Business Selection using Multi-Criteria Decision Analysis

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Abstract

One of the major challenges facing an entrepreneur in business prioritization entails coming-up with a reliable model that will rank the available opportunities (what type of business to be invested?). Usually, investors have multiple and conflicting criteria to base their selection decision. In this paper we first review some of the criteria used to select business type. We then propose the use of multi-criteria decision analysis (MCDA) models that involves a single decision maker (the potential investor). Specifically, we propose the use of three deterministic families of models i.e. the WSM, WPM and AHP. The models are illustrated with prototypes of the real problem. Later, we propose ways of deriving and estimating the model parameters. Subsequently, we provide a statistical framework of enumerating business types within a catchment area through the use of fall-back principal. In our conclusion, we outline the research gaps, propose a modeling framework for the MCDA business selection tool, and give a snap-shot of the menu driven screen for the model.

Key words: business selection, business prioritization and multi-criteria decision method.

1. Introduction

One of the major problems facing a potential investor is on the type of business to invest. According to (Hisrich, et.al. 2005) an entrepreneurial problem has four distinct phases: (1) identification and evaluation of the opportunity, (2) development of the business plan, (3) determination of the required resources, and (4) management of the resulting enterprise. Opportunity identification and evaluation is the most difficult task to an investor because it requires time, effort, money and temperament. The problem is further compounded by the fact that investor's have different taste, experience, risk level, amount of capital, business intention among other criteria. In a nutshell the problem involves choosing a business type under multiple decision criteria.

Consequently, one will automatically get inclined to search for a model that aids business selection. Unfortunately, our study of the literature showed that such models has not been researched, or to be more precise, has not been published in the literature. Many researchers will either give a heuristic, a series of steps or guiding questions to select a business opportunity but not a model. Furthermore, these heuristics and set of questions can only be applied when business alternatives are known beforehand.

For instance, (Hisrich,et.al., 2005) advances that the idea initially comes from: consumers and business associates, members of the distribution system, and technical people. Thereafter, this step is followed by an evaluation process i.e. looking at the length of the opportunity, its real and perceived value, its risks and returns, its fit with the personal skills and goals of the entrepreneur, and its uniqueness or differential advantage in its competitive environment.

Stowe (2011) poses three fundamental questions (1) Does your proposed business solve a problem and can you define what that problem is, who has that problem, what is that solution worth to them, and finally, can you solve the problem profitably? (2) Would you want to spend 12-14 hours a day working in that business? and (3) Can you keep your day job while you prototype your business?"

The Government of Saskatchewan (2008) has published a checklist for potential investors contemplating going into business for the first time. The checklist has a series of questions that scrutinizes whether the idea represents a real business opportunity. The questions requires a YES or NO answer and are broadly classified under: General personal considerations, specific personal considerations, general project description, requirements for success, major flaws, desired income, equipment and supplies, expenses, miscellaneous, and venture feasibility.

Gundry and Kickul (2007) also concurs that many questions can be asked during opportunity evaluation that can be classified according to four primary areas of exploration: (1) The person behind the idea such as his background, talents, and business experience (2) The resources available to the investor (3) The knowledge and information possessed by the investor; and (4) The business potential to generate revenue. He further remarked on the use of an alternate technique, the *Business Evaluation Scoring Technique* (BEST) depicted on Table 1.1, where the following questions are posed and rated on a 1–5 scale: 1 = low and 5 = high.

1. Is the business really differentiated from other similar businesses?
2. Does the business have growth potential?
3. Will the business require capital?
4. Can financing be secured?
5. Does the business suit the individual's entrepreneurial profile (e.g., mind-set, experience, etc)?

In an attempt to aid potential investors, many entrepreneurs have come-up with unpublished online version of such questions or e-book, these include: Alli's (2012) *fourteen questions to ask every time*, Grinda's (2012) nine *business selection criteria*, Falter's (2012) e-book on *six or even seven figure: how to select a home-based business* , Sayre's (2010) e-book on *how to choose the perfect business opportunity for you*; and Bwisa's (2012) e-book on *MUKIMIK business selection tool.*

Our study targets a single investor defined as an individual who commits money to investment products or services with the expectation of financial return. According to the definition given by Kenya Association Investment Groups (KAIG, 2012) he differs from group investors since he is solo while the latter are group of individuals, who pool resources together, to invest in a project that will yield a profit, which will be shared among the members in prescribed ratio. These groups are developed by people who share similar social interests and a desire to learn more about investing.

The rest of the paper is structured as follows: first we give the statement of the problem and objectives of the study, then introduce the concept of MCDA technique where both theoretical and conceptual frameworks are discussed. In the conceptual framework, we make an illustration by prototyping the use of MCDA models (WSM, WPM and AHP methods). Further, we discuss the model salient features and address issues touching on (1) business selection criteria and statistical correlation; (2) preferences and weights; and (3) the process of identifying business opportunities through the fall-back principle. Finally, we conclude by identifying the research gaps, suggestion of a modeling framework and give a snap-shot of the menu driven screen of the model.

2. Statement of the problem and objectives

One of the major challenges facing an entrepreneur in business prioritization entails coming-up with a reliable model that will rank the available business opportunities (where should we invest). A useful class of models that rank the opportunities is called multi-criteria decision analysis (MCDA) that deals with decisions involving the choice of a best alternative from several potential candidates, subject to several criteria such as those faced by a potential investor. Although MCDA technique seems to offer a natural mechanism to tackle problems of this nature, there is no evidence of their use. Partly this is because the problem is an inter-disciplinary in nature (i.e. Entrepreneurship and Management Science) but mainly because MCDA requires intervention of Management Science that lacks in an entrepreneur. We therefore propose to build the first *MCDA business selection tool* with inherent family of models to solve the problem.

For the MCDA model to work, four data issues relating to the model parameters have to be addressed. First, we need to identify the most relevant set of questions that can be used by a single investor wishing to invest in a certain region. Example of such questions can include: what are the objectives for starting a business? Why does someone want to own a business? etc. Although there is rich literature on such questions, the major challenge is to establish the relevance of such questions to the type of investment. In essence, one way of establishing this relevance is through a study involving statistical correlation analysis.

Second, as individual investors have boundaries on the investment capability and preferences, we wish to develop a framework that would account these limitations. This will only be possible if, for each question asked, we enumerate the possible responses from the investor. As the responses are directly linked to the model, it is essential that the validity of such responses is supported via a triangulation research technique.

Initially, literature review can be done followed by a panel discussion and frequency distribution analysis from an administered structured questionnaire.

The third challenge entails weighting the responses from the potential investors and linking them to the MCDA model. In this case, weight normalization heuristic needs to be developed and embedded in the MCDA model. While numerous methods exist for weights normalization, we propose a popular rating method that requires the responses to be expressed on a numerical scale.

Finally, for the model to work we requires a database hooked into the MCDA model that enumerates possible business opportunities available within a region. Initially, a sample size based on stratified random sampling technique will be selected. The sample will then be analyzed and generalized for the remaining regions (population) through a *fall-back* principle that uses statistical induction.

The overarching research objective to be addressed in this concept paper can be summarized as: To design an MCDA investor's business selection model. The research has the following specific objectives:

a. Present a new model using MCDA techniques that will prioritize business opportunities.
b. Analyze the criteria used by an entrepreneur for aiding investment decisions.
c. Establishing a process of assigning weights to the different criteria identified in (b).
d. Weighting the preferences (answers) selected by the investors based on the criteria identified in (b).
e. Establishing a process of identifying the business types in a region (i.e. the investment opportunities available in the region).

3. Theoretical and conceptual frameworks

In this section, we begin with a review of the theoretical framework followed by the conceptual framework on how the MCDA can be applied to solve the business selection problem. The theoretical framework gives an overview of the MCDA technique; the steps involved and discussion on the various classification methods.

In the conceptual framework, operationalization of the MCDA is presented through a prototype example. The adaptation of a family of models of MCDA with assumptions on how the parameters can be obtained is then discussed. Specifically, we first present details of three types of deterministic - single decision-maker models and illustrate how they can be applied in real life. For the model to work, the parameters need to be obtained through a logical sound reason. Under model salient features, initially we discuss how to obtain the model's criteria and justify the corresponding model's matrix through literature review and correlation study, respectively. Next, we propose that the investor's most probable response to the questions can be obtained through literature review backed-up by a triangulation method incorporating panel discussion and frequency distribution from an administered structured questionnaire. To standardize the weights, we propose use of rating algorithm that can be integrated in the MCDA model. Finally, we illustrate a statistical induction approach (fall-back principle) that can be used to enumerate possible business opportunities for the model.

3.1 Theoretical framework

MCDA is a branch of Management Science which deals with decision problems under the presence of multiple, usually conflicting criteria. It is a set of procedures that analyze complex decisions based on distinct, conflicting criteria and by deriving scores provide an overall ordering of options, from the most preferred to the least preferred option. MCDA consists of a series of techniques (i.e., weighted summation, concordance, analysis, etc.) that facilitate the scoring, ranking, or weighting of decision-making criteria based on stakeholder preferences. These techniques ideally operate within a transparent framework that encourages informed decision-making by providing opportunities for genuine, substantive participation in decision-making. This framework is also supported by the best available scientific knowledge that can also incorporate uncertainties in an honest, rigorous and consistent manner (Suedel et.al. 2011). MCDA typically involves the following steps (Communities and Local Government, 2009):

1. Establish the decision context: Establish aims of the MCDA, and identify decision maker(s) and other key players.
2. Identify the options to be appraised: inputting all the available options.
3. Identify objectives and criteria: Identify criteria for assessing the consequences of each option.
4. Scoring: Assess the expected performance of each option against the criteria. Then assess the value associated with the consequences of each option for each criterion. Describe the consequences of the options; score the options on the criteria; and check the consistency of the scores on each criterion.
5. Weighting: Assign weights for each of the criterion to reflect their relative importance to the decision.
6. Combine the weights and scores for each option to derive an overall value: Calculate overall weighted scores at each level in the hierarchy; calculate overall weighted scores.
7. Examine the results.
8. Sensitivity analysis: Conduct a sensitivity analysis: do other preferences or weights affect the overall ordering of the options? Look at the advantage and disadvantages of selected options, and compare pairs of options. Create possible new options that might be better than those originally considered. Repeat the above steps until a 'requisite' model is obtained.

In MCDA, the alternatives are given scores based on stipulated criteria normally on an interval or ratio scales. Thereafter, weights are assigned to the criteria and then computed with an appropriate algorithms based on value or utility functions, goal programming, outranking or descriptive/multivariate statistical methods to determine the rank of the alternatives. One of the greatest challenges associated with MCDA is how to compare and combine dissimilar metrics. Often dissimilar criteria are transformed or normalized to a single scale such as zero to one. Transformation to this commensurable scale can be accomplished through multiple techniques. Following scale transformation, criteria and value are combined through aggregation algorithms, and alternatives are compared and ranked (Suedel et.al. 2011).

The multi-criteria analysis problems can be divided into three types: problems of multi-criteria choice, problems of multi-criteria ranking and problems of multi-criteria sorting (Vassilev, Genova and Vassileva , 2005). The problem of choice essentially entails finding the relevant MCDA technique among the various methods in use or in literature. This also breeds the classification problem where there is no universal agreement on a standard approach.

According to (Vincke, 1992) the methods can be grouped in three separate classes; these include the multi-attribute utility, (value) theory methods, outranking methods and interactive algorithms. An alternate way of classification is according to the number of individuals involved in the decision-making process. Hence, we have single decision maker MCDA methods and group decision making MCDA. Yet another classification distinguishes deterministic, stochastic and fuzzy methods (Mateu, 2002). In the deterministic approach, the decision-making problem (i.e. the alternatives, criteria, etc.) are known with certainty and well defined. The stochastic or probabilistic case corresponds to uncertainty surrounding the decision-making problem e.g. the criteria are viewed as random variables. Finally, fuzzy methods consider different types of uncertainty and imprecision in some of the elements of the decision making problem.

3.2 Conceptual framework

In this paper we concentrate our attention on single decision maker deterministic MCDA methods (Chen and Hwang, 1992) and according to (Triantaphyllou and Baig, 2005) the most popular of these include the WSM, WPM, AHP, revised AHP, and the multiplicative AHP. For concept illustration and simplicity, we give a prototype of WSM, WPM and AHP methods. The three methods have similar data structure and can easily be integrated in one tool.

Illustration 1

Suppose that the business selection problem involves four criteria and four business alternatives (i.e. MPESA, TAXI, TUKTUK and KIOSK). Further, suppose that the relative preference of the four criteria (C_j) were selected by a potential investor to be Q1-C, Q2-A, Q3-B and Q4-D that correspond to $W_1 = 0.20$, $W_2 = 0.40$, $W_3 = 0.25$ and $W_4 = 0.15$, respectively (as shown in Figure 2.1). Note that the weights are part of the model logic but remain invisible to the potential investor. Also assume research has shown that the identified criteria *correlate* (on a 100% scale) with the business types as shown by the matrix. We are required to rank the business alternatives in order of the investor's preference using the WSM, WPM, and AHP methods.

	Criteria 1	Criteria 2	Criteria 3	Criteria 4
	0.20	**0.40**	**0.25**	**0.15**
MPESA	30	15	30	20
TAXI	10	25	30	25
TUKTUK	30	25	10	10
KIOSK	25	30	20	10

3.2.1 Weighted Sum Model (WSM)

The WSM (Triantaphyllou, 1997) is the best known and simplest MCDA method for evaluating a number of alternatives in terms of a number of decision criteria.

In general, suppose that a given MCDA problem is defined on *M* alternatives and *N* decision criteria. Furthermore, let us assume that all the criteria are benefit criteria, that is, the higher the values are, the better it is. Next suppose that w_j denotes the relative weight of importance of the criterion C_j and a_{ij} is the performance value of alternative A_i when it is evaluated in terms of criterion C_j. Then, A^*_{WSM} is the preference value of the best alternative and is defined as:

$$A^*_{WSM} = \max_i \sum_{j=1}^{N} a_{ij} w_j, \quad \text{for } i = 1, 2, 3. \ldots\ldots, M.$$

For the maximization case, the best alternative is the one that yields the maximum total performance value. Now, returning to *illustration 1*, when the formula for A^*_{WSM} is applied, the scores of the three alternatives are:

- *MPESA* (WSM score) = (30×0.20) + (15×0.40) + (30×0.25) + (20×0.15) = 22.50
- *TAXI* (WSM score) = 23.25,

- *TUKTUK* (WSM score) = 20.00.
- *KIOSK* (WSM score) = 23.50

The best alternative is *KIOSK* because it has the highest WSM score of 23.50. The following ranking is derived:

KIOSK > TAXI > MPESA >TUKTUK

3.2.2 Weighted Product Model (WPM)

The WPM (Triantaphyllou, 1997) is also a popular MCDA and similar to the WSM. The main difference is that instead of addition in the main mathematical operation we have multiplication. In this case each decision alternative is compared with the others by multiplying a number of ratios, one for each decision criterion. Each ratio is raised to the power equivalent to the relative weight of the corresponding criterion. Suppose similar notations hold as for the previous problem. Then, if one wishes to compare the two alternatives A_K and A_L (where $m \geq K, L \geq 1$) then, the following product has to be calculated:

$$R\ (A_K/A_L) = \prod_{j=1}^{N} \left(\frac{a_{Kj}}{a_{Lj}}\right)^{w_j}, \text{ for K, L = 1, 2, 3, M.}$$

If the ratio $R(A_K/A_L)$ is greater than or equal to the value 1, then it indicates that alternative A_K is more desirable than alternative A_L (in the maximization case). The best alternative is the one that is better than or at least equal to all other alternatives.

Returning to *illustration 1*, when the formula for *WPM* is applied, the scores of the four alternatives are:

- *R(MPESA/TAXI*) = $(30/10)^{0.20}\times(15/25)^{0.40}\times(30/30)^{0.25}\times(20/25)^{0.15}= 0.98 > 1$
- *R(MPESA/TUKTUK)* = 1.19 > 1 (means MPESA ranks higher than TUKTUK)
- *R(MPESA/KIOSK)*= 0.97 < 1 (means MPESA ranks lower than KIOSK)
- *R(TAXI/TUKTUK)*= 1.21 > 1 (means TAXI ranks higher than TUKTUK)
- *R(TAXI/KIOSK)*= 0.98 < 1 (means TAXI ranks lower than TUKTUK)
- *R(TUKTUK/KIOSK)*= 0.81 < 1 (means TUKTUK ranks lower than KIOSK)

By the above inferential, we can deduce that KIOSK is a better option and the ranking will be similar as for WSM:

KIOSK > TAXI > MPESA >TUKTUK

3.2.3 The Analytic Hierarchy Process (AHP)

The AHP (Saaty, 1980) is based on decomposing a complex MCDM problem into a system of hierarchies. The final step in the AHP deals with the structure of an $M\times N$ matrix. This matrix is constructed by using the relative importance of the alternatives in terms of each criterion. The entry q_{ij}, in the $M\times N$ matrix, represents the relative value of the alternative A_i when it is considered in terms of criterion C_j.

In the original AHP the sum $\sum_{i=1}^{N} q_{ij}$ is equal to one.

According to AHP the best alternative (in the maximization case) is indicated by the following relationship

$$A^{*}_{AHP} = \sum_{j=1}^{N} q_{ij} w_j, \quad \text{for i = 1, 2, 3. …….,M.}$$

The similarity between the WSM and the AHP is evident. The AHP uses relative values instead of actual ones. Thus, it can be used in single- or multi-dimensional decision making problems.

Returning to *illustration 1*, instead of the absolute data, the AHP would use the following relative data:

	Criteria 1	Criteria 2	Criteria 3	Criteria 4
	0.20	**0.40**	**0.25**	**0.15**
MPESA	30/95	15/95	30/90	20/65
TAXI	10/95	25/95	30/90	25/65
TUKTUK	30/95	25/95	10/90	10/65
KIOSK	25/95	30/95	20/90	10/65

- *MPESA* (WSM score) = (30/95)0.20× (15/95)0.40)×(30/90)0.25×(20/65)0.15 = 0.256
- *TAXI* (WSM score) = 0.267
- *TUKTUK* (WSM score) = 0.219
- *KIOSK* (WSM score) = 0.258

The highest score is *TAXI* with 0.267. Moreover, the ranking of these alternatives is as follows:

TAXI > KIOSK > MPESA >TUKTUK

3.2.4 Selection criteria and correlation matrix

In business selection criteria, there are a number of variables that influence an individual to select a business types. We argue that these criteria differ by industry and business type. According to Bwisa (2011), some of the criteria that can be used for business selection in Kenya include:

1. What are your objectives for starting a business? Why do you want to own a business?
2. In which part (town) of Kenya would you like to start the business?
3. What are you passionate about in life?
4. What are your interests/hobbies?
5. What are your skills?
6. What is your personality?
7. How much risk can you tolerate? E.g. how do you usually feel when you suffer a financial loss?
8. How much time can you commit to your startup?
9. How much contact do you want to have with your customers?
10. Where do you want to do most of your work from?
11. What do you want to sell?
12. Who would you like to be your target customer?
13. What business experience do you have?
14. What are your views about competition?
15. What group of business interests you most
16. What annoys you most in life?
17. What would you consider to be your personal business strength(s)?
18. What would you consider to be your personal business weakness (es)?
19. Where would you love to locate your business?
20. How much do you want to invest?

Although the above criterion gives a basis for our research, we need to establish two facts. On one hand, should we limit ourselves only on these or should we increase the number of criteria? Secondly, what is the degree of correlation (Figure 2.2) that the above criteria influence the business type to invest? It makes sense to narrow down on the criteria that have strong correlation with the business type. Note that for the MCDA problem, the correlation factors will form the basis of the matrix a_{ij} for WSM, WPM and AHP models.

3.2.5 Preferences and weights

One of the challenges is to enumerate all possible preferences (investor's answers) for each criterion and assign a numerical value (weight). In this case, we can tackle the problem using triangulation method. Triangulation refers to the process of using multiple data collection methods, data sources, analysis, or theories to check the validity of the findings. Through the process of triangulation, any finding or conclusion is likely to be much more convincing and accurate if it is based on several different sources of information, following a corroboratory mode.

Quantitatively, we can administer a questionnaire and ask the previous investors on their preferential attributes; the attributes with a higher frequency distribution will be assigned more weight. Similarly, a focus group of entrepreneurs in different business segments can be conducted to validate the findings of the questionnaire.

The other challenge is to assign weights to the chosen preference. For instance, in *illustration 1*, we have subjectively normalized the weights to add up to one (i.e. $W_1 = 0.20$, $W_2 = 0.15$, $W_3 = 0.40$ and $W_4 = 0.25$); ideally, a computer algorithm should been used to normalize the weights. In this respect, initially, all weights at each level in the hierarchy are normalized so they sum to 1.0 (Communities and Local Government, 2009), and then weighted averages are calculated for each alternative across the criteria at a given level. Although this is one of the most popular ways of assigning weights that we have also adopted for our research, there are numerous methods that have been proposed in the literature (Choo et. al., 1997). For a detail account on the interpretation of weights, the aggregation rules and the misunderstanding construed by decision makers and researchers, Choo et. al., (1997) have dwelt much on the underlying issues of scale validity, commensurability, criteria importance and rank consistency.

<u>Illustration 2</u>

Extending illustration 1, assuming that through triangulation method the investors most probable scores have been assigned as shown in the *score* column of Figure 2.3. Note that the last three columns (*weight*, *score* and *selection*) are hidden from the potential investor. The resultant weights will be normalized as follows (depicted in the *weight* column):

$$w_1 = \frac{19}{95} = 0.20,\ w_2 = \frac{38}{95} = 0.40,\ w_3 = \frac{24}{95} = 0.25 \text{ and } w_4 = \frac{14}{95} = 0.15$$

3.2.6. Business identification process and classification

Although identifying business opportunities is a non-trivial task, depending on the region under consideration, there are a number of sources where such information can be obtained. Through such sources, one can have a starting point to begin enumerating the possible opportunities. However, the enumeration process should be supplemented by expert opinion to cover other attributes such as level of competition, economic activities in the region (e.g. poverty level, employment level, infrastructure, etc), among others.

A sample size of previous investors can initially be selected based on successful business entities (ventures) using a stratified random sampling technique; thereafter a mapping can be done to the whole region (population) using *fall-back principle* illustrated below.

Illustration 3

Assume we wish to unleash the business potentials in three regions (counties): Lamu, Malindi and Mombasa. A sample of 15 business types was selected and the degree of correlation on the business attractiveness is as shown in Table 2.1. Based on the sample size, we are required to enumerate all the possible business opportunities using the *fall-back principle* (Ahmed, 2010).

Solution

Based on the sample selected, we first enumerate all possible business opportunities using Table 2.1 to derive the first three columns (*country*, *category* and *type*) of Table 2.4. Next, we compute the average correlation in two levels (as shown in Table 2.2 and Table 2.3); *Level 1* is by *county* and *category*; *level 2* by *type*. Finally we apply the *fall-back principle* using the following algorithm to generate Table 2.4:

```
begin;
if the enumerated business was captured by the sample, use:= sample values (Table 2.1);
else if enumerated business was not captured by the sample, use: = Level 1 values (Table 2.2);
else if enumerated business was not captured by Level 1, use: = Level 2 values (Table 2.3);
end;
```

3.3 Summary

In our conceptual framework, we have proposed three types of models that although maintains the same data structure, yield different ranking.

- WSM: *KIOSK* > *TAXI* > *MPESA* >*TUKTUK*
- WPM: *KIOSK* > *TAXI* > *MPESA* >*TUKTUK*
- AHP: *TAXI* > *KIOSK* > *MPESA* >*TUKTUK*

Although ranking differences may still be visible when comparing different methods, it may not be statistical significant considering the nature of the strategic decision. In any case, this is one of the major challenge facing practitioners in tackling MCDA problems. Although a perfect MCDA technique might not exist, it is always prudent to have a combination of methods than relying on a single technique. A multiple approach will have a strong convincing argument especially if two or more techniques yield similar ranking. For example, in our case an investor will most likely choose to invest in a KIOSK than a TAXI since it appears first in WSM and WPM. However, we might still be in a dilemma if the three methods yield significant ranking differences.

In our research, we have proposed WSM, WPM and AHP that are based on a single decision maker, have the same data structure and are the most commonly used. Other models which fit this description include the multiplicative AHP (Barzilai and Lootsma, 1994) and revised AHP (Belton and Gear, 1983). In the multiplicative AHP, the relative performance values q_{ij} and criteria weights w_j are not processed according to formula P^*_{AHP}, but the WPM formula is used instead. Furthermore, one can use a variant of formula

WPM to compute preference values that in turn, can be used to rank the alternatives. These preference values can be computed as follows:

$$P_{i,\text{ multi-AHP}} = \prod_{j=1}^{n} (a_{ij})^{w_j}$$

Similarly, an inconsistency, as demonstrated by Belton and Gear (1983) can occur when the AHP is used. In their example, where three criteria and three alternatives were used, it was shown that the best alternative changes when an identical alternative to one of the non-optimal alternatives is introduced now creating four alternatives. The root for that inconsistency is due to the fact that the relative values for each criterion sum up to one. Instead of having the relative values of the alternatives A_1, A_2, A_3, ..., A_M sum up to one, they propose to divide each relative value by the maximum value of the relative values.

Although these two models (the multiplicative AHP and revised AHP) look promising, they are mere variant of the AHP that has already been accounted for in our research and consequently ignored. This also applies to many other MCDA methods such as ELECTRE (Roy, 1991) and TOPSIS (Hwang and Yoon, 1981), among others. Both TOPSIS and ELECTRE can equally be used to solve the business selection problem but do not have the same data structure as WSM, WPM and AHP. The disadvantage of not having a uniform data structure means that the models cannot be easily integrated in one platform and have to be invoked independently. This will require more modeling time, computation time and cost.

4. Conclusion

4.1 Research gaps

There have been a number of valuable insights on business selection heuristics and questionnaires proposed by different researchers, but we have not encountered a model of the same. The use of MCDA technique seems to offer a natural mechanism to bridge the following gaps:

- Structured questions: The questions posed by different researchers are mainly unstructured and open-ended, which implies rigidity and subjectivity if they are to be translated in a model language. Ideally, we should have close-ended multiple-choice questions.
- On-time solution: Although quite a number of opportunity identifications questionnaires are available online, they are not directly linked to the analyzer. In other words, it take a while when a potential investor submit the questionnaire to an entrepreneur and get the results on the type of investment to make. This disconnection also means that the potential investor cannot have an interactive session with the analyzer (model) since manual intervention is required.
- Criteria to use: Although different criteria are used to evaluate the business selection, we have not encountered published work that shows which criteria have the greatest influence to the investment type.
- Business identification approach: The methodology of incorporating all the business opportunity in a region is a demanding task and ever dynamic. One will wish to know how this can be done, the scope, assumptions and limitations.

4.2 Modeling platform and solver

The modeling of MCDA can be done using mathematical programming language such as AMPL, AIMMS, GINGO, LINGO, etc; or object oriented language such as Visual Basic, C++, Fortran, COBOL, etc. Mathematical programming language is relatively powerful and robust but requires expensive solvers. On the other hand, object oriented language is more appealing and can be used to create attractive graphical user interface (GUI). In either case, a database containing business opportunities needs to be developed and hooked to the model. In this respect, Microsoft Access is readily available, can handle more records (compare to say, Microsoft Excel) and has Visual Basic modeling platform.

Alternative, one can use one of the many free (MCDM Society, 2011) developed MCDA tools that are available on the web; or purchase off-the-shelve commercial version. Unfortunately, the uses of commercial or free tools have a number of disadvantages. The tools usually are not customized to meet other model requirements, and even worse, access rights to modify the codes are usually restricted.

4.3 Menu Driven Screen

The *MCDA business selection tool* would have the following features that form the basis of our research contribution:-

1. A use of MCDA models based on WSM, WPM and AHP techniques.
2. An online or on-time solution process; where an investor selects preferences (select your answer) and get the results instantaneously (refer to Figure 4.1 and 4.2).
3. The criteria used (correlation matrix) would be statistically proven based on data obtained from the field in a defined geographical region (catchment area).
4. The preferences used (weights) would have a logical backing from the triangulation method derived from the questionnaire and focus group.

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