"Using Economic Modeling to Prioritize Infrastructure Development Projects to Achieve Afghanistan's Socio-Economic and Political Goals."

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ABSTRACT:
The international community is investing billions of dollars to create the basis for a future Afghanistan that is secure, politically stable, and meets the educational, medical, and socio-economic needs of its people. International efforts include both military operations to achieve security, and aid efforts to rebuild or construct basic infrastructures, promote education, provide medical support, and promote economic development in legitimate market activities. The basic infrastructure needs alone exceed available funding. Afghanistan's future depends on maximizing these international investments to achieve optimal political, social, and economic returns on investment. This paper discusses how economic modeling can be used to calculate expected returns on infrastructure investments in terms of regional economic growth, education, household income, and healthcare, and enable prioritization of infrastructure projects based on optimal returns in socio-economic performance.

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1.0 INTRODUCTION

Military battlefield victory rarely translates to winning the post conflict peace. The ultimate test of victory is the compassion that a victor displays toward quickly reestablishing the vanquished state as a viable partner. Central toward this strategy is the utilization of all elements of national power that is: diplomatic, informational, military and economic. Economic power is the most important of the four elements, but one must carefully tailor it to support the development goals of the indigenous population, rather than the victor. Implementing a recovery strategy is a matter of life and death for both individuals and the state. Inherent in this process is the simultaneous synchronization of economic interaction of externally supported activities with the internal goals for economic infrastructure development. Traditionally, this has been done subjectively, but with integrated economic modeling we propose a quantitative approach to predict the best reconstruction strategy to improve the vector and impact of the money spent, "the best bang for the buck". Simulations and modeling systems can focus on both metrics in peace operations and determine the relative worth of activities for proactive humanitarian assistance and evaluate objectives. While we are developing Bayesian probability trees to prioritize the correct implementation of resources to ensure the best timely execution.

At present, the most serious threat to securing Afghanistan's future is the failure of international partners to provide the promised donor assistance. The *Afghanistan National Development Strategy* requires total funding of $50 billion between 2008 and 2015, $43 billion in donor assistance and the remaining $7 billion from the Islamic Republic of Afghanistan's budget.[3] The International Monetary Fund and International Development Association note that this is approximately $18 billion more than donors may provide.[4] The funding shortfall for the 2009-2010 budget is approximately $3.2 billion.[5]

In this paper we discuss the use of integrated economic modeling to prioritize reconstruction projects to achieve the maximum level of rapid economic growth within the limited resources available. We developed the Integrated Investment Prioritization Model to combine economic modeling with System of Systems Analysis and Bayesian probability trees to identify those projects which return the greatest degree of rapid economic growth. Economic growth is critical to providing a revenue source for the Government of the Islamic Republic of Afghanistan to continue to fund socio-economic, and infrastructure programs on its own.

Despite the billions of dollars the international community has invested into the reconstruction of Afghanistan, the per capita Gross Domestic Product (GDP) remains just

[3] Islamic Republic of Afghanistan. 2009. Afghanistan National Development Strategy First Annual Report. http://imf.org/external/pubs/ft/scr/2009/cr09319.pdf

[4] International Monetary Fund and the International Development Association. 2008. *Islamic Republic of Afghanistan Joint Staff Advisory Note on the Poverty Reduction Strategy Paper*. http://siteresources.worldbank.org/INTPRS1/Resources/Afghanistan_JSAN-PRSP(May15-2008).pdf

[5] Islamic Republic of Afghanistan. 2009. Afghanistan National Development Strategy First Annual Report. http://imf.org/external/pubs/ft/scr/2009/cr09319.pdf

US$500.[6] While the GDP has grown substantially, more than a third of this growth is the result of foreign aid as is shown below in Table 1.0.

The Government of the Islamic Republic of Afghanistan's long-term goal is to create a secure, stable nation with a strong economy that can provide basic services for its people without dependence on foreign aid.

Table 1.0 Afghanistan's Foreign Aid and Gross Domestic Product Trends[7]

Year	Foreign Aid	Aid Growth From Prior Year	GDP	Aid As A Percentage Of GDP
2000	$135,970,000	-	-	-
2001	$404,640,000	66%	$2,461,638,802	16%
2002	$1,300,490,000	68%	$4,387,847,002	30%
2003	$1,590,700,000	18%	$4,762,517,011	33%
2004	$2,169,220,000	27%	$5,729130,575	38%
2005	$2,750,380,000	21%	$6,851,669,702	40%
2006	$2,999,410,000	8%	$8,186,204,489	37%
2007	$3,951,080,000	24%	$10,169,548,111	39%

After thirty years of war, Afghanistan's needs range from providing basic services to eradicating illegal narcotics trafficking, providing security, reforming government, and spurring economic growth. Afghanistan took important steps towards addressing these needs through its work with international partners in the formation of the *Afghanistan National Development Strategy*[8]; *Securing Afghanistan's Future: Accomplishments and the Strategic Path Forward*[9]; and the *Afghanistan Development Forums of 2003, 2004, 2005, and 2007.*[10] These documents lay out a clear set of goals with defined milestones, the challenge is meeting these milestones quickly enough to improve the lives of the Afghanis to maintain their support for the reconstruction. Noticeable and rapid improvement is necessary to maintain a consensus for reform and meet the expectations and commitments of the differing segments of Afghan society.

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[6] CIA. 2010. The World Factbook. https://www.cia.gov/library/publications/the-world-factbook/geos/af.html

[7] World Bank. World Development Indicators Database. http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20535285~menuPK:1192694~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html

[8] Islamic Republic of Afghanistan. 2008. *Afghanistan National Development Strategy 2008-2013.* http://www.ands.gov.af/

[9] Islamic Republic of Afghanistan. 2004. *Securing Afghanistan's Future: Accomplishments and the Strategic Path Forward.* A Government/International Agency Report. http://www.adb.org/Documents/Reports/Afghanistan/securing-afghanistan-future-final.pdf

[10] Islamic Republic of Afghanistan. 2003. *Afghanistan Development Forum*
Islamic Republic of Afghanistan. 2004. *Afghanistan Development Forum.*
Islamic Republic of Afghanistan. 2005. *Afghanistan Development Forum.*
Islamic Republic of Afghanistan. 2007. *Afghanistan Development Forum*
http://www.ands.gov.af/ands/Provincial_Consultations/details.asp?id=47&sn=1&psn=0&awareness=1&national=expanded

In 2003, 53 percent of the population lived below the poverty line. Much of the population, not just those living in poverty, lacked access to clean drinking water, electricity, transportation and paved roads. Basic services were available to only 10 percent of the population.[11] Today, approximately 23 percent of the population has access to safe drinking water and only 10 percent to sanitation. Tables 2.0 and 3.0 below depict the status of basic infrastructures post-invasion and the development goals that are planned for 2015.

Table 2.0 Infrastructure Status and Goals[12]

Government Infrastructure	2003	2015
Paved roads	16 %	48%
Motor vehicles per 1,000 people	13.71	40
Buses per 1,000 urban population	0.06	0.30
Electricity access to national grid	6 %	33%
Urban electricity access to national grid	27 %	89 %
Countrywide natural gas access	8 %	42 %
Population with basic services	10 %	100 %
Kabul water supply coverage	20 %	80 %
Kabul sanitation coverage	20 %	80 %

Table 3.0 Social Goals[13]

Social Indicators	2003	2015
Poverty (rural)	53%	21%
Population below min level of dietary energy consumption	70%	35%
Male Literacy (age 15 and older)	43%	56%
Female Literacy (age 15 and older)	14%	56%
Primary school enrollment males	67%	100%
Primary school enrollment females	40%	100%
Infant mortality per 1,000 births (2001)	165	55
Under-five mortality per 1,000 births (2001)	257	130
Maternal mortality (per 100,000)	1600	205
Measles cases per year	718	0
Polio cases per year	10	0
Malaria (% at risk)	16%	8%
Tuberculosis cases per year	321	48
Access to safe drinking water	13%	80%

[11] Islamic Republic of Afghanistan 2005. Accelerating Infrastructure Development. Draft for Discussion at ADF 2005. http://www.ands.gov.af/admin/ands/documents/upload/UploadFolder/%5CNDF%202005%20-%20Theme%201%20-%20Accelerating%20Infrastructure%20Development.pdf

[12] Islamic Republic of Afghanistan 2005. Accelerating Infrastructure Development. Draft for Discussion at ADF 2005. http://www.ands.gov.af/admin/ands/documents/upload/UploadFolder/%5CNDF%202005%20-%20Theme%201%20-%20Accelerating%20Infrastructure%20Development.pdf

[13] Islamic Republic of Afghanistan. 2004. *Securing Afghanistan's Future: Accomplishments and the Strategic Path Forward.* A Government/International Agency Report. http://www.adb.org/Documents/Reports/Afghanistan/securing-afghanistan-future-final.pdf

Achieving economic growth in an agricultural based economy where forty percent of the 15 million strong workforce is unemployed is challenging. Although agriculture represents 52 percent of the GDP, 70 percent of the population consumed less than the minimal dietary energy intake in 2003, and the goal for 2015 would only reduce that number to 35 percent. Twelve percent of the land is arable and less than six percent of the arable land is under production.[14] The sector is largely under developed with little use of machinery, chemical fertilizers, or pesticides, and irrigation networks are limited. Limited irrigation puts agricultural production at great risk during droughts such as that ending in 2009, which slowed economic growth to just 2.3%.

Industry constitutes 24 percent of the GDP and consists of small-scale production and mining. The industrial sector is very undeveloped with few modern facilities. The service sector contributes the remaining 24 percent of the GDP and includes transport, retail, and telecommunications.

Limited use of technology and machinery in the agricultural and industrial sectors, and limited transportation and information technology assets in the service sector suggests all of these areas of the economy are ripe for investment and development. Integrated Investment Prioritization Model results suggest that there are significantly different performance responses across provinces. For example, increased agricultural production may not translate directly to increased economic growth as the food is consumed by under-nourished subsistence farmers, rather than sold. This is not to say that feeding the hungry is without benefit. Additionally, districts in the Hindu Kush region lack accessibility to markets. Security and political instability hamper much needed foreign investment in the industrial sector. These factors that vary by province and even district emphasize the need for prioritization of investments that goes beyond simple economic modeling.

Implementation of the *Afghanistan National Development Strategy* is supported by a combination of internal government funding and external support through international donors. The intent is to reduce the need for international aid by stimulating economic growth. The nation's development strategy is based on achieving an increase in GDP per-capita to US $500 in a narcotics free economy by 2015. While Afghanistan would remain a poor country this would achieve acceptable, visible economic and social progress for most Afghanis.

An annual growth rate of nine percent is required to achieve a per-capita GDP of US$500. The growth rate of 9 percent is arrived at based on the need for a 3 percent growth rate in order for the populace to experience visible improvements in their living conditions. As the population is expected to rise 2 percent per year, a total of a 5 percent growth rate is needed. Illegal narcotics constitute a large portion of the economy, and the goal is to eradicate illegal narcotics while also growing the legitimate economy. Based on these goals, in order for the total economy (drugs included) to grow five percent

[14] US Department of State. Nov 2008. *Background Note: Afghanistan.* Bureau of South and Central Asian Affairs. http://www.state.gov/r/pa/ei/bgn/5380.htm.

annually, while eliminating the drug economy over time, a total non-drug growth rate of 9 percent annually is needed through 2015.[15]

Table 4.0 below shows the projected economic growth goals necessary to create a stable Afghanistan that can support itself and meet the basic needs of its people. Table 5.0 shows the actual growth that has occurred.

Table 4.0 Economic Development Goals[16]

GDP (USD Million)	**2003**	**2004**	**2005**	**2006**	**2010**	**2015**	**2011-15**	**2004-15**
Non-drug GDP	4,868	5,428	6,085	6,744	9,886	14,454	12,510	9,618
Drug related income	2,449	2,262	2,075	1,888	885	-	367	1,103
Growth (%)	**20**	**11**	**12**	**11**	**9**	**8**	**8**	**9**

Table 5.0 Actual Economic Growth

FISCAL YEAR	**2004/05**	**2005/06**	**2006/07**	**2007/08**	**2008/09**
GDP Growth (%)	8.8	16.1	8.2	11.5	3.4

These are very aggressive growth goals in a nation where economic growth is limited by security concerns; lack of a skilled workforce; lack of basic infrastructures such as electricity, water, and transportation; lack of foreign investment; weak regulatory institutions; and corruption. Despite these obstacles, impressive growth has occurred. Progress is expected to slow as the easiest problems have already been resolved. Stabilization objectives are moving aid into the East and South where development objectives are relatively harder to achieve, and beginning in the 2009-2010 fiscal year, international aid donors failed to provide $3.2 billion of the pledged external budget resources.

Given the likely shortfall in external funding, how can Afghanistan secure its future? This paper discusses the use of the Integrated Investment Prioritization Model to prioritize investments made by the U.S. Department of Defense (DOD), the International Security Assistance Force (ISAF), and the U.S. Agency for International Development (USAID) in terms of their ability to generate rapid economic growth. Economic growth is even more critical now as the entire National Development Strategy rests on strong economic growth to bridge the loss of international donor funding.

[15] Islamic Republic of Afghanistan. 2004. *Securing Afghanistan's Future: Accomplishments and the Strategic Path Forward.* A Government/International Agency Report. http://www.adb.org/Documents/Reports/Afghanistan/securing-afghanistan-future-final.pdf

[16] Islamic Republic of Afghanistan. 2004. *Securing Afghanistan's Future: Accomplishments and the Strategic Path Forward.* A Government/International Agency Report. http://www.adb.org/Documents/Reports/Afghanistan/securing-afghanistan-future-final.pdf

2.0 THE INTEGRATED INVESTMENT PRIORITIZATION MODEL

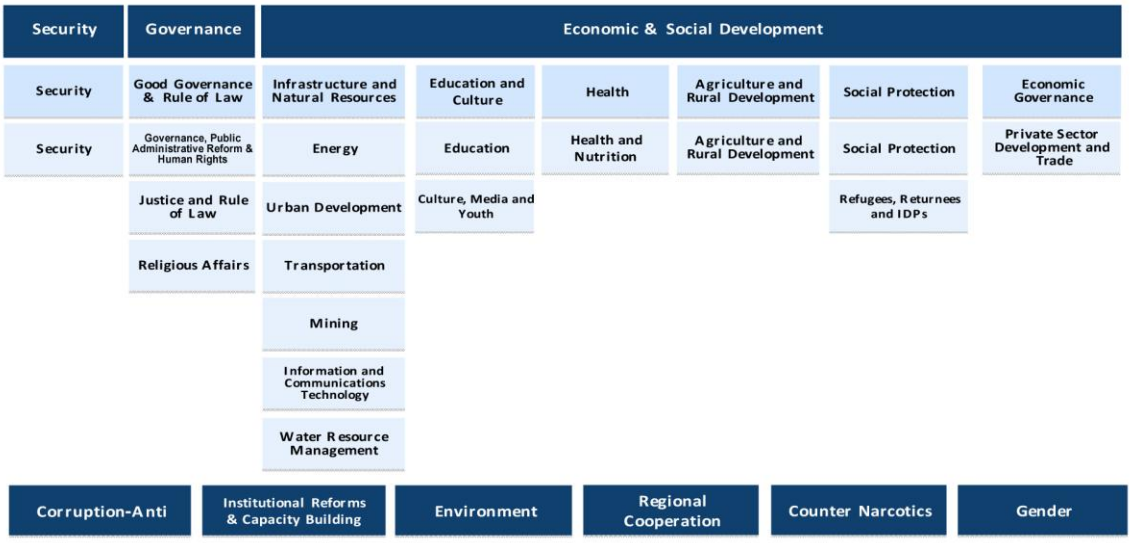
Tetra Tech has developed a number of economic consequence, post-disaster economic recovery, and hazard mitigation investment. Drawing on this experience, we propsoe the development of an Integrated Investment Prioritization Model that combines economic input-output modeling with System of Systems Analysis and Bayesian probability trees. Once completed the model will be a useful tool to prioritize funding for reconstruction projects on the basis of a program's ability to rapidly generate economic growth in Afghanistan.

Each of the components of the Integrated Investment Prioritization Model and their integration is described in the following sections.

2.1 Prioritization of Afghanistan's Development Goals

The first step in model development was to take the National Development Strategy program and prioritize its components on the basis of their ability to generate rapid economic growth. Afghanistan has established its National Development Strategy under the three broad pillars of security, governance, and economic and social development. Under these pillars are eight sub-pillars, 17 sectors, and six cross-cutting issues, as is shown in Figure 1.0 below.[17]

Figure 1.0 Development Prioritization



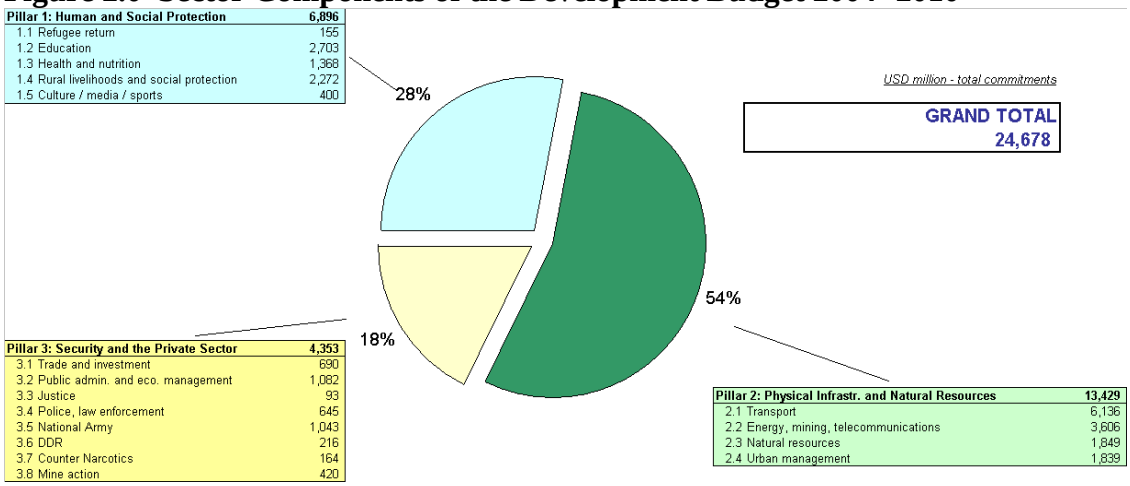
The declines in the GDP growth rate in 2009 and an anticipated international donor funding gap of $18 billion, require National Development Strategy program funding cuts. Figure 2.0 below shows how government expenditures have been allocated across the Human and Social Protection; Security and Private Sector; and Physical Infrastructure and Natural Resources programs for the previous six years. The Physical Infrastructure

[17] Islamic Republic of Afghanistan. 2009. Afghanistan National Development Strategy First Annual Report. http://imf.org/external/pubs/ft/scr/2009/cr09319.pdf

and Natural Resources programs have received the bulk of the funding. This is not surprising given Afghanistan's state of development and the fact that poor countries represent 39 percent of the world's population, but possess only 13 percent of the world's infrastructure.[18]

The Physical Infrastructure programs should continue to receive the majority of the funding as these infrastructures are necessary for rapid economic growth, while Human and Social Protection, and Natural Resources Sectors will maintain current levels of service rather than expand, as these areas influence long-term economic growth, not rapid growth.

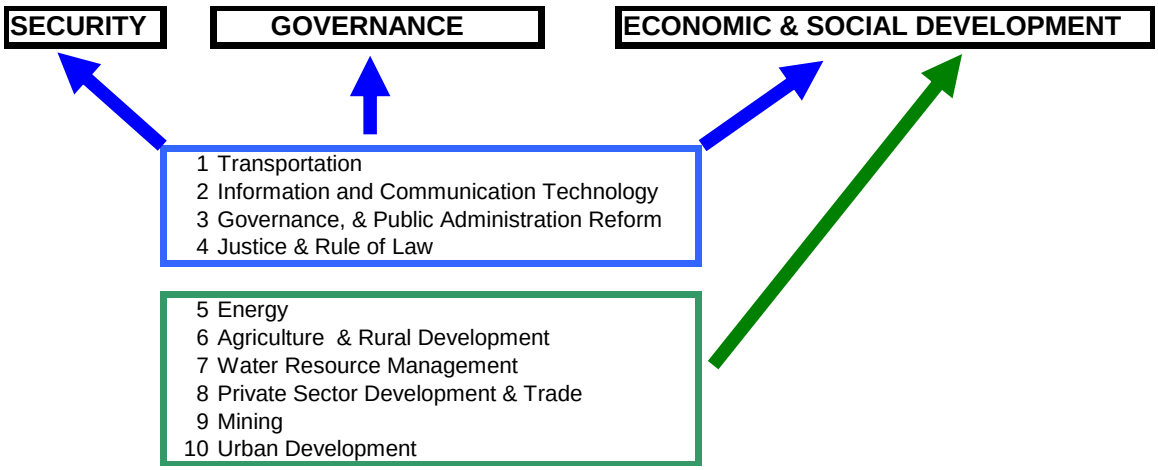
Figure 2.0 Sector Components of the Development Budget 2004 -2010



The three broad pillars of security, governance, and economic and social development identified in the Afghanistan National Development Strategy remain critical to achieving economic growth as is shown in Figure 3.0 below. What we prioritized are the 17 sectors and six cross-cutting issues, as there simply are not sufficient resources to achieve all goals. Over time, as the economy grows, they can add these additional goals.

[18] Schwartz, J., S. Hahn, and I. Bannon. 2004. "The Private Sector's Role in the Provision of Infrastructure in Post-Conflict Countries: Patterns and Policy Options." *Social Development Papers Conflict Prevention and Reconstruction.* World Bank. http://cpr.web.cern.ch/cpr/Library/CPRWP16.pdf

Figure 3.0 Prioritization of Afghanistan's Development Goals



We determined that the first four sectors were the greatest importance because each one of them supports the three over-arching goals of security, governance, and economic and social development. The next six sectors were selected because they support rapid economic development. Their prioritization is based on the following factors: 1) 2005 and 2008 World Bank Enterprise Survey results[19]; 2) energy supply sufficient to support development; 3) the estimated economic multiplier for each sector in the regional economy; 4) the size of the sector in relationship to the GDP; 5) current growth level in the sector.

Security and governance go hand in hand. Security is important to economic growth, not only because it is necessary to encourage foreign investment, but because international reconstructions programs spend anywhere from 20 to 35 percent of their project budgets on security for their employees and the projects themselves. Governance is critical to maintain political stability, develop a set of laws that create a climate conducive to business development and ensure investors their property rights will be upheld. Governance must extend to strengthening anti-corruption efforts as businesses cite corruption as a major limiting factor for growth. Both security and good governance are key to nurturing and maintaining the social and economic gains that will provide Afghanistan with and educated, healthy and economically viable population.

2.1.1 Sectors Not Receiving Increased Funding

Due to budgetary restrictions the government should operate the following sectors at maintenance levels and the programs not expanded until such time as international donor funds or government revenues increase. These programs are listed in order of priority for increased funding once economic growth occurs:

1. Education
2. Health

[19] Economic Policy and Poverty Team South East Asia Region. 2009. *Afghanistan Economic Update*. World Bank. http://siteresources.worldbank.org/AFGHANISTANEXTN/Resources/305984-1237085035526/AfghanistanEconomicUpdateOct2009.pdf

3. Refugees
4. Social Protection
5. Culture, Media, and Youth
6. Religious Affairs

While education and health are both important sectors, they influence long-term economic growth, rather than rapid economic growth, which is the priority. Furthermore, World Bank Enterprise Surveys conducted in 2005 and again in 2008 both ranked education/skilled workforce near the bottom of their needs for business expansion. Despite this, province by province analysis may dictate that education and health care must be expanded in some regions of the country in order to prevent the Taliban from providing these services. In these cases, education and health care relate directly to security and move up the prioritization list.

The government should not expand the refugee programs in hopes that this will slow their return until the economy grows enough to support the influx. The remaining programs are primarily social programs that don't significantly influence economic growth. Substantial gains were made in many of these sectors and improvements were experienced by the Afghan populace. They should maintain these programs sufficiently to retain public support.

2.1.2 The Six Cross-Cutting Issues

By their very nature, the six cross-cutting issues are intended to be addressed in part through actions taken in all of the seventeen sectors. However, investments directly in some of the cross-cutting sector do occur. These investments should again be limited to program maintenance until economic growth occurs.

With respect to the Counter-Narcotics issue, aggressive activities in this area could hamper overall economic growth as opium production generated 4 percent of the GDP in 2009, and approximately 1.2 million Afghans were engaged in poppy cultivation. Poppy cultivation is very lucrative as dry opium is worth $85.16 per kilo, versus $0.60 per kilo of wheat.[20]

The projected international donor funding shortfalls will make it difficult to maintain the 5 percent growth rate needed, let alone a 9 percent growth rate required with the elimination of narcotics economy. Therefore, it is recommended that the government not expand its counter narcotics programs until growth rates of 9 percent is assured. This is unlikely to occur in 2010 or 2011 given the state of the global economy and international funding shortfalls.

2.2 The Economic Model

We selected economic input-output modeling because it is commonly used to predict the regional economic impacts of construction projects, such as new highways, airports, or

[20] Alternative Development Program – Southwest 2009. *Revised Performance Monitoring Plan Year 2. (1 April 2009 -31 March 2010).*

new businesses.[21] [22] Input-Output modeling focuses on the interrelationships of sales and purchases among sectors of the economy. An input-output model is based on the theory that when new money enters a region either through investment, revenues, or income, some of it is re-spent one or more times in the local economy, creating additional economic impacts beyond the initial investment.[23] The model captures what each industrial sector must purchase from every other sector in order to produce a dollar's worth of goods or services.

Input-output models use multipliers to quantify the economic impact of certain industries on the national economy. Multipliers are mathematical factors used to calculate the value of an initial amount of spending on goods and services plus the value of additional spending linked to the purchases of inputs required to produce those final goods and services. Economic impact analyses take into account the multiplier effect that one industry or group of industries has on all other industries throughout the economy. Multipliers express the degree of interdependency between sectors and quantify the economic impact of specific sectors. For example, if agriculture has a multiplier of 0.29, every $1.00 increase in sales results in a $1.29 increase in the regional economy's output.

Economic models require data to operate. Like so many things in Afghanistan, we don't have enough data to model economic impacts precisely. Given this lack of data we used proxy data in the form of estimates from how similar economies behave, and data garnered from contractors' quarterly progress reports. Data from a similar economy is a bit tricky as we need an economy of not only roughly the same size and development level, but also an economy that has a robust illegal narcotics market. In this case we have used data from Tetra Tech's projects in Afghanistan, International Monetary Fund reporting, and economic data from agricultural economies.

Given the data constraints, the economic model is not a true input-output model, but a hybrid that combines probabilistic decision modeling with economic modeling. The model captures both the direct and indirect effects of a project and reports them as total economic impacts to the regional economy. As additional data becomes available, the model could be expanded to calculate induced economic impacts.

The model will enable the partitioning of economic impacts into short-term and long-term economic impacts. This is necessary so as not to overestimate actual economic impacts to the region. This especially important in construction projects, where two types of impacts occur. There are short-term economic impacts based on the construction related employment. In the case of Afghanistan, the short-term economic gains for many projects will result from a mix of local construction labor and international construction support. Also, the model includes economic impacts generated by international workers

[21] Lynch, Timothy. 2000. *Analyzing the Economic Impact of Transportation Projects Using RIMS II, IMPLAN, and REMI.* Prepared for Office of Research and Special Programs US DOT.
[22] Rose, Adam. Economic Principles, issues, and Research Priorities in Hazard Loss Estimation. in Y. Okuyama and S. Chang (eds.), *Modeling the Spatial Economic Impacts of Natural Hazards*, Heidelberg: Springer, 2004, pp. 13-36. < http://www.geog.psu.edu/news/images/rose_disasterbook.pdf>
[23] Meek, Alfie. Economic Models for Decision Making. *Georgia Economic Developers Association Gazette*. November, 2002. <http://www.geda.org>

in rental car, hotel and restaurant sectors as short-term regional impacts. Moreover, the model calculates, where sufficient data exists, international workers's income (who send most of their pay to their home countries) as out of region transfers to avoid overstating economic impacts. The long-term economic impact results from the permanent employment of personnel to operate the new business, or it results in increased trade as transportation improves.

The first step within the economic model is to take either the set of projects proposed or the proposed contract value if specific projects have not yet been indentified. These values are then decomposed to extract expenditures spent on goods purchased in Afghanistan, services procured from Afghani businesses, and income spent in the local economy by international workers. These expenditures are then entered into the economic model as direct expenditures into their representative industry sectors. The output from the economic model at this stage is the short-term economic growth to the region.

The second step within the economic model is to calculate the direct economic impact of the completed project, whether it is a road, or an agriculture training program. Often an anticipated economic return on the project was developed to justify the initial allocation for the project. This is the starting point for developing the direct impact, but one must consider factors, such as access to markets, and maintenance needs. For agriculture projects, one should consider that because many Afghanis are under-nourished, that subsistence farmers will consume increased crop production and not market it. Thus, until a basic level of caloric intake is achieved, this sector will not experience economic growth, but can achieve important gains in welfare. To calculate the long-term economic impact one must consider all of these factors.

The third step is to take the economic modeling results and process them through a Bayesian Probability Tree to determine the expected value of economic growth within a 95 percent confidence interval. This stage of the model allows subject matter expert input to address issues such as security concerns, corruption, illegal narcotics trade, availability of local resources to maintain and repair the project, availability of transportation resources, weather, and other factors that influence the potential for economic growth.

2.3 Developing the Bayesian Probability Tree

The final piece of the Integrated Investment Prioritization Model is the Bayesian Probability Trees. The Bayesian Probability Tree provides the probability of any of the diagramed outcomes negatively influencing the economic growth potential of the project. These probabilities are combined with economic modeling output to produce an expected economic growth value for each of the potential outcomes. The design of the Bayesian Probability Tree is shown in Figures 4.0 and 5.0. below. Figure 4.0 shows how multiple projects are compared, while Figure 5.0 depicts the elements of the in-depth analysis conducted for each project evaluated.

Figure 4.0 Bayesian Probability Tree

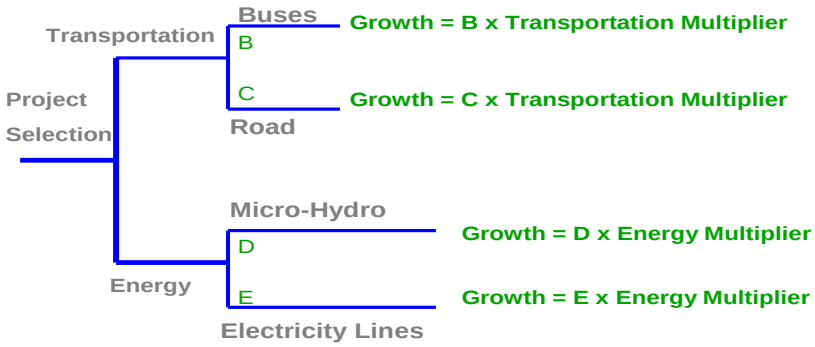
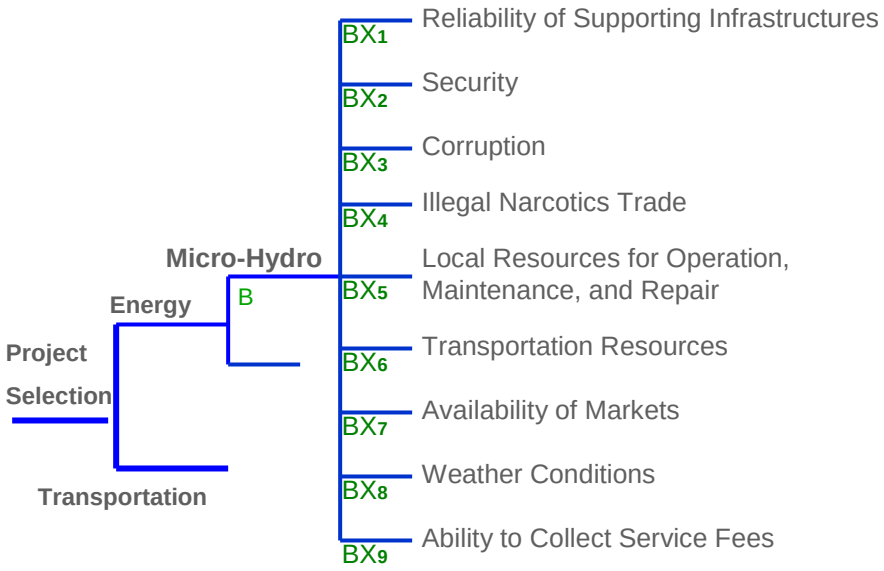


Figure 5.0 Detailed Bayesian Probability Tree



$$\mathbf{B} = BX_1 * BX_2 * BX_3 * BX_4 * BX_5 * BX_6 * BX_7 * BX_8 * BX_9$$

For the initial design of the model, we used Tetra Tech's resident subject matter experts in the fields of engineering, meteorology, economics, System of Systems Analysis, and prior service in Afghanistan to calculate the probabilities that the following factors would negatively influence the success of the project, as this would in turn reduce the ability of the project to generate economic growth:

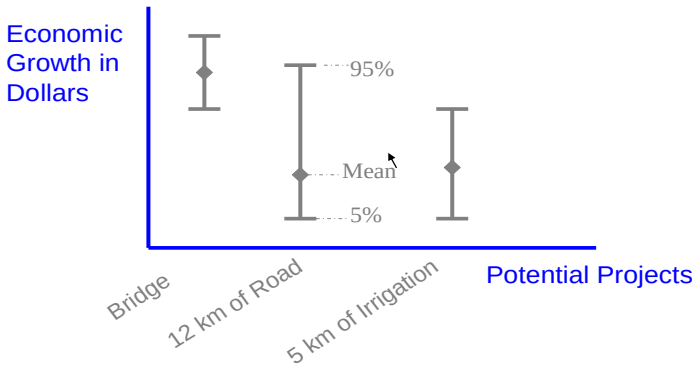
- Reliability of Supporting Infrastructures
- Security
- Corruption

- Illegal Narcotics Trade
- Local Resources for Operation, Maintenance, and Repair
- Transportation Resources
- Availability of Markets
- Weather

We asked each subject matter expert to assign probabilities for each tree node and their associated 95 percent confidence intervals. This was done to capture what they felt was most likely the "right" probability, but to also capture their degree of uncertainty. The mean and the 95th percentile probabilities for each criterion were then multiplied to produce the total probability of the project achieving economic growth. These values were then multiplied by the results from the economic model.

Results are shown as the short-term expected economic growth over a one year period; the long-term expected growth over a five year period; and the total expected economic growth, combining both short-term and long-term growth over a five year period. The results are shown as a box plot where the degree of uncertainty in the expected economic growth is shown as the range about the mean. This enables to decision-makers to easily understand the uncertainty within the analysis.

Figure 6.0 Uncertainty Bands



Analysis is of greater value if it treats uncertainty explicitly thereby allowing decision makers to evaluate its conclusions and limitations in the changing context of the on-going decision process.[24] The Integrated Investment Prioritization Model emphasizes the importance of capturing uncertainty throughout the analyses process and expressing it

[24] Clemen, R.T. T Reilly. 2004. *Making Hard Decisions*. South-Western College Publishers.

explicitly within the results reporting. This adds to the decision makers' understanding of the limitations and uncertainty associated with any of the model results so that they can confidently make sound risk-informed decisions.

Integrated Investment Prioritization Model (IIPM) is highly flexible, so that it can incorporate better data as it becomes available, whether it is economic data, mechanical performance data, or security/threat information.

3.0 CONCLUSIONS

Measuring progress in Afghanistan is difficult, as prior to 2003, very little statistical data was available with respect to infrastructure services, socio-economics, health, education, and the national economy. Today, national statistics are collected through Afghanistan's Central Statistics Office and international aid organizations. Despite this, good data at the provincial level or lower is extremely difficult to find and data quality varies by province.

While insufficient data exists documenting the ratio of international donor investment to short-term economic growth, clearly progress is being made. However, will Afghanistan achieve its projected 2015 goals? It seems unlikely, but the Integrated Investment Prioritization Model does show potential as a tool for prioritizing DOD, ISAF, and USAID reconstruction projects.

4.0 RECOMMENDATIONS

While the proposed Integrated Investment Prioritization Model will facilitate the prioritizing investment decisions to maximize economic growth and achieve security, the model represents a first iteration based on the limited data available. As data improves the model becomes more robust and the uncertainties within the analysis decreased.

Quantitative data at the provincial level and below are virtually non-existent. Yet this is the level where the development projects are implemented. While Afghanistan's Central Statistics Office has limited data, contractors on USAID, ISAF, and DOD funded projects provide measureable metrics and statistics in their quarterly status reports. Tetra Tech is performing a number of large reconstruction projects in Afghanistan for USAID, and this work has provided some of the data used for developing the model. By making all of the data contained within the contractor reports easily accessible, a more robust data set can be created very efficiently. We recommend the creation of a single data repository warehouse to improve data capture, availability and enable quantitative results analysis.

Securing Afghanistan's future isn't just about maximizing our investments, it is about creating a better life for the citizens of Afghanistan, creating stability in the region, and depriving terrorist organizations of a safe haven, which makes us all safer.