Technical Report 14-001

"Who do you know?" Developing and Analyzing Entrepreneur Networks: An Analysis of the Entrepreneurial Environment of Kampala, Uganda

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**United States Military Academy
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14. ABSTRACT

The goal of this project is to quantify the entrepreneurial network in such a way that the analysis provides concrete policy recommendations. Our center has experimented with several data collection methodologies and we have developed an innovative yet simple technique that allows us to develop quantifiable entrepreneur networks. Our innovation is not to develop each individual entrepreneur's network but to understand the entire network of the community in with the entrepreneur lives and operates. In order to develop this model, we have adapted a technique used in sociology to measure social capital called the Position Generator (Lin & Dumin, 1986; Lin et Al, 2001). This technique circumvents the massive effort of mapping an individual's social network before locating the social resources in it. By approaching the entrepreneur's network through the analysis of his connections to prominent structural positions in the community or society, researchers are able to construct measures that obtain information on the strength of ties and structural holes (Lin, 2001). For example, in a developing world entrepreneurial network these roles might include a non-governmental organization, a government program, or a family member.

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Abstract

Our research goal is to quantify the entrepreneurial network in such a way that the analysis provides concrete policy recommendations. Our Center has experimented with several data collection methodologies and we have developed an innovative yet simple technique that allows us to develop quantifiable entrepreneur networks. Our innovation is not to develop each individual entrepreneur's network but to understand the entire entrepreneurial network of the community in which the entrepreneur lives and operates. In order to develop this model, we have adapted a technique used in sociology to measure social capital called the Position Generator (Lin & Dumin, 1986; Lin et Al, 2001). This technique circumvents the massive effort of mapping an individual's social network before locating the social resources in it. By approaching the entrepreneur's network through the analysis of his connections to prominent structural positions in the community or society, researchers are able to construct measures that obtain information on the strength of ties and structural holes (Lin, 2001). For example, in a developing world entrepreurial network these roles might include a non-governmental organization, a government program, or a family member.

Sequential to this effort, we will designate a "goal network," an entrepreneurial environment that is considered to be especially conducive for successful Small and Medium Enterprises (SMEs) establishment. We will construct a network model using the same methodology and then mathematically determine which nodes in the "network of interest" are the "driver nodes." By influencing these nodes, or their links to other nodes, we can encourage the "network of interest" to evolve towards the propitious centrality metrics of the "goal network." The quantitative findings from this methodology will determine specific policy recommendations for each network based on its own specific centrality metrics.

Background

The facilitation of entrepreneurship and the establishment of Small and Medium Enterprises (SMEs) in the developing world is one of the keys to addressing many of the world's social and economic problems. Major international organizations such as the World Bank, International Monetary Fund, and the United Nations agree that SMEs are engines of growth, essential for a competitive and efficient market and critical for poverty reduction

Sociologists, economists, and network scientists concur that the entrepreneur's network, or specifically the people and organizations they interact with, are essential to his or her ability to identify and evaluate new business opportunities, access vital resources, and succeed economically. These practitioners have consistently struggled with developing models that are measurable or quantifiable. Most research on this subject tends to focus on the entrepreneur's social network and utilizes the Name Generator approach to develop the social network model. This method maps an ego-centered network and assembles an inventory of information about every social contact, such as the relationship between the person under analysis and the people within the social network.

The Name Generator approach creates numerous challenges. First, the person under analysis might be hesitant to provide names. Additionally, in many cultures, spelling may be an issue and the use of nicknames or numerous surnames make it challenging to determine the true identity of members of the networks. Finally, a member of the network may leave the network for numerous reasons but the role they serve in the network remains filled by another individual. Because of these issues, our team has determined that the Name Generator approach to network development is not appropriate in order to achieve our research goals.

Research Goal

Our research goal is to quantify the entrepreneurial network in such a way that the analysis empowers decision-makers with the requisite knowledge to develop specific policy recommendations. After experimenting with several data collection methodologies we adapted a technique used in sociology to measure social capital called the Position Generator. This technique circumvents the massive effort of mapping an individual's social network before locating the social resources in it. Our innovation is not to develop each individual entrepreneur's social network but to understand the entire entrepreneurial network of the community in which the entrepreneur lives and operates. By approaching the entrepreneur's network through the analysis of his connections to prominent structural roles in the community or society, we are able to construct models that can determine the influence of each role in specific entrepreneurial environments. For example, in a developing world entrepreneurial network these roles might include a non-governmental organization, a government program, or a family member.

Our research team has developed an innovative survey that allows us to aggregate each respondent's input, forming a network model that accurately measures the entrepreneurial environment in a particular location. The survey was tested during a visit to Addis Ababa, Ethiopia, last summer and we have modified it as a result of the lessons learned from that visit. This paper will focus on an initial descriptive analysis of the data collected in Kampala, Uganda.

Initial Data Collection

The team selected Kampala, Uganda, as its first data collection site for two reasons:

1. The team had previously been introduced to Jon Gosier, a software developer and designer working at the intersection of open data, human rights, and African development. Jon is the founder or co-founder of several organizations and initiatives, some of which include AfriLabs, Appfrica, and Hive Colab in Kampala. Jon agreed to cooperate on the project and his staff volunteered to host the team.

2. Kampala is a hot-bed of young African tech entrepreneurs. The current government has set the conditions for economic growth and has encouraged the growth of small businesses. There are four other business incubators besides Hive CoLab in Kampala. Additionally, Kampala is the home of Makerere University, one of the leading universities in Sub-Saharan Africa. The student body is energetic and tech savvy.

Based on our coordination with the staff of Hive CoLab, we were also able to collect data at other business incubators in Kampala. The following incubators allowed our team to visit and survey entrepreneurs operating at each location.

- Hive CoLab- the first tech-focused business incubator in Uganda. It was founded in 2010 through the efforts of Jon Gosier and Teddy Ruge. Hive CoLab is a large open space with a reliable Internet connection, a back-up power source, and a conference space for one-on-one meetings. It is a community-owned, collaborative, co-working space for the Uganda's Technology community. Membership is open to all and free. Hive currently has a rental structure for a dedicated workspace for the firms that are working out of the incubator.
- Outbox- Outbox was founded in 2012 and is the newest business incubator in Kampala. Outbox is financially supported by Google, Deloitte, and Samsung. Outbox markets itself not just as an incubator, but also as a place for the tech community to meet with potential mentors and access professional services. It is also involved in facilitating innovation competitions and industry workshops. Outbox also has a quality Internet connection and a back-up power supply.
- @TheHub Kampala- @TheHub is located in two renovated Kampala City Council flats on a quiet street and has a different membership focus. Their members are

more diverse. There are tech-focused entrepreneurs as well as a number of graphics artists, journalists, and local small businesses needing office space. @TheHub also has a quaint garden cafe that serves excellent food, coffee, and a wide selection of fresh juices. It's a natural gathering place for Kampala's creative set.

- Mara LaunchPad- LaunchPad was founded in 2010 by the Mara Foundation which was established by the founder and Director of Mara Group, Ashish J. Thakkar. Ashish is a Ugandan-born entrepreneur who grew a small computer trading operation into a diversified conglomerate with approximately $100 million in revenues. Mara LaunchPad has an open-plan layout with modern furniture. Members are able to take advantage of the fast Wi-Fi Internet connection, lounge area, and conference room. The businesses under incubation at Mara LaunchPad are more diverse than those at the other incubators that we visited. Their start-ups include manufacturing companies, call center operations, and agriculture in addition to tech start-ups. LaunchPad typically seeds approximately $2,000- $4,000 per company and takes an equity stake with a three to five year time frame. Additionally, each firm pays rent ranging from $35-$125 per month depending on the size of their space. The incubation goal is 24 months. Mara can house up to 40 businesses at one time and additionally, their Innovation Center has room for another 50-60 individuals.

Position Generator Survey

In order to collect the necessary data, the team has developed a six-question survey that gathers some basic demographic data yet keeps the respondent's identity anonymous. The survey analyzes six different focus areas in the network:

1. Business Registration
2. Start-Up Capital
3. Equipment
4. Legal Issues
5. Infrastructure
6. Human Resources

Each of the six questions is similarly structured. The questions ask the position or role the subject would most likely approach in order to get assistance with one of the focus areas. For example, the first question asks:

"If you require assistance with **the legal registration** of your business, who would you most likely approach in order to address this issue?"

Each of the questions has the same possible responses:

1. Myself
2. Government Representative
3. Government Business Development Program
4. Private Incubator
5. Non-Governmental Organization
6. Venture Capitalist or Angel Investor
7. Family Member
8. Religious Leader
9. Someone in Social Network
10. Commercial Bank
11. White Collar Professional
12. Military Leader
13. Education Leader

This particular survey structure allows for the development of network models that can be accurately compared and contrasted.

Analysis

Over the course of four days, we were able to interview 39 local entrepreneurs. Based on their answers to the survey, we developed the matrix depicted in Table 1 that captures the number of times that each entrepreneur answered a specific role to one of the six survey questions.

Based on this collected data, we developed an initial network (Figure 1) that illustrates how the respondents are connected to each of the roles in the network. The resulting network model is interesting but still does not present the necessary insights to a policy maker. The ability to understand the influence that each role possesses and its relationship to other roles in the entrepreneurial network is vital to effective policy making. Fortunately, network analysis techniques allow us to quantify this influence.

	Self	Govt Rep	Govt Biz Dev	Incubator	NGO	VC/Angel	Family	Religious	Social Network	Bank	Prof	Military	Education
1	3	0	0	1	0	0	0	0	2	0	0	0	0
2	0	0	0	4	0	0	1	0	1	0	0	0	0
3	0	0	0	0	0	1	0	0	2	0	3	0	0
4	0	1	0	1	0	0	2	0	1	0	1	0	0
5	0	1	0	0	0	0	2	0	2	0	1	0	0
6	0	0	0	1	0	0	1	0	3	0	1	0	0
7	1	1	1	0	0	1	1	0	0	1	0	0	0
8	1	0	0	1	0	0	1	0	1	0	2	0	0
9	1	0	0	0	0	0	2	0	1	0	1	0	1
10	1	1	0	1	0	0	1	0	1	0	1	0	0
11	0	0	1	0	0	1	0	0	2	1	1	0	0
12	3	0	0	0	0	1	0	0	0	0	2	0	0
13	1	0	0	0	0	0	2	0	2	0	1	0	0
14	2	0	2	0	0	2	0	0	0	0	0	0	0
15	1	0	0	0	0	1	0	0	4	0	0	0	0
16	2	0	0	0	0	0	1	0	1	0	2	0	0
17	2	0	0	0	0	0	0	0	4	0	0	0	0
18	1	0	0	1	0	1	1	0	1	0	1	0	0
19	2	0	0	1	0	1	0	0	0	0	2	0	0
20	2	0	0	0	0	0	1	0	0	0	3	0	0
21	3	0	0	1	0	0	0	0	1	0	1	0	0
22	2	0	1	0	0	0	0	0	2	0	1	0	0
23	1	0	0	0	0	0	0	0	3	0	2	0	0
24	1	0	0	0	0	0	0	0	0	1	4	0	0
25	0	0	0	0	0	1	0	0	5	0	0	0	0
26	0	0	0	0	0	1	0	0	5	0	0	0	0
27	0	0	0	0	2	0	0	0	3	0	2	0	0
28	2	0	0	0	1	0	0	0	1	0	2	0	0
29	1	0	0	0	1	1	0	0	3	0	0	0	0
30	1	0	1	0	0	1	0	0	2	0	1	0	0
31	1	0	0	1	0	2	0	0	0	0	2	0	0
32	3	0	0	0	0	0	1	0	1	0	1	0	0
33	3	0	0	0	0	0	1	0	1	0	1	0	0
34	2	0	1	0	1	0	0	0	2	0	0	0	0
35	1	1	0	1	0	0	2	0	0	0	0	0	1
36	1	0	0	0	0	0	0	0	4	0	1	0	0
37	2	0	0	0	0	0	0	0	3	0	1	0	0
38	1	0	0	0	0	0	2	0	2	0	1	0	0
39	0	0	0	0	0	0	0	0	6	0	0	0	0

Table 1-Raw data

Network Science Center, West Point
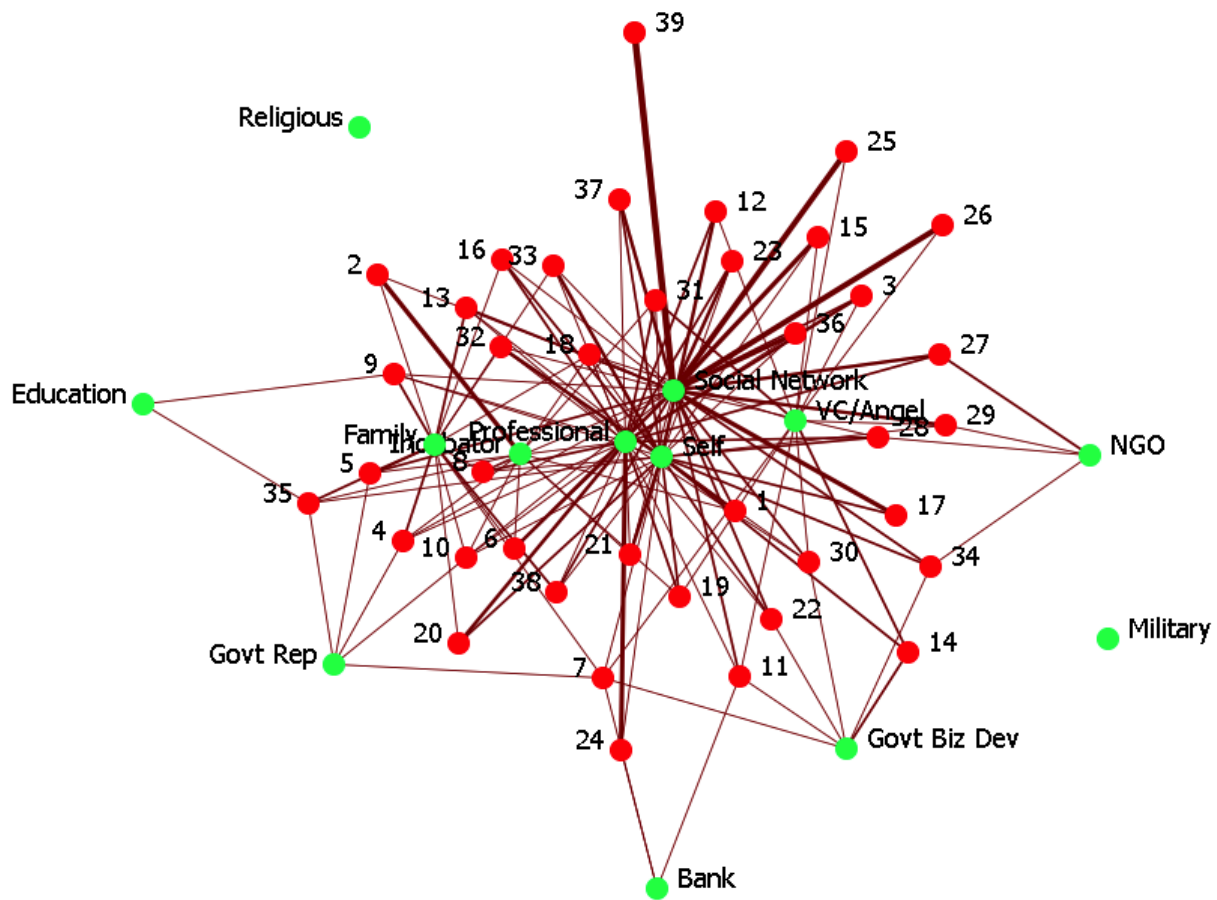www.netscience.usma.edu
845.938.0804

Figure 1

A technique commonly referred to as "data folding" uses matrix algebra techniques to enable us to infer both influence and relationships of the roles in this particular network. This technique takes the original two-mode network (survey respondents and roles) and converts it to a single-mode network. In this case, it illustrates how the roles are connected through the respondents and captures the weighting of the number of times that the respondent answers a survey question citing a specific role.

	Self	Govt Rep	Govt Biz Dev	Incubator	NGO	VC/Angel	Family	Religious	Social Network	Bank	Prof	Military	Education
Self	0	3	10	13	5	16	22	0	65	2	54	0	2
Govt Rep	3	0	1	3	0	1	8	0	4	1	3	0	1
Govt Biz Dev	10	1	0	0	1	7	1	0	8	2	3	0	0
Incubator	13	3	0	0	0	4	12	0	14	0	11	0	1
NGO	5	0	1	0	0	1	0	0	12	0	6	0	0
VC/Angel	16	1	7	4	1	0	2	0	24	2	14	0	0
Family	22	8	1	12	0	2	0	0	26	1	22	0	4
Religious	0	0	0	0	0	0	0	0	0	0	0	0	0
Social Network	65	4	8	14	12	24	26	0	0	2	53	0	1
Bank	2	1	2	0	0	2	1	0	2	0	5	0	0
Professional	54	3	3	11	6	14	22	0	53	5	0	0	1
Military	0	0	0	0	0	0	0	0	0	0	0	0	0
Education	2	1	0	1	0	0	4	0	1	0	1	0	0

Table 2-Role x Role Matrix

Based on this resulting matrix, we can now develop the following network model:
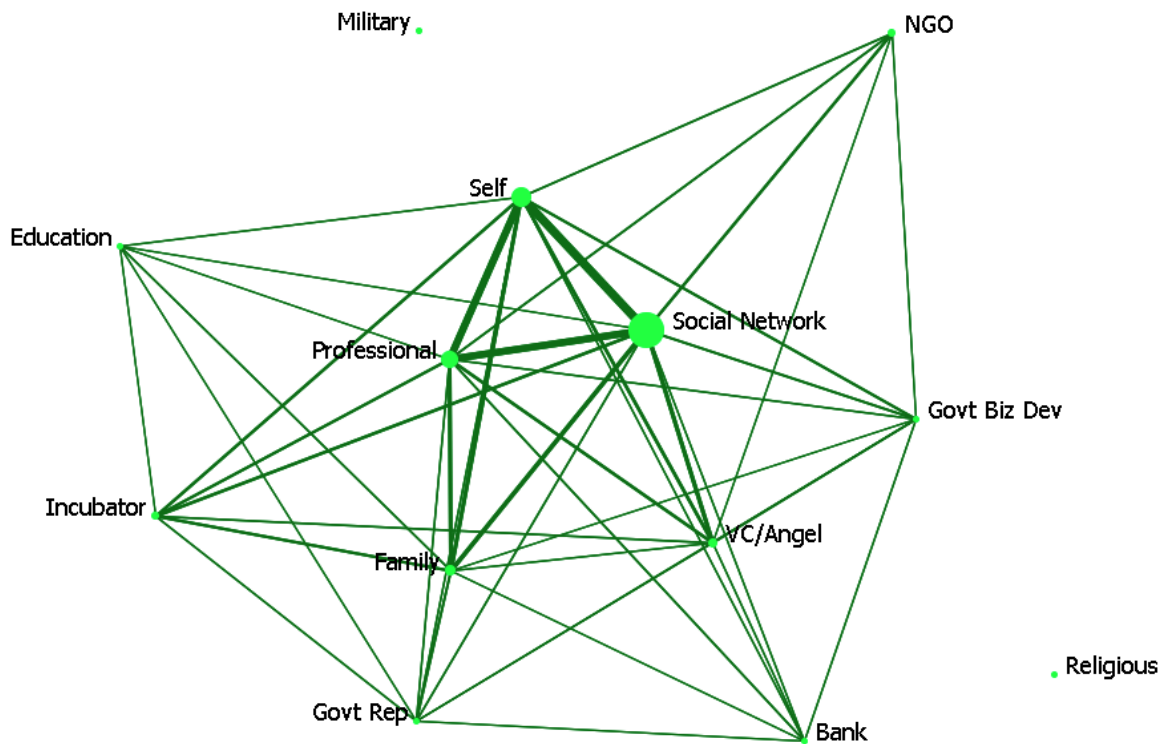

Figure 2
The nodes in Figure 2 are sized by eigenvector centrality (a measure of how connected a node is to other influential nodes) and the links are weighted based on the

strength of the connection between the nodes. A visual inspection of the network model illustrates the importance of several roles in the network. For instance, Social Network, Professional, Self, Family, and VC/Angel are very central in the network. Interestingly, both Military and Religion are not connected to the network, indicating that these roles are not influential in the Kampala entrepreneurial environment.

Network analysis techniques enable us to quantitatively characterize the nodes in this network. For our initial analysis, we will focus on three common measures commonly referred to as centrality metrics.

1. Degree Centrality-a measure of how important or influential a node is based on the number of connections a node has in comparison to the total possible number of connections in the network. Nodes that are high in degree centrality tend to be in the center of the network graph.
2. Eigenvector Centrality-a measure of how connected a node is to other influential nodes. Nodes that have a high eigenvector value tend to be the most influential and sometimes it identifies hidden influencers.
3. Betweenness Centrality- a measure of how many sub-groups within the network of which the node is a member. Nodes that have a high betweenness value tend to connect sub-groups within the network.

The following table is a summary of the centrality metrics for the Kampala entrepreneur network:

	Degree	Eigenvector	Betweenness
Self	0.295	0.752	0.000
Govt Rep	0.039	0.084	0.456
Govt Biz Dev	0.051	0.131	0.154
Incubator	0.089	0.243	0.000
NGO	0.039	0.124	0.011
VC/Angel	0.109	0.305	0.070
Family	0.151	0.397	0.019
Religious	0.000	0.000	0.000
Social Network	0.322	0.773	0.000
Bank	0.023	0.055	0.128
Professional	0.265	0.696	0.000
Military	0.000	0.000	0.000
Education	0.015	0.034	0.485

Table 3-Network Centrality Metrics

The centrality metrics are normalized from 0 to 1; this enables us to effectively compare the nodes within this network. For example, an analysis of degree centrality indicates that Self is approximately twice as influential as Family (.295 to .151).

Our initial analysis of the survey data yields some interesting insights. Confirming the visual inspection, Social Network and Self have the highest values in both degree and eigenvector centrality. Interestingly, they both do not appear to be a connector between the roles; they both have a betweenness centrality value of 0.

A side-by-side comparison of degree and eigenvector centrality measures in descending order confirms that both measures are correlated; the roles' order of influence are the same using both centrality measures.

	Degree	Eigenvector
Social Network	0.322	0.773
Self	0.295	0.752
Professional	0.265	0.696
Family	0.151	0.397
VC/Angel	0.109	0.305
Incubator	0.089	0.243
Govt Biz Dev	0.051	0.131
NGO	0.039	0.124
Govt Rep	0.039	0.084
Bank	0.023	0.055
Education	0.015	0.034

Table 4-Degree and Eigenvector Centrality Comparison

An analysis of betweenness centrality yields more interesting insights. Using betweenness centrality to compare, we find that the Education and Government Representative roles play an important connecting role in the entrepreneurial network.

An Analytical Challenge

The survey data that we collected is weighted because we "count" the number of times a respondent selects a particular "position or role" in response to a survey question as illustrated in Table 1. This is problematic when we use the "data folding" technique because it involves matrix multiplication and the resulting values in the new matrix exaggerate the scale of the relationships between the nodes. A relationship that is nominally strong in the original two-mode matrix receives a profoundly higher weighting in the final Role by Role matrix.

A network analysis technique commonly used to avoid this issue is to binarize the data (links either exist or they don't; zero or one) prior to folding the network. Because the survey instrument captures the number of times a respondent selects a particular role, this

technique would lose the strength of the relationships between the roles in the entrepreneurial environment under analysis.

As our project progresses, we will explore other analytical techniques in order to more accurately portray the nodes' influence and the strength of the relationships. Some of these techniques will include several "projection techniques" which are quantitative techniques that utilize additive instead of multiplicative techniques in order to better convey the true information in regards to tie or link-strength in the network.

Conclusion

We will collect similar data from three other entrepreneurial environments in emerging economies. Once these network models are completed, our team will develop a quantitative technique that will enable the classification of each network. Based on this classification technique, we will be able to state, quantitatively, whether the networks are the same or if they are different and what quantitative differences exist.

As previously stated, we will then quantitatively compare the networks with the "goal network" and mathematically determine the nodes in the "network of interest" which are potentially the "driver nodes." These "driver nodes" are nodes that can be influenced in order to make network outcomes more socially desirable (Barabasi, 2011). The quantitative findings from this methodology will determine specific policy recommendations for each network based on its own specific centrality metrics. This methodology also develops a strong foundation for future economic development simulation exercises.

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