes MSF and PIH ideal NGOs to partner with. Both have well-established frameworks for entering a country, region, or village, and uses social science methodologies in order to find the greatest need and create a viable solution.⁵¹²

Among its many ventures around the world, the Bill and Melinda Gates Foundation, often known simply as the Gates Foundation, is providing library services, reading classes, and technological training to the most underserved areas of Bangladesh where an estimated 20 million people lack clean water, electricity, and telephone services.⁵¹³ In addition, Bangladesh is one of the worst hit countries in South Asia with tuberculosis, diarrheal diseases, and malaria. Issues with poverty, natural disasters, and child malnutrition only add to the health problems in the tiny coastal country.⁵¹⁴ It has long been believed that one of the most effective ways to increase health is to strengthen the economy of a region and promote development. However, the staggeringly low

⁵¹¹ Farmer, Paul. Pathologies of Power: Health, Human Rights, and the New War on the Poor. University of California Press: Berkeley, CA, 2005.

⁵¹² Farmer, Paul. “The Uses of Haiti.” Common Courage Press; Monroe, Maine. 2006.

⁵¹³ “Rivers of Technology: How Boats are Bringing Libraries to Rural Bangladesh.” Bill & Melinda Gates Foundation. 15 Apr. 2009 <<http://www.gatesfoundation.org/atla/Pages/rural-libraries-on-boats-in-bangladesh.aspx/rural-bangladesh-boat-atla-2005>>.

⁵¹⁴ “Bangladesh.” World Health Organization Countries. 20 Apr. 2009 <<http://www.who.int/countries/bgd/en/>>.

literacy rates, at less than one third of the adult population being able to read at a 5th grade level in both rural and urban Bangladesh make sustainable development nearly impossible.⁵¹⁵

In an effort to improve economic and political conditions, the Gates Foundation intervened in Bangladesh using the very rivers and coastal routes that flood seasonally, ruining any chances for development, to get to the poorest villages to teach reading and computer classes. They use boats, which serve as the classrooms and anchor at the crumbling docks in the villages, using generators and solar energy to power mobile phones and computers with internet access.⁵¹⁶ Other boats arrive later, offering training on many topics, which according to the Gates Foundation include, “literacy, agricultural practices, and microenterprises, all businesses started by poor people in the developing world.”⁵¹⁷

As a result of their work, the people of rural Bangladesh trust and depend upon the volunteers of the Gates Foundation. The relationship being built there is one that will likely last a very long time, as the foundation often sees huge development projects through from start to finish.

Partnering with the Gates Foundation to implement VIKAs throughout rural Bangladesh will likely bring energy, water, and telecommunications services to some of the most impoverished regions of South Asia, in a shorter amount of time than if the U.S. had to build a relationship on its own.

Working through NGOs may allow the U.S. to take advantage of the existing relationships without needing to take extra time to develop new trust relationships in order to gain entrance

⁵¹⁵ “Country Health System Profile: Bangladesh.” World Health Organization Regional Office for South East Asia. 10 Apr. 2009 <http://www.searo.who.int/EN/Section313/Section1515_6922.htm>.

⁵¹⁶ “Rivers of Technology: How Boats are Bringing Libraries to Rural Bangladesh.” Bill & Melinda Gates Foundation. 15 Apr. 2009 <<http://www.gatesfoundation.org/atla/Pages/rural-libraries-on-boats-in-bangladesh.aspx/rural-bangladesh-boat-atla-2005>>.

⁵¹⁷ “Rivers of Technology: How Boats are Bringing Libraries to Rural Bangladesh.” Bill & Melinda Gates Foundation. 15 Apr. 2009 <<http://www.gatesfoundation.org/atla/Pages/rural-libraries-on-boats-in-bangladesh.aspx/rural-bangladesh-boat-atla-2005>>.

and acceptance. Then, via cooperation with an NGO, a diplomatic relationship between the U.S. and the partner nation is likely to develop over time.⁵¹⁸ The NGOs mentioned here are only three of the hundreds that the U.S. could consider working with in order to ensure a more successful implementation of the VIKA.

In addition to NGOs, there are also numerous IGOs to consider. One of the most experienced IGOs for this type of project is USAID, the United States Agency for International Development. According to a statement on their official website, “USAID is an independent federal government agency that receives overall foreign policy guidance from the Secretary of State... [USAID] supports long-term and equitable economic growth and advances U.S. foreign policy objectives by supporting economic growth, agriculture and trade, global health, and democracy, conflict prevention and humanitarian assistance.”⁵¹⁹

In order to fulfill this goal, USAID partners with numerous organizations including universities, private industry, volunteer organizations, international agencies, and local or indigenous organizations. They currently report having over 3,300 working relationships with American companies and voluntary organizations.⁵²⁰ Furthering their success, USAID has divisions in the U.S., Sub-Saharan Africa, Asia, Europe, Eurasia, Latin America, the Caribbean, and the Middle East.⁵²¹ USAID provides expertise in many areas including international development, global health, and child malnutrition, making it one of the most expansive and diversified IGOs in the U.S.

⁵¹⁸ Doh, Jonathan P., Teegen, Hildy, & Vachani, Suchil. “The Importance of Nongovernmental Organizations (NGOs) in Global Governance and Value Creation: An International Business Research Agenda.” Questia: Trusted Online Research. 18 Mar. 2009

<[http://scholar.google.com/scholar?hl=en&q=author:%22Teegen%22+intitle:%22The+Importance+of+Nongovernmental+Organizations+\(NGOs\)+...%22+&um=1&ie=UTF-8&oi=scholar](http://scholar.google.com/scholar?hl=en&q=author:%22Teegen%22+intitle:%22The+Importance+of+Nongovernmental+Organizations+(NGOs)+...%22+&um=1&ie=UTF-8&oi=scholar)>.

⁵¹⁹ “This is USAID.” About USAID. 20 Mar. 2009 <http://www.usaid.gov/about_usaid/>.

⁵²⁰ “This is USAID.” About USAID. 20 Mar. 2009 <http://www.usaid.gov/about_usaid/>.

⁵²¹ “Locations” USAID. 15 Feb. 2009. <<http://www.usaid.gov/locations/>>.

TESTING

As a means to determine the most beneficial way to implement a VIKA, a testing schedule has been developed to allow for trial runs before a VIKA is introduced to an underserved population. This simulation allows for any problems in the supply chain to be worked out before a VIKA program is fully functional. This developmental two stage process is critical to understand all elements of a successful implementation.

Stage 1

Stage One of VIKA testing would be an internal supply chain test within the U.S. to provide feedback on the Hardware Selector (VHS) and distribution center, therefore an actual VIKA implementation would not take place in this stage. In order to test the supply chain a series of characteristics for a hypothetical area would be inserted into the VHS, which would compute a package ID for the VIKA most fitting that area. The components of this specific package would be sent to the procurement warehouse where the VIKA would be constructed and prepared for shipping. The VIKA would then be transported to its departure location. Afterwards, the kit would be shipped to the appropriate continent, but for the practicality of this stage, a shipment should be sent to the desired location within the U.S. Testing in the U.S. allows for close examination of the efficiency of the supply chain, and quick fix of problems.

Stage 2

Stage Two of VIKA testing is a case study on implementation, or flagship model, of a VIKA to gauge its success rate when all aspects are taken into consideration. This would consist of a full-

fledged VIKA effort before a program would be established. Besides functioning technology this includes socio-cultural concerns and society assimilation to the VIKA. It is recommended that this flagship model allot for ample time to receive feedback on each step in the process and fix them as they are being implemented. The following timeline is a tentative progression for this flagship model. Based on the results of the model, the timeline ought to be scaled accordingly to reflect more accurate accounts of implementation timeliness. Additionally, the VIKA testing model is based on the Millennium Villages, which are in the process of implementing a similar schedule and based on the feedback and responses of their plan, the VIKA can change accordingly.⁵²²

Key Steps for Years 1 and 2:

1. Recruit staff: This should include two sets of staff, an immersion team that will be assisting in the implementation of the project in the host country and a local team that will be the support and logistics committee for the immersion team. Each team should have a coordinator that will lead the group, and varying expertise to cover a wide variety of needs.
2. Perform PMESII and CROPS analysis: A thorough investigation of the country and its means of operating. This is a pertinent time for staff to become familiar with the inner workings of the village and country as a whole.

⁵²² “Millennium Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach.” Millenium Villages. 3 Mar. 2009. < Villages Handbook: A Practitioner’s Guide to the Millennium Villages Approach>.

3. Coordinate with IGO/NGO: Find organizations that have already built relationships in the specific region and already have expertise working with the culture. These partnerships will be extremely important for initial contact with the village and continual support.
4. Build relationship within host village: Before entry into the village, a bond and trust relationship must be built in order to maintain creditability and begin fostering development.
5. Determine Needs: After relationships with community leaders have been developed it will be extremely important to determine the specific needs of the community, not what the U.S. believes will be most beneficial.
6. Implementation Plan: The teams collectively should develop an individualized implementation plan for the next five years based on the PMESII and CROPS analysis as well as the responsiveness of the host country.
7. VIKA Hardware Selector (VHS), Package ID, Shipping: Enter the specified geographical conditions of the region into the VHS to determine appropriate hardware for the region, the distribution center should then locate the correct matches for the package ID, which is then loaded and shipped to its destination.
8. Implementation and Training: When the community is ready, the new technologies should be implemented into full-functional form. This is should be accompanied by a thorough training process and mechanisms to build community ownership.
9. Assessment: An ongoing assessment of the process should be evaluated and community feedback will be necessary to continually increase the value of the program. After the final assessment the immersion team should return to the U.S. to report findings and debrief.

10. Continual Support: The local IGO/NGO's should maintain the relationships and support on the ground. This will assist in prohibiting destruction, improper use, as well as maintenance of the hardware after the team has returned to the U.S.

RECOMMENDATIONS

After extensive research into the hardware, socio-cultural aspects, and associated factors related to a VIKA, the team determined the following recommendations were necessary in order to ensure successful implementation of the VIKA:

Utilize the VIKA hardware selector to determine optimal technology for water, energy, and telecommunications needs in order to increase efficiency and decrease manpower. Especially in times of crisis, such as a natural disaster, when time is undoubtedly of the essence, a program like the Hardware Selector could save time, money, and most importantly, lives. Future additions to the VIKA could include cultural and political aspects of a society, as well as livestock needs.

Incorporate the socio-cultural concerns presented in CROPS to effectively implement the VIKA on a case-by-case basis. Due to the dynamic nature of each individual society, a one-size-fits-all approach to the VIKA will not likely be successful. While the PMESII analysis is effective and has been used by the U.S. Air Force for years, the research team recommends a more detailed approach to socio-cultural aspects of any society in order to create a better fit between the society and the VIKA.

Analyze existing economic and political conditions of nation, state, and village to develop strategies for implementation, and understand the crucial importance of generating community ownership of VIKA technology, which may be done through methods such as micro financing. In order for the VIKA to fully succeed and spur development, it is crucial to examine the existing political and economic conditions in order to develop proper strategies. Creating community

ownership of the VIKA through microfinance is also important, as it can generate a new means of exchange and open the door to further development.

Prepare the necessary logistics and supply chain to allow for quick implementation of the VIKA.

As the VIKA may be used in numerous geographic locations and for varying purposes, it is important to have a centralized procurement warehouse and a tested supply chain for fast and reliable implementation.

Increase the effectiveness of the VIKA by collaborating with U.S. governmental agencies and non-governmental organizations. IGOs and NGOs have been on the ground establishing relationships with underserved nations for decades. The U.S. should attempt to use those preexisting relationships by working through these organizations.

Summary of Recommendations

- Utilize VIKA Hardware Selector to choose proper technology
- Incorporate CROPS analysis to supplement success of VIKA
- Analyze existing economic and political conditions of state and village
- Generate community ownership with methods such as micro finance
- Establish an efficient supply chain to ensure quick implementation of VIKA
- Cooperate with U.S. government agencies and NGOs to sustain implementation

FURTHER RESEARCH

There are many additional topics that should be addressed for the success of the VIKA and future development projects. Future projects could research the specific legal and regulatory restrictions of partner states that pertain to water, energy and telecommunications. These laws could limit U.S. access to the country or determine local ownership of the VIKA. It is important to investigate a variety of repayment methods for the VIKA that are tailored to both socio-cultural norms and the need for an incentive structure. After testing, it is necessary to determine the limitations of the VIKA. This may allow the promotion of continued research and problem-solving to produce the most effective VIKA. Additionally, exploring the development process of the VIKA, and how it might work to transition from a VIKA village to sustainable long term growth. Lastly, examine how the US could encourage the increased development in the market for sustainable technology, especially so that it can better incorporate domestic technology into the VIKA.

Summary of Further Research

- Research the regulatory environment of partner states
- Investigate the effectiveness of potential repayment plans
- Determine the limitations of the VIKA after testing
- Explore the potential transition from VIKA to long-term national growth
- Examine how the U.S. could promote increased development in sustainable technology

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ABOUT THE AUTHORS

Nicholas Arreola is currently a graduate student at the University of Nebraska Omaha working on a Master's degree and then Ph.D. in industrial and organizational psychology. Originally from South Sioux City, Nebraska, he moved to Omaha five years ago to attend college. For the last couple of years, he has volunteered for various political campaigns, the Nebraska AIDS Project, and other service-oriented projects. Currently, he is active in two research groups in the Psychology Department at UNO. Last spring, Nick was fortunate to have received two scholarships including one for research and the other for academic performance and involvement in extracurricular activities. Outside of work and school, he enjoys spending time with friends and family, traveling, and discovering new things.

Ryan Bouckaert is a senior economics major in the College of Business Administration at Creighton University. At Creighton, he has become involved in Youth Leadership Omaha, which is a program that puts on a series of leadership-oriented seminars for a selected group of high school sophomores. For an econometrics class this past semester, he analyzed the effect of the number of police officers on crime in major metropolitan areas. His past work experience includes being an underwriting intern for a Berkshire Hathaway-owned insurance company, a runner for a corporate law firm, and a lawn mowing professional. He has recently had the honor of winning an intramural co-ed volleyball championship and participating in the Omaha half marathon this past September.

Ashlie Franz is a senior at Creighton University majoring in International Business and Marketing. During her sophomore year Ashlie had the opportunity to study abroad in Madrid, Spain. Throughout this period she was able to broaden her business knowledge and gain a better

understanding of the global world. The time spent in Madrid, Spain allowed her to enhance her interest in new cultures and expand her social skills by meeting a variety of individuals from across the world. Additionally, she is a member of Pi Beta Phi sorority and J. Mark Integrated Marketing Association. She is currently the Vice President of Finance in both organizations, which have given her an appreciation for the time and commitment it takes to manage a large number of people. Ashlie is also an active member in her community, in which she annually organizes and participates in the Susan G. Komen Race for the Cure and Relay for Life.

Rachel Huggins is from Alma, a small town in western Nebraska on the Harlan County Reservoir. Prior to this she lived in Rifle, Colorado and Edmond, Oklahoma. She is currently a junior at Creighton University where she recently decided to study political science and business administration. At Creighton, she is a member of the Creighton Students' Union Program Board and Kappa Kappa Gamma Sorority. In her spare time, Rachel enjoys listening to music, reading, writing, running, gymnastics, and watching old movies.

Carrie Lacy is an active member of the UNO Sociology/Anthropology Department as a second year graduate student. She currently serves as the Vice President of the Student Anthropological Society, the Assistant to the AKD Alpha Chapter Advisors, and a voting member of the UNO Sociology Club. Her current research focuses on Epidemiology, Alternative Medicines, Environmental Conservation, and the Development of Sociological Theory. Most notably, she recently took 2nd Place at the Nebraska Undergraduate Sociological Symposium for her work on curing Tuberculosis in South Asia. Her academic and career goals involve conducting research and proposing strategies to aid in curing contagious diseases and preserving crucial environmental resources, and someday working for the Center for Disease Control and the World Health Organization.

Hailey Rademacher is a junior at Creighton University, majoring in International Relations and French. She grew up in Seattle, Washington, and loves to ski and camp. Last semester she lived in Washington, DC, completing an International Law and Organizations Program with American University. After completing her Bachelor's degree, Hailey hopes to go into international law. After French, she plans (optimistically!) to learn Spanish, Chinese, and Arabic. Her favorite reading materials are J.D. Salinger, E.E. Cummings, John Irving, Chuck Palahniuk, Harry Potter, and The Economist. She loves to go to concerts, meet people from around the world, read, play volleyball with her sisters, and explore.

Charline "Charlie" Ticknor, who was born and raised in Omaha, Nebraska. Charlie is a graduate of UNO with a Bachelor of Science in Biotechnology and a minor in Chemistry. She intends to pursue a Master's Degree; however, she hasn't narrowed her vast interests to a single field of study. In the meantime, she started learning Spanish, and wants to continue with French. She loves learning new skills and enjoys most anything that inspires a rush of adrenaline. She is an avid cyclist anytime of the year the thermometer reads 40 or more degrees, and relies on her bicycle for transportation as much as possible. This coming summer, she and a friend will ride and camp the 1200+ miles along the west coast from Vancouver, Canada to San Francisco, CA. Aside from traveling and camping, she enjoys reading books, painting and photography, cooking for friends and family, snowboarding in Colorado, and sleeping in.

Jessica S. Tok is a licensed attorney who serves with the U.S. Strategic Command. She holds a Bachelor of Science of Biological Sciences, a Juris Doctor of Law, and an LL.M. in Space and Telecommunications Law (expected), from the University of Nebraska. Her specializations include space law and cybersecurity law, and her LL.M. thesis dealt with the comparison of the arms traffic control laws, e.g., ITAR/Wassenaar, between the United States and European Union.

During law school, Jessica clerked for the U.S. Army and U.S. Air Force Judge Advocate General (JAG) Corps., was a research assistant to several distinguished professors, including Professor Dr. Frans von der Dunk, the preeminent space law scholar, and held an internship with Hon. Laurie Smith Camp of the U.S. Federal District Court - District of Nebraska, aside from her work with the U.S. Strategic Command Global Innovation and Strategy Center. In conjunction with her assistantship, Jessica served as the Editor of “Asteroid Threats: A Call for Global Response,” a policy document released by the Association of Space Explorers. Written by a multidisciplinary group of international United Nations dignitaries, ambassadors, scientists, astronauts, and cosmonauts, it detailed the need to create a multilateral decision protocol with regard to cosmic threats. She also helped organize the University of Nebraska’s “Near-Earth Objects: Risks, Responses and Opportunities” Conference in 2009. In her personal life, Jessica enjoys traveling both domestically and internationally, speaks several languages conversationally, and enjoys collecting art.