

**AHP IN THE CLASSROOM AND THE COMMUNITY:
CARLOW UNIVERSITY-UGANDA INITIATIVES**

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ABSTRACT

Through this project, we intend to show how utilization of the AHP methodology in the experiential learning process of MBA students taking a decision-making class may also provide the benefit of allowing to address a specific decision faced by Carlow University, related to faculty proposed initiatives in Uganda. The questions are if the University should pursue these initiatives, to what extent they are congruent with Carlow's mission and interests and finally, -if a decision to pursue any Uganda initiative is made-, what would be the priorities that should be given to these initiatives. In addition, an undergraduate class in organizational studies was given a more focused task of developing a specific small business project for an Uganda family. At the end of the course, students were asked to evaluate and rank their business proposals; first, intuitively and the following week, using the Analytic Hierarchy Process-after having been explained the methodology and software. A final session to compare the differences, and pros/cons of each approach was made. This panel will present the findings of all these classroom experiences rooted into an experiential learning approach toward learning and also practicing engaged scholarship to address specific problems of the academic community (Carlow) and society (Uganda) at large. Finally, the Carlow-Uganda decision-making model developed here may constitute the basis for a more generic model to assess overseas opportunities for higher-education institutions.

Keywords: Carlow, Uganda, Carlow-Uganda, AHP Experiential Learning, AHP Engaged Scholarship, AHP Education

CARLOW UNIVERSITY - UGANDA INITIATIVE I: AN AHP BENEFIT/COST ANALYSIS

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ABSTRACT

The Carlow-Uganda Initiative was created to support Ugandan citizens in strengthening their communities through the collaboration on one of the four identified initiatives. The project proposes overseas cooperation between Carlow University and selected institutions in Uganda. The nature of the cooperation is the training of teachers and caregivers for vulnerable adults, children and adolescents which ultimately benefits the nation of Uganda, but also gives Carlow students the ability to participate and experience life outside of the United States. We utilized the Analytic Hierarchy Process software for our decision-making approach and used the hierarchical structure to determine which initiative carried the most weight in terms of criteria and sub criteria determined by the team.

Keywords: Carlow University, Uganda, Benefits, Cost

1. Introduction

Taking on this initiative is an opportunity for Carlow University to demonstrate her global corporate responsibility by extending help and humanitarian programs to a nation in need, thus bolstering Carlow's image & reputation amongst other academic institutions. By pursuing the Carlow-Uganda Initiative Carlow would be fulfilling the core value for Student Progress, which states, "We educate, challenge, and expect all students to uncover, expand and realize their potentials" (Mission & Core Values, 2014).

The four project initiatives that were evaluated are the following: To enhance care provided to youth in the orphanage Bright Kids Uganda Entebbe Home and Health Clinic; To enhance the education offered to children with special needs at the Entebbe Children's Welfare School; To enhance self-sufficiency and decrease vulnerability of youth by collaborating with villagers and the organization, Advocacy for Vulnerable Children's Rights ; and To decrease citizen vulnerability to human trafficking by collaborating with Project to End Human Trafficking-Uganda Branch, which is currently run by volunteers in Uganda. The overall goal for the project is to evaluate which initiative would benefit both Uganda and Carlow University the most.

2. Literature Review

Applying AHP to one or more decision making projects can be overwhelming. The following are steps associated with AHP method: outlining the decision problem and clarifying the goal, and designing the hierarchy by identifying general criteria to which benefit and cost are related, and alternatives for those criteria (Kambiz, et al., 2012, p. 5). AHP helps leaders to make decisions based on judgmental debates, consensus and often compromises made in a group session. In order to make the job easier, group members identify priorities by conducting a questionnaire that is then turned to a debate or discussion about the best options available. A conclusion is then reached after careful and thorough judgments are made (Saaty, 2008, pg. 272-73).

For the purpose of this paper, two hierarchies are constructed. One hierarchy that deals with the benefit criteria and the other hierarch relates to the cost criteria. The only problem with benefit and cost analysis is that one cannot be separated from the other. In most, if not all cases, benefit outweighs cost. A comparative assessment of all the benefits anticipated and cost projected were made in order to help in the decision of whether or not Carlow University should undertake the project and estimate resources required. Another problem faced is that it is hard to put a value (monetary perhaps) to benefit and costs. The solution is to consider

both tangibles and intangibles where benefit and cost are considered as criteria and projects as alternatives (Wijnmalen, 2007, pg. 892).

3. Hypotheses/Objectives

This study is aimed at evaluating the benefits and cost of the proposed overseas collaboration between Carlow University and special education and health institutions in Uganda. Our hypothesis is: the preferred initiative has the highest B/C ratio.

4. Research Design/Methodology

For the analysis of the Carlow University overseas collaboration, we will develop a Benefit and Cost ANP model and also evaluate the Benefit and Cost (B/C) analysis using the relative and ratings model. The criteria and pairwise comparison judgment will be computed from the developed ANP framework done by co-authors Diana Nsemo, Nora Suehr and Arielle Sagbohan. The proposed methodology was summarized from the perspective of education. The team carried out comprehensive research, literature review and survey to consolidate findings, definition of criteria and judgments in the respective categories for this decision making analysis. After derivation of B/C analysis result, there was an aggregation of the designed AHP framework and the alternative that received the highest B/C ratio was considered to be the best alternative.

5. Data/Model Analysis

With the application of SuperDecisions software, we have developed a model of the Benefit and Cost ANP framework. The criteria for all four initiatives in each ANP framework, was developed by all team members with much deliberations and tradeoffs. The developed BC hierarchy is shown in Figure 1 and Figure 2.

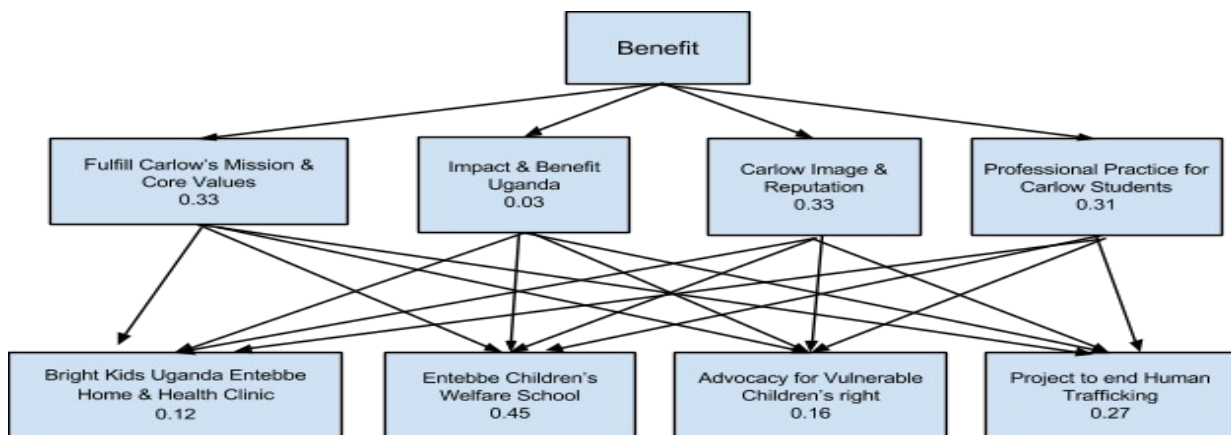


Figure 1: Benefit Hierarchy

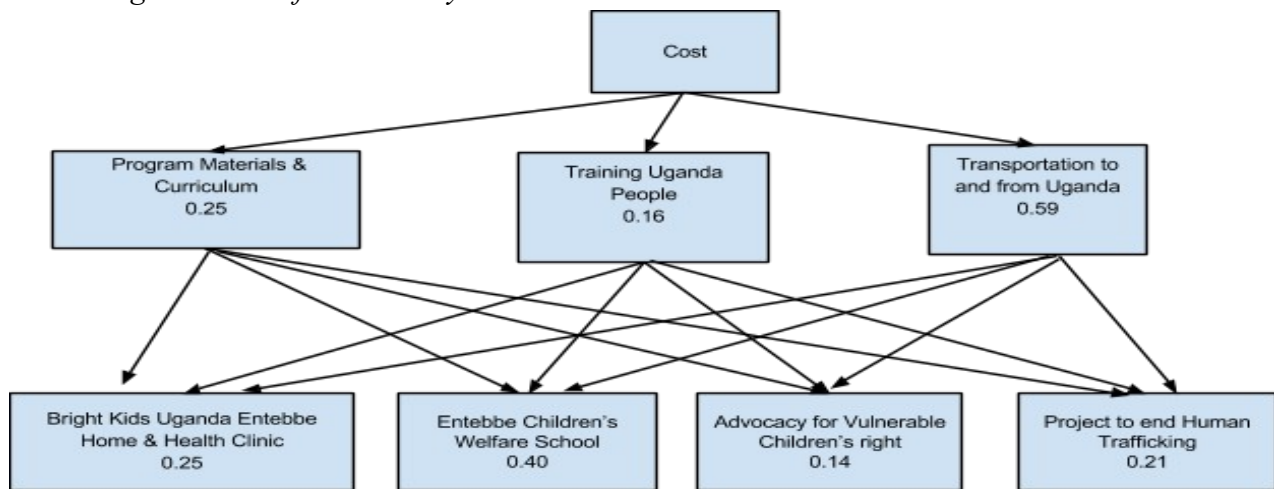


Figure 2: Cost Hierarchy

6. Limitations

The limitations in this particular model is that this is a new venture for Carlow University and although much thought and research has gone into this analysis. The study does not give a definitive right or wrong option for the University. The criterion has also been selected through the lens of education, psychology, management and health. This is not considering any other points of view that might have an actual impact on the business of Carlow University. For example, we have not taken into consideration how this would affect Carlow politically. Why Uganda? Why not help people in our backyard in the United States? For this reason, we can only expect the result of this analysis to be based off of the lenses in which we have chosen to look at this case.

7. Conclusions

From the Benefit/Cost analysis, our recommendation to the President of Carlow University and the board of trustees is to adopt the Project to end Human Trafficking as an initiative for the University to pursue. It proves to yield the most benefit at a low cost. This is a result of the highest B/C ratio from the ANP analysis.

From a practical standpoint, we believe we have abetted the identification of important factors to make a decision on which initiative to pursue and have provided the rationale behind our recommendation. This revision will be formally presented to the decision makers of Carlow for use in deliberating upon which project to endorse.

From an academic standpoint, we used of ANP models in the context of public administration decisions is still in budding state and this study underwrites the engagement of decision making leaders when using ANP to solve complex decisions.

8. Key References

Carlow University Mission & Core Values . (n.d.). Retrieved from http://carlow.edu/Mision_and_Core_Values.aspx

Guidance for special education Parent Advisory Council (March 2010). Retrieved from <http://www.doe.mass.edu/sped/pac/guidelines.pdf>

Kambiz, S., Amin, K., Shabnam, A., Elnaz, S., Kamyar, S. H., and Mohammad, N. (2012). Application of Analytical Hierarchy Process (AHP) Technique to evaluate and selecting suppliers in an effective supply chain. *Kuwait chapter of Arabian Journal of Business and Management Review*, Volume 1, Number 8. Retrieved from <http://www.omicsonline.com/open-access/2224-8358/pdfdownload.php?download=2224-8358-1-166.pdf>.

Outreach evaluation Resource Center. Getting started with Community-based outreach. Retrieved from http://nnlm.gov/evaluation/booklets/booklet1/booklet1_whole.pdf

Saaty, T. (2008). *Decision Making for Leaders: The Analytical Hierarchy Process for Decisions in a complex world*. Pittsburgh: RWS. Publications

Wijnmalen, D.J.D., (2007). Analysis of benefits, opportunities, costs, and risks (BOCR) with the AHP–ANP: A critical validation. *Mathematical and computer modeling*, Volume 46, Issue 7-8, 892-905. Retrieved from http://ac.els-cdn.com/S0895717707000994/1-s2.0-S0895717707000994-main.pdf?_tid=6284444a-c28d-11e3-816f-00000aab0f27&acdnat=1397340005_7c9e51eb40ed604fb46c6cbff2043db5.

CARLOW-UGANDA INITIATIVE II: AN AHP BOCR DECISION ANALYSIS

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ABSTRACT

Through this project, we intend to demonstrate how utilization of the AHP methodology will allow the academic community of Carlow University to assist with societal issues in Uganda through collaboration, leadership, and community service. The mission for our selected project is to provide professional development to teachers and caregivers of vulnerable children and adolescents in Uganda. Through the assistance of Dr. Enrique Mu and the learnings from class focused around AHP, we will attempt to demonstrate the best possible alternative for Carlow University and the Global Human Rights and Wellness: Project Focus – Uganda utilizing Benefit/Cost/Opportunity/Risk (BOCR) analysis. AHP methodology of modeling hierarchies (goals, criteria, and alternatives), prioritization of criteria, and pairwise comparison of the alternatives in terms of their preference was done via a transdisciplinary pedagogical approach, with a primary focus on global health care through the Carlow University School of Nursing.

Keywords: Uganda, Carlow University, AHP methodology, Benefit/Cost/Opportunity/Risk (BOCR) analysis.

1. Introduction

In many regions of the world where resources are scarce, children live in situations of extreme vulnerability and are exposed to a number of challenges in meeting their basic needs. Carlow University is a private, Catholic-affiliated, women-centered, liberal arts university located in Pittsburgh, Pennsylvania. The University is part of the Conference for Mercy Higher Education and was founded by the Sisters of Mercy, an international community of Roman Catholic women who vow to serve people who suffer from poverty, sickness, and lack of education; there is special emphasis placed on the care of women and children. Through collaboration with the Ugandan people, Carlow University is focused on providing professional development to teachers and caregivers of vulnerable children and adolescents. This collaboration will also offer Carlow nursing students authentic learning experiences through building problem solving skills, developing communication and team building skills, and placing emphasis on the importance of critical and creative thinking within the context of the real world.

The project goal is to support Ugandan citizens in strengthening their communities through collaboration on four identified alternatives. These alternatives include: 1) To enhance care provided to youth in the orphanage, Bright Kids Uganda Entebbe Home and Health Clinic; 2) To enhance the education offered to children with special needs at the Entebbe Children's Welfare School; 3) To enhance self-sufficiency and decrease vulnerability of youth in the Teso region by collaborating with villagers and the organization, Advocacy for Vulnerable Children's Rights; and 4) To decrease citizen vulnerability to human trafficking by collaborating with the Project to End Human Trafficking-Uganda. In order to facilitate this assessment, the identified benefits, opportunities, costs, and risks will be synthesized using AHP BOCR analysis to identify the best overall alternative for this collaborative project. This authentic, real world project and its emphasis on global social awareness and service learning is consistent with the Carlow University mission of service to others.

2. Literature Review

As a University embracing the liberal arts, Carlow recognizes that a vibrant, integrated system of higher education offers many rewards, well beyond those that serve a utilitarian purpose. Consistent with service learning and global ethics, participation in this project can provide an active role in the development of emerging professionals at the university, as well as in Uganda, the community at large in Pittsburgh, caregivers in Uganda, and Carlow students. The key literature has been drawn from scholarly journal articles and expert consultations. A list of relevant key literature is included in the reference section.

3. Hypothesis/Objectives

This collaborative project is focused on selecting the best alternative for Carlow University and the Ugandan citizens. This project is aligned with Carlow's Mission, Vision, and Values and through AHP synthesis the identified alternative will provide the Ugandan citizens the support they desire.

4. Research Design/Methodology

For this project, a BOCR AHP model was developed to analyze the proposed decision. Identified benefits, costs, opportunities, and risks were defined and criteria were weighted. Pairwise comparison was conducted by this student MBA team and after analysis and synthesis, a best alternative was identified in keeping with the project goal. Utilizing pairwise comparisons includes determining weights for the identified criteria – always controlling for consistency – and deriving priorities for the known alternatives. In order to cope with the complexity of this decision, SuperDecisions software was applied.

5. Data/Model Analysis

The model was developed using AHP BOCR analysis framework, using SuperDecisions. Criteria specific to each benefit, cost, opportunity, and risk hierarchies were defined. The pertinent data have been derived by using sets of pairwise comparisons of criteria and alternatives. The figures below show the individual benefits, costs, opportunities, and risks hierarchies and BOCR analysis. Validity was maintained with a coefficient of inconsistency for each comparison matrix (CI) ≤ 0.1 ; thereby assuring the underlying judgments can be considered consistent and relevant.

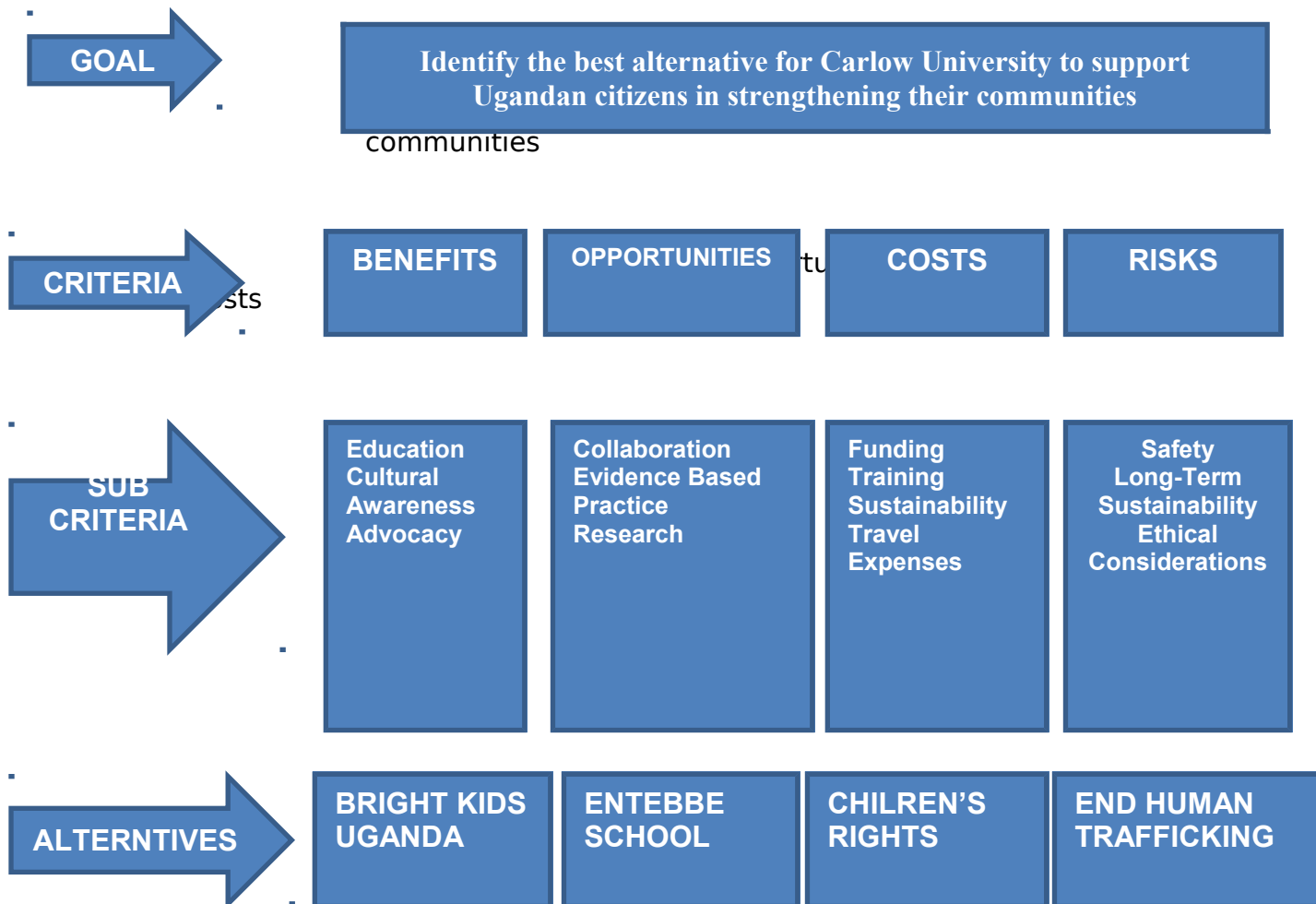
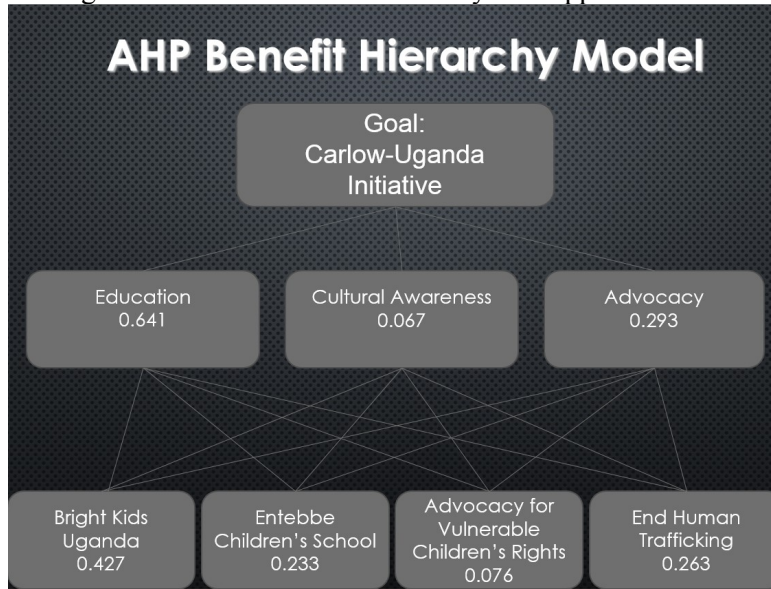


Figure 1: BOCR Decision Hierarchy and Applied Criteria



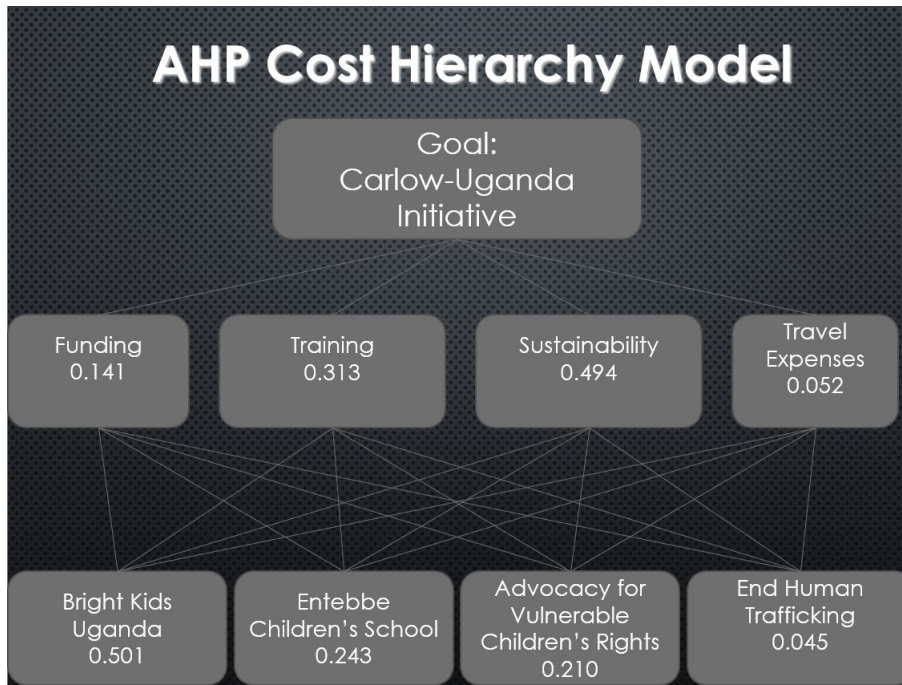
Super Decisions Main Window: Uganda Benefits.sdmod: Priorities

Here are the priorities.

Icon	Name	Normalized by Cluster	Limiting
No Icon	Advocacy for Vulnerable Children's Rights	0.07606	0.038032
No Icon	Bright Kids Uganda	0.42734	0.213669
No Icon	End Human Trafficking	0.26371	0.131855
No Icon	Entebbe Children's Welfare School	0.23289	0.116443
No Icon	Advocay	0.29256	0.146280
No Icon	Cultural Awareness	0.06680	0.033401
No Icon	Education	0.64064	0.320319
No Icon	Benefit	0.00000	0.000000

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Figure 2 – Benefits Hierarchy priorities



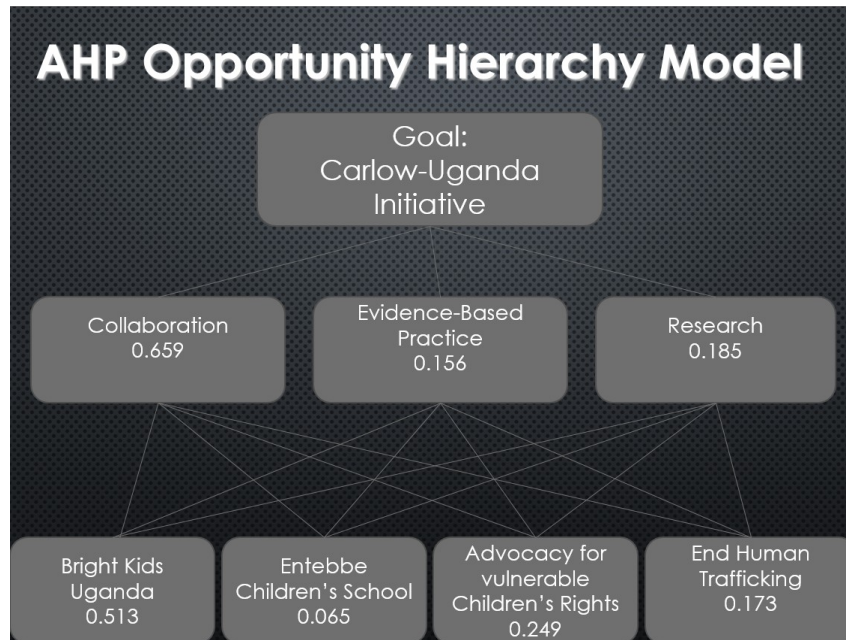
Super Decisions Main Window: Uganda Costs-1.sdmod: Priorities

Here are the priorities.

Icon	Name	Normalized by Cluster	Limiting
No Icon	Bright Kids Uganda	0.50146	0.250727
No Icon	End Human Trafficking	0.04518	0.022590
No Icon	Entebbe Children's Welfare School	0.24302	0.121512
No Icon	Vulnerable Children's Rights	0.21034	0.105170
No Icon	Funding	0.14145	0.070725
No Icon	Sustainability	0.49355	0.246777
No Icon	Training	0.31328	0.156638
No Icon	Travel Expenses	0.05172	0.025860
No Icon	Costs	0.00000	0.000000

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Figure 3- Costs Hierarchy priorities



Super Decisions Main Window: NursesInAction_SuperDecision.doc.s...

Here are the priorities.

Icon	Name	Normalized by Cluster	Limiting
No Icon	Bright Kids Uganda	0.51297	0.256486
No Icon	Human Trafficking	0.17298	0.086488
No Icon	Vulnerable Children's Rights	0.24915	0.124575
No Icon	Entebbe Children's Welfare	0.06490	0.032451
No Icon	Evidence Based Practice	0.15618	0.078091
No Icon	Research	0.18517	0.092587
No Icon	Collaboration	0.65864	0.329322

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Figure 4 – Opportunities Hierarchy priorities

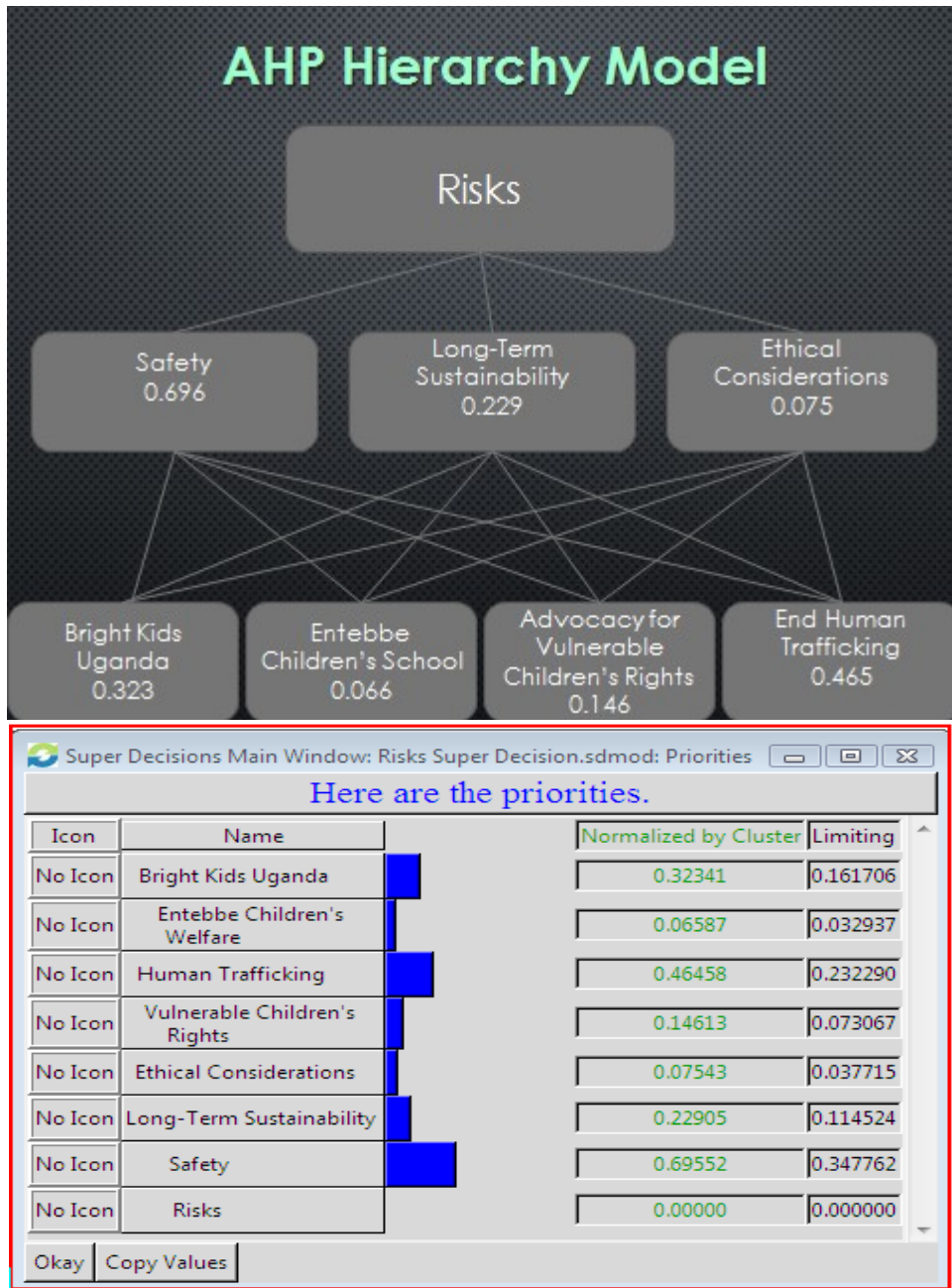


Figure 5- Risk Hierarchy priorities

BENEFIT/OPPORTUNITY/COSTS/RISKS ANALYSIS

	Benefi ts	Opportun ity	Costs	Risks	B*O	C*R	B/C	B*O/C	B*O/C*R
Bright Kids	0.427	0.513	0.501	0.323	0.219	0.162	0.852	0.457	1.352
Entebbe School	0.233	0.065	0.243	0.066	0.015	0.016	0.959	0.062	0.937
Children’s Rights	0.076	0.249	0.210	0.146	0.019	0.031	0.362	0.090	0.613
Human Trafficking	0.263	0.173	0.045	0.465	0.045	0.021	5.844	1.0	2.143

According to the calculations, the BEST alternative overall would be the
END HUMAN TRAFFICKING INITIATIVE

Figure 6 – BOCR Analysis

6. Limitations

At this time, the main limitation of the project is that all of the criteria are based on student input and are not evidence-based. The criteria weights and the evaluations of the alternatives have been chosen from the point of view of the decision maker. The alternatives have been selected in advance by the University. One must take into consideration that there are identified gaps that need to be addressed beyond Carlow University. This project was developed under the guidance of Dr. Enrique Mu and formulated by MBA students learning the AHP methodology for the first time.

7. Conclusions

The goal of this project was to identify the best collaborative alternative for Carlow University and the Ugandan community. By using AHP BOCR analysis, we have identified the best alternatives for the proposed Carlow-Uganda Initiative. From this analysis we believe we have helped identify the best collaborative alternative, from a nursing/global health care perspective, which fulfills the collaborative goal of this project between Carlow University and the Uganda community. Therefore, we strongly are recommending that Carlow University select the Project to End Human Trafficking-Uganda.

References

- Baumann, S. L. (2012). Dilemmas of international collaborative nursing partnerships. *Nursing Science Quarterly*, 25, 182-183.
- Carlow University (2014a). Business Plan for Uganda Collaborative. Unpublished manuscript, Carlow University, Pittsburgh, PA.
- Carlow University (2014b). Mission & core values. Retrieved from http://www.carlow.edu/Mission_and_Core_Values.aspx
- Crigger, N. J. (2008). Towards a viable and just global nursing ethics. *Nursing Ethics*, 15 (1), 17-27.
- Hill, M. G., McCarty, K., & Bowers, D. (2012). Essentials for health care providers traveling to low-resource countries. *Nursing: Research and Reviews*, 12 (2), 45-53.
- Isabaliya, S. R. Mayoka, K. G., Rwashana, A. S., & Mbarika, V. W. (2011). Factors affecting adoption, implementation and sustainability of telemedicine information systems in Uganda. *Journal of Health Informatics in Developing Countries*, 5 (2), 299-316.
- Johnson, K., Hays, C., Center, H., & Daley, C. (2004). Building capacity and sustainable prevention innovations: A sustainability planning model. *Evaluation and Planning Program*, 27, 135-149.
- Leffers, J., & Mitchell, E. (2010). Conceptual model for partnership and sustainability in global health. *Public Health Nursing* 28 (1), 91-102. doi: 10.1111/j.1525-14446.2010.00892x.
- Merry, L. (2012). Global health for nursing...and nursing for global health. *Canadian Journal of Nursing Research*, 44 (4), 20-35.
- Nicholas, P.K., Corless, I.B., Fulmer, H., & Meedzam, N. (2012). Preparing nursing students for education in the global village. *The American Journal of Maternal Child Nursing* 37(6), 367-372. doi: 1098/NMC.0b013e18258a931.
- Powell, D.L., Gilliss C.L., Hewitt, H.H., & Flint, E.P. (2010). Application of a partnership model for transformative and sustainable international development. *Public Health Nursing*, 27, 54-70.
- Saaty, T.L. (2000). *Decision making for leaders*. Pittsburgh, PA: RWS Publications.
- Shah, A. (2006). Global health overview. Retrieved from <http://www.globalissues.org/article/588/global-health-overview>

**Upvall, M. (Personal Communication). Phone conversation 2/5/2014,
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CARLOW-UGANDA INITIATIVE III:

MULTIPLE BOCR TEAM PERSPECTIVE INTEGRATION

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ABSTRACT

A project has been recommended for collaboration between Carlow University specific institutions in Uganda. There are foreseeable benefits for Carlow students including professional development, cultural enrichment, social responsibility and other benefits related to experiences a student would see in Uganda. There are 4 alternatives students to choose from with compelling arguments. A Benefit/Cost/Opportunity/Risk (BOCR) analysis has been

performed. The information has been weighed using the AHP methodology and SuperDecisions software. The results will be presented at the ISAHP 2014 symposium.

Keywords: Carlow University, Uganda, Collaboration

INTRODUCTION

In Uganda, resources are limited; children live in poor conditions. They have great difficulty meeting their basic needs. In Uganda, HIV/AIDS related deaths have led to a large number of orphans. The care for these orphans is not enough. The four project alternatives can be achieved through specific initiatives through Carlow. Students will have the opportunity to engage in global community service in a variety of ways. This is a list of current initiatives that closely align with the Carlow University.

- Bright Kids Uganda Entebbe Home— rescue vulnerable and economically disadvantaged children from poor conditions in which they are currently living. They provide housing and education.
- Entebbe Children’s Welfare School— provide education for special needs students. They provide educational supplies such as books, papers, and writing material. They also provide training for teachers in order to teach special needs students.
- Advocacy for Vulnerable Children’s Rights— collaborate with teenaged girls and identify ways to stay in school. They work to build a sustainable community garden. They work with villagers to build a sustainable system that includes animals such as chickens for eggs, and cows for milk.
- Project to End Human Trafficking-Uganda Branch— provide prevention education locally, nationally, and internationally that addresses to human trafficking such as culture, globalism, sex tourism, and victim identification.

There are benefits, opportunities, costs, and risks to consider. In order to prioritize these alternatives, an AHP decision method is engaged to identify the best alternative to enhance the mutual benefits/student experience while keeping with the Carlow University Mission.

2. LITERATURE REVIEW

In order to closely examine all the risks for such a vital project, an extensive literature review was necessary. This review included the social and political climate in Uganda as well as risk considered by other Universities. Cost criteria associated with Uganda initiatives include time for training, resources, and building renovations. Benefit criteria associated with Uganda initiatives include

learning potential, recognition for Carlow, and interaction with growing Uganda industries. Opportunities include learning leadership and social responsibility.

3. HYPOTHESES/OBJECTIVES

It was determined that even if the barriers of resources and other factors were overcome, the looming risks of terrorism, accidents and sickness are too enormous to ignore and must be grappled with. The cost could be too excessive for Carlow University and students. However, the benefits and opportunities cannot be overlooked. The benefits and opportunities a student would receive could overshadow both risks and costs. The objective is to weigh all factors objectively and identify the best alternative.

4. RESEARCH DESIGN/METHODOLOGY

"Analytical Hierarchy Process (AHP) is an approach to decision making that involves structuring multiple choice criteria into a hierarchy, assessing the relative importance of these criteria, comparing alternatives for each criterion, and determining an overall ranking of the alternatives", as defined by DSS Resources. The concept of AHP was developed, amongst other theories, by Thomas Saaty, an American mathematician working at the University of Pittsburgh.

AHP is a multi-criteria decision making (MCDM) method that helps decision-maker facing a complex problem with multiple conflicting and subjective criteria (e.g. location or investment selection, projects ranking, etc). Several MCDM methods have been developed (e.g. ELECTRE, MacBeth, SMART, PROMETHEE, and UTA (Barthélemy, 2003; Valerie Belton & Stewart, 2002)) and all are based on four steps: problem modelling, weights valuation, weights aggregation and sensitivity analysis.

4.1 PROBLEM MODELLING: the goal is to structure the problem into humanly-manageable sub-problems. AHP has the advantage of permitting a hierarchical structure of the criteria, which provides users with a better focus on specific criteria and sub-criteria when allocating the weights. This step is important, because a different structure may lead to a different final ranking. Iterating from top (the more general) to bottom (the more specific) is performed. Navigating through the hierarchy from top to bottom, the AHP structure comprises goals (systematic branches and nodes), criteria (evaluation parameters) and alternative ratings (measuring the adequacy of the solution for the criterion). Each branch is then further divided into an appropriate level of detail. At the end, the iteration process transforms the unstructured problem into a manageable problem organized both vertically and horizontally under the form of a hierarchy of weighted criteria. By increasing the number of criteria, the importance of each criterion is diluted, which is compensated by assigning a weight to each criterion.

4.2 WEIGHTS VALUATION: a relative weight is assigned to each criterion, based on its importance within the node to which it belongs. One of AHP's strengths is the possibility to evaluate quantitative as well as qualitative criteria and alternatives on the same preference scale. These can be numerical, verbal or graphical. The sum of all the criteria belonging to a common direct parent criterion in the same hierarchy level must equal 100% or 1. A global priority is computed that quantifies the relative importance of a criterion within the overall decision model.

4.3 WEIGHTS AGGREGATION: we synthesized the local priorities across all criteria in order to determine the global priority. We used multiplicative aggregation to prevent the rank reversal phenomenon (Barzilai & Lootsma, 1997; Lootsma, 1993). The multiplicative aggregation has non-linearity properties allowing a superior compromise to be selected, which is not possible with the additive aggregation (Ishizaka, et al., 2010; Stam & Duarte Silva, 2003).

4.4 SENSITIVITY ANALYSIS: The last step of the decision process is the sensitivity analysis, where the input data are slightly modified in order to observe the impact on the results. As complex decision models may be inherently unstable, it allows the generation of different scenarios, which may result in other rankings and further discussion may be needed to reach a consensus. If the ranking does not change, the results are said to be robust otherwise it is sensitive. In AHP, the sensitivity analysis can be done on three levels: weights, local priorities and comparisons. Our sensitivity analysis concluded the same results indicating the robustness of our synthesis.

4.5 CONSISTENCY: as priorities make sense only if derived from consistent or near consistent matrices, a consistency check must be applied. Saaty (1977) has proposed a consistency index (CI), which is related to the eigenvalue method:

$$CI = \frac{\lambda_{max} - n}{n - 1}, \quad (7)$$

where n = dimension of the matrix
 λ_{max} = maximal eigenvalue

The consistency ratio, the ratio of CI and RI, is given by:

$$CR = CI/RI, \quad (8)$$

where RI is the random index (the average CI of 500 randomly filled matrices)

If CR is less than 10%, then the matrix can be considered as having an acceptable consistency.

Prof. Saaty (1977) calculated the random indices.

N	3	4	5	6	7	8	9	10
RI	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

4.6 AHP IN GROUP DECISION MAKING: the standard AHP has been adapted in order to be applied in group decisions. In this case, the hierarchy of the problem is the same for all decision-makers. On the judgments level an aggregation after the calculation of priorities was followed to reach a unanimous decision.

5. DATA/MODEL ANALYSIS

The models developed for analysis of the benefit/opportunity/cost/risk hierarchies include the pairwise model comparison using SuperDecision Software. The criteria were developed based on research of Uganda, study abroad programs, and project materials developed by Dr. Burke and Dr. O'Rourke of Carlow University. Criteria weights and influence matrix were developed by the participants of the three teams from MBA728 – Decision Making for Leaders class at Carlow University in Spring 2014 semester (Team JKNS, Nurses in Action, and Team Purple) (figure1).

Each team identified different criteria in their individual hierarchies, and using SuperDecision software, assigned weights to the criteria and compared the alternatives with the pairwise comparison. Consistency index for weights of criteria and pairwise comparison were all less than 0.1. All results of the same alternatives in each model were compared and calculated to identify which alternative provides the best opportunities while keeping with the Carlow University Mission (figure 2).

- Figure 1 – Comparison of Alternatives Based on all Criteria in Pairwise Comparison:

To determine the best fit between Carlow's objectives as a University and proposed global initiatives in Uganda



- Figure 2- Integrated B*O/C*R Tables

Benefits

ALTERNATIVES	Team Purple (T ₁)	Nurses in Action (T ₂)	Team JKNS (T ₃)	Total (T ₁ * T ₂ * T ₃)
BRIGHT KIDS UGANDA ENTEBBE HOME AND HEALTH CLINIC	0.120	0.427	0.263	0.013
ENTEBBE CHILDREN'S WELFARE SCHOOL	0.447	0.233	0.550	0.057
ADVOCACY FOR VULNERABLE CHILDREN'S RIGHTS	0.160	0.076	0.108	0.001
PROJECT TO END HUMAN TRAFFICKING – UGANDA	0.273	0.263	0.077	0.006

Opportunities

ALTERNATIVES	Team Purple (T ₁)	Nurses in Action (T ₂)	Team JKNS (T ₃)	Total (T ₁ * T ₂ * T ₃)
BRIGHT KIDS UGANDA ENTEBBE HOME AND HEALTH CLINIC	0.140	0.513	0.185	0.013
ENTEBBE CHILDREN'S WELFARE SCHOOL	0.550	0.065	0.447	0.016
ADVOCACY FOR VULNERABLE CHILDREN'S RIGHTS	0.079	0.249	0.140	0.003
PROJECT TO END HUMAN TRAFFICKING – UGANDA	0.231	0.173	0.225	0.009

Cost

ALTERNATIVES	Team Purple (T ₁)	Nurses in Action (T ₂)	Team JKNS (T ₃)	Total (T ₁ * T ₂ * T ₃)
BRIGHT KIDS UGANDA ENTEBBE HOME AND HEALTH CLINIC	0.248	0.501	0.334	0.041
ENTEBBE CHILDREN'S WELFARE SCHOOL	0.397	0.243	0.458	0.044
ADVOCACY FOR VULNERABLE CHILDREN'S RIGHTS	0.140	0.210	0.096	0.003
PROJECT TO END HUMAN TRAFFICKING – UGANDA	0.214	0.045	0.112	0.001

Risks

ALTERNATIVES	Team Purple (T ₁)	Nurses in Action (T ₂)	Team JKNS (T ₃)	Total (T ₁ * T ₂ * T ₃)
BRIGHT KIDS UGANDA ENTEBBE HOME AND HEALTH CLINIC	0.233	0.323	0.297	0.022
ENTEBBE CHILDREN'S WELFARE SCHOOL	0.131	0.066	0.167	0.001
ADVOCACY FOR VULNERABLE CHILDREN'S RIGHTS	0.328	0.146	0.480	0.023
PROJECT TO END HUMAN TRAFFICKING – UGANDA	0.308	0.465	0.054	0.008

Total Integrated Table

	Benefits	Opportunity	Costs	Risks	B*O	C*R	B/C	B*O/C	B*O/C*R
Bright Kids	0.013	0.013	0.041	0.022	0.000169	0.00902	0.317	0.004	0.187
Entebbe School	0.057	0.016	0.044	0.001	0.000912	0.000044	1.295	0.021	20.727
Children's Rights	0.001	0.003	0.003	0.023	0.000003	0.000069	0.333	0.001	0.043
Human Trafficking	0.006	0.009	0.001	0.008	0.000054	0.000008	6.000	0.054	6.75

6. LIMITATIONS

The AHP process has been widely discussed in the literature by scientists and practitioners. Though mathematically proofed there are still debates on the possibilities of application and the degree to which the results are relevant. We felt that one major limitation of pairwise comparison is that it is time consuming. $[n \times (n-1) \times j]$ pairwise comparisons have to be conducted per level with $n =$ number of comparisons and $j =$ number of criteria. If we had an opportunity to start over we would try to think of even more diverse criteria and analyze them to conclude.

7. CONCLUSION

Each team produced different results for the best alternatives using the pairwise comparison model in AHP. However, using the integrated group decision making AHP process, with the benefit/opportunity/cost/risk hierarchies, Entebbe Children's Welfare School appears to be the best alternative, while Advocacy for Vulnerable Children's rights seems to be the least desirable alternative.

References

- Bright Kids Uganda: A Group Home History, Future & Challenges. Video. https://www.youtube.com/watch?v=fOzHagKuyrA&feature=youtube_gdata_player.
- Barzilai, J. and Lootsma, F. (1997) Power relation and group aggregation in the multiplicative AHP and SMART. *Journal of Multi-Criteria Decision Analysis* 6(3): 155–165. | [Article](#)
- Braunschweig, T. (1997). An Illustrative Example for Research Priority Setting Using the AHP Approach. ISNAR, The Hague, Unpublished
- Falkenberg, Luke. (2013) Youth Lost: Ugandan Child Soldiers in the Lord's Resistance Army. *Small Worlds Journal*. Retrieved from

<http://smallwarsjournal.com/jrnl/art/youth-lost-ugandan-child-soldiers-in-the-lord%E2%80%99s-resistance-army>.

- Mangaliman, Jessie. (1998) St. Mary's College Examines Its Study-Abroad Program. *Wall Street Journal*. March 1, 1998, M03. Retrieved from <http://www.washingtonpost.com/wp-srv/local/longterm/stmarysrape/reexamine0398.htm>.
- Rising Fear of Lawsuits Is Threatening Programs of Study Abroad. *New York Times*. January 21, 1998. Retrieved from <http://www.nytimes.com/1998/01/21/us/rising-fear-of-lawsuits-is-threatening-programs-of-study-abroad.html>.
- Specter, Michael. (1998) Uganda AIDS Vaccine Test: Urgency Affects Ethics Rules. *New York Times*. October 1, 1998. Retrieved from <http://www.nytimes.com/1998/10/01/world/uganda-aids-vaccine-test-urgency-affects-ethics-rules.html>.
- Stam, A. and Duarte Silva, P. (2003) On multiplicative priority rating methods
- Uganda project materials developed by Dr. Burke and Dr. O'Rourke. Blackboard.carlow.edu.
- <http://eprints.port.ac.uk/1770/1/ORI-preprint-AIshizaka.pdf>

CARLOW-UGANDA INITIATIVE IV: CASE STUDY OF USING AHP AT THE UNDERGRADUATE LEVEL

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ABSTRACT

This case study explores the use of AHP in the quality of decision making at the undergraduate level. Students were charged to make small business recommendations for an entrepreneur in Uganda then rank those recommendations in preferred order without any model of decision making. Second, students were taught the AHP process and asked to reconsider the rankings. Comparative results of decision making processes were shared and discussed as well as the value of teaching AHP at the undergraduate level.

Keywords: undergraduate AHP teaching, global AHP

1. Introduction

Carlow University is a private, liberal arts, catholic university in Pittsburgh, Pennsylvania with newly-established connections in Uganda. The initial project involving the School of Education concerns bringing education and resources to those adults with special needs children. While the primary faculty were visiting Uganda early in January 2014, a project opportunity arose for business management students at the undergraduate level who are taking a Global

Management and Organizational Behavior class. Students were asked to help a young mother set up small business in Uganda so that she may have a means of supporting her special-needs child long term.

2. Literature Review

We will be reviewing Saaty's "Decision Making for Leaders" article (2000) as well as several working documents published by the Uganda Project Team Leaders of Carlow University: Drs. Mary Burke and Susan O'Rourke (2013) and Dr. Enrique Mu (2014).

A Culture Gram (Proquest, 2013) on the country of Uganda was used as one of the documents for the students to perform an environmental analysis as a foundation for their case recommendations and subsequent decision making process. The other document, the SEPTE+C Framework worksheet, was provided by the author, Dr. Cynthia Busin Nicola (2004).

3. Hypotheses/Objectives

The goal of the case study is to first address a small business project presented to the class by the Uganda Project Team leaders: Drs. Burke and O'Rourke. Students would make recommendations and a decision on the best small business option for a budding entrepreneur in Uganda. Second, students would be given instruction in AHP and allowed to make a second decision using the model. Comparisons in quality of decisions could show students the advantages of decision making between using management opinion/instinct and using an AHP model. Receptiveness of the model at the undergraduate level will be observed.

4. Research Design/Methodology

Currently, the course has twenty three students. The students formed themselves into groups of 4-5 and decided on their business focus. Each group was given a Culture Gram of Uganda and will perform an environmental analysis before they begin their projects. They also formed a Facebook page to communicate with the budding entrepreneur in Uganda so that they may ask her specific questions about product, market, interests, distribution, and technology. Students will present their proposals to each other with no guidelines for decision making and choose one group's alternative. Next, students will receive instruction in developing and AHP model and then make a decision. Students will be asked to reflect and compare both processes.

5. Data/Model Analysis

Figure 1: ISAHP

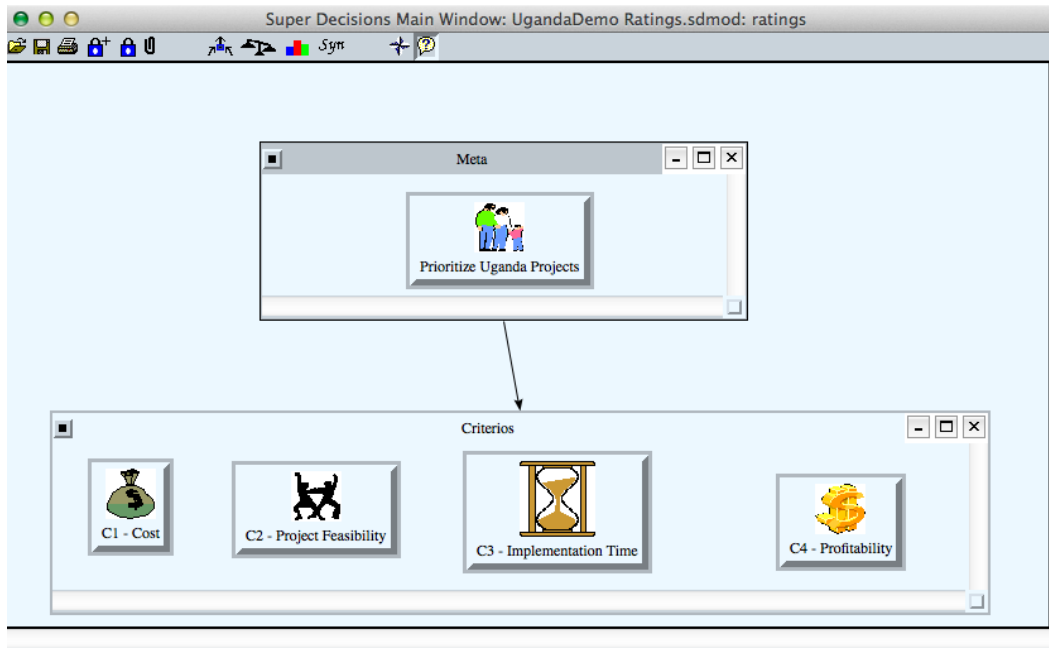


Figure 2: Criteria Weights

3. Results

Normal Hybrid

Inconsistency: 0.09939

C1 - Cost		0.09930
C2 - Proj-		0.62230
C3 - Impl-		0.06183
C4 - Prof-		0.21657

Figure 3: Absolute Measurements – Results

RANKING	PROJECTS	TOTAL	C1 COST 0.099	C2 FEASIBILITY 0.622	C3 TIME 0.061	C4 PROFITABILITY 0.216
2	P1	0.72774	0.72	0.75	0.6	0.71
1	P2	0.76912	0.78	0.77	0.8	0.76
5	P3	0.54858	0.55	0.53	0.43	0.64
4	P4	0.58773	0.61	0.58	0.5	0.63
3	P5	0.61211	0.7	0.59	0.51	0.67

6. Limitations

Students had limited access to their Ugandan source; they communicated through Facebook. They also were taught the AHP process in an expedient manner. More practice using different scenarios and in developing AHP models for each would have perhaps made a richer outcome in this case.

7. Conclusions

This exercise shows undergraduate students are receptive and understand the fundamental ideas behind AHP while – at the same time – use advanced software to make decisions. The results constitute a strong recommendation to teach AHP in undergraduate management curricula rather than waiting until graduate programs.

8. Key References

- Burke, M. and O'Rourke, S. (2013). Carlow University Business Plan for Uganda Collaborative - Specific Project: Vulnerable Children. Unpublished draft.
- Mu, E. (2014). Carlow-Uganda: Proposed Initiative, Executive Summary. Unpublished draft for Carlow University Business Plan for Uganda.
- Nicola, C. (2004). SEPT+ C Model of environmental analysis. Copyrighted.
- Proquest. CultureGrams: World edition. (2013). Republic of Uganda. Ann Arbor, MI.

9. Appendices