AHP-Based Micro and Small Enterprises' Cluster Identification

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Abstract— **Micro and Small Enterprises' (MSEs) cluster is a group of small firms operating in a defined geographic location, producing similar products or services, cooperating and competing with one another, learning from each other to solve internal problems, setting common strategies to overcome external challenges, and reaching distance markets through developed networks. During recent years, identifying MSEs cluster has become a key strategic decision. However, the nature of these decisions is usually complex and involves conflicting criteria. The aim of this paper is to develop an AHP-based MSEs cluster identification model. As a result, quantitative and qualitative factors including geographical proximity, sectorial concentration, market potential, support services, resource potential and potential entrepreneurs are found to be critical factors in cluster identification. In this paper, linguistic values are used to assess the ratings and weights of the factors. Then, AHP model will be proposed in dealing with the cluster selection problems. Finally, a case study was taken to prove and validate the procedure of the proposed method. A sensitivity analysis is also performed to justify the results.**

Keywords-AHP;MSEs cluster;Cluster identification

I. INTRODUCTION

Micro and Small Enterprises (MSEs) are generally recognized as a main contributor to economic growth and equitable development. Their contribution to employment generation and poverty reduction opens a wider opportunity for developing countries. However, the role of MSEs is not often realized because of a set of problems and limitations they encounter towards their path to establishment and growth. Among others, they are facing problems associated with capital, skill, schooling, information, technical knowhow, simplicity and quality of products. MSEs operating independently would also face difficulty in attracting traders, as trading cost per transaction would be disproportionately high. In the literature, cluster approach is seen to be the viable approach in view of developing small enterprises to overcome the challenging competition for survival [4,17,18,23].

MSEs cluster is a concentration of interconnected, geographically close firms operating together within the same commercial sector and whose activities rely on certain local specificities such as availability of natural resources, centres for technological development (through universities, research centres, technology parks, or a technology-based industry), and a consolidated productive structure for all tiers of the productive chain of a region [2]. As shown in Figure 1, a cluster is an agglomeration of firms, suppliers, service providers, and associated institutions in a particular field. Often, financial providers, educational institutions, and various levels of government are included. These entities are linked by externalities and complementarities of different types and are usually located near each other. Geographic proximity helps cluster constituents to enjoy the economic benefits of several location-specific externalities and synergies [18]. Concept of cluster suggests connection and association of firms that are linked vertically and horizontally through their commonalities and complementarity in products, services, inputs, technologies, transportation, warehouse and communication [17]. Research has extended Porter's theory to different types of industries where clusters are viewed as a way to maintain global competitiveness.

In this globalized world, economic success will only come by integrating the societies and economies. Ability of a nation or a region to succeed in today's global economy depends directly on its ability to create an economic relevance at the national as well as at the global level. According to Sonobe and Otsuka, a cluster approach is the most feasible approach for developing small enterprises [23]. There are different arguments regarding the methods and techniques used for identifying clusters [24]. Generally, the choice of method for cluster mapping depends on the kind of clusters wanted to be identified. As summarized by Feser and Bergmann, (2000) [5], Yoo, (2003) [16], Andersen et al., (2006)[24], Titze, et al., (2011) [20], Jijiao and Junheng,(2012) [12], and Stejskal and Hajek, (2012) [15] there are five widely used cluster identification methods. These are: Expert Opinion, Location Quotients (LQ), Input-Output Analysis, Network Analysis/Graph Analysis and Surveys.

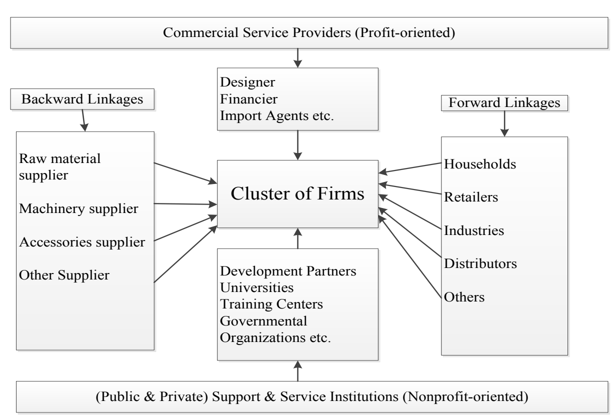

Figure 1. Typical cluster map

Expert opinion gathers information by interview, focused group discussion, Delphi method and other means of gathering key informant's information [16]. The methodology of asking experts, however, has some limitations, such as: there is a risk of getting a subjective opinion about the clusters area in question. This form of identification is also difficult to standardize and compare across regions and national borders, which is an impediment to benchmarking. Nonetheless, the approach is a good supplement to other identification methods.

Location Quotient (LQ) measures the extent to which a region is more specialized in an industry compared to the geographic area in question [24]. This methodology is very simple and easy to use [14]. However, it says absolutely nothing about regional MSEs clusters and offers no insight into interdependences between sectors [6]. Another limitation of the LQ technique is that it can be used in only bottom-up analyses as one of several measures of sector performance. The choice of regions must be made before the clusters can be identified. Although the sizes of the regions can be altered in order to find a best fit, only one choice of regional aggregation can be made before the actual mapping [24]. Therefore, the result of this method is not fully relevant for cluster formation decision [14].

Input-output Analysis seems to be used most widely and frequently [22]. Although, this analysis can overcome the limitation of the LQ technique, it lacks of concern for interdependence between sectors. Therefore, input-output analysis is especially useful in an analysis of a vertically-integrated cluster, in which the buyer-seller linkages are more obvious [24]. There are two types of input-output cluster identification techniques: (1) Input-output analysis of business relationships (IOA) and (2) Input-output analysis of innovations. The first method can identify the relationships among firms, which are necessary for cluster initiatives. The drawbacks of this method are quick obsolescence, low accuracy and the inability of its application in small regions [14]. The limitation of the second method is that, it does not actually focus on the clusters [14].

Network Analysis/Graph Analysis is a very good method of finding networks and social capital that can refer to individual connections compared to a general term of networks [16]. This method is mostly applied as a visualization tool [14].

Finally, survey is one of the methods frequently-used to identify industry clusters. However, it seems that the cases using only surveys are rare and very expensive. Thus, many empirical reports seem to use surveys in conjunction with other quantitative methods. Table 1 shows the advantages and pitfalls of each method.

From the above methods it has been clearly seen that cluster identification process is a complex process that involves both qualitative and quantitative, often conflicting criteria. There is no single method, which incorporates the two criteria together. To solve this limitation this paper introduces multi-criteria decision-making (MCDM) technique. The most important advantage of MCDM techniques is that it can include both qualitative and quantitative data [19]. The aim of this paper is to contribute a tested model for Micro and Small Enterprises cluster identification. Basically, the new model will solve the pitfalls with the cluster identification methods and approaches.

Multi-Criteria Decision-Making (MCDM) is a powerful tool used widely for solving problems with multiple, and usually conflicting, criteria [11]. The most important advantage of MCDM techniques is to analyze and synthesize both qualitative and quantitative data [19]. With this characteristic, decision-makers have the possibility to easily examine and scale the problem in accordance with their requirements. Some of the commonly used MCDM techniques are AHP, Fuzzy-AHP, Analytic Network Process (ANP) and Technique for the Order of Prioritization by Similarity to Ideal Solution (TOPSIS). In this paper AHP is used to develop MSEs cluster identification model.

The rest of the paper is organized as follows: Section II explores the literature review; Section III presents research methodology. Section IV presents results and discussions. Finally, Section V presents the conclusions.

II. LITERATURE REVIEW

The Analytic Hierarchy Process (AHP), introduced by Saaty (1980), is a useful and practical tool that provides the ability to incorporate both qualitative and quantitative factors in the decision-making process [3]. AHP is a powerful method to solve complex decision problems. Any complex problem can be decomposed into several sub-problems using AHP in terms of hierarchical levels, where each level represents a set of criteria or attributes relative to each sub-problem [26]. One of the main advantages of the AHP method is the simple structure and design, which represent human mind and nature [7]. It uses a pairwise comparison methodology between several alternatives under particular criteria with respect to a specific goal. It is supported by a software package called Super Decisions software, which processes the collected data in the form of numerical tables and figures. AHP reduces inconsistencies in human judgment by providing a consistency ratio (CR) [9].

Recently, AHP has been widely used to solve multi-criteria decision problems; so far, Supplier selection using combined analytical hierarchy process and grey relational analysis by Ching-Chow and Bai-Sheng [27], A web analytics tool selection method: an analytical hierarchy process approach Process by Kazuo and Ta-Tao [21].

Table 1. Methods of identifying cluster [16]

Method	Advantage	Pitfalls
Expert opinion	Very easy, low cost, detailed contextual information	It's just opinion, not axiom
Location Quotients (LQs)	Very easy, inexpensive, can supplement other methods	Focuses on sectors, not clusters
Input-output analysis	Comprehensive and detailed, key measure of interdependence	May be dated, industry definitions imperfect; neglect supporting institutions
Network analysis	Visualization aids interpretation and analysis	Software still limited
Surveys	Flexibility with collecting ideal data, up-to-date	Costly, difficult to implement properly

An analytical hierarchy process-based tool to evaluate value systems for lean transformations by Fazleena et al. [1], Evaluating organization core competences and associated personal competencies using analytical hierarchy process by Khalid and Essmail [9] are some of the published works.

However, up to now, no research has been conducted on AHP for identification of industrial clusters, particularly for MSEs, which have critical contribution to the developing and developed countries.

III. Research Methodology

The main aim of this paper is to contribute a tested model for MSEs cluster identification. Generally, the cluster identification process consists of five main steps as summarized in Figure 2. In the first phase, MSEs cluster identification criteria are selected. In the second phase, weights of MSEs cluster selection criteria are calculated. In the third phase, case study is selected and alternatives are developed. The selected case study is Ethiopian bamboo MSEs. During the fourth phase, the alternative raking results are calculated and best alternative for the MSEs cluster is determined. Finally, sensitivity analysis is provided.

IV. Results and Discussion

A. *Identification of MSEs Cluster Selection Criteria*

Five experts, who work as MSEs cluster development specialist (agent), in United Nations Industrial Development Agency (UNIDO) were selected. All the important criteria which could affect the MSEs cluster have been discussed with the experts. Other MSEs cluster studies in the literature were also reviewed. Comparing their views with the literature review, the following criteria are determined in the study.

- *Geographical proximity*: the close proximity of MSEs cluster members makes it easier for on-site work to be performed. Additionally, having a group of firms that produce complementary products and services in close proximity to one another can enhance the ability of the firms to make cluster-wide changes in their product offerings. Close geographical proximity also allows for more frequent and rich communication between the firms.
- *Sectorial concentration*: the geographic location of a specific dense group, e.g. the group people with the same ethnics, religion, culture etc.
- *Market potential*: the estimated maximum total sales revenue of all suppliers of a product in a market during a certain period.
- *Support services*: services provided in relation to enhance MSEs cluster development such as: training, financial support, facilitate import and export service, create conducive atmosphere for rapid MSEs development, etc.

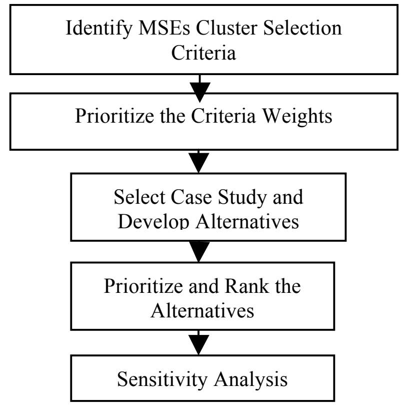

Figure 2. The methodology procedure

- *Resource potential*: a natural resource that exists in a region and may be used in the future. For example, bamboo in Ethiopia is a potential resource as long as it has not been fully used yet.
- *Potential entrepreneurs*: MSEs firms which have the skills and initiative necessary to take good new ideas to market and make the right decisions to the change idea to profit.

B. *Pairwise comparisn*

After identifying the criteria, the different priority weights of each criterion were calculated using the AHP approach. The comparison on the importance of one criterion over another was achieved by the help of the questionnaire. See [Appendix A] for the questionnaire form. The questionnaire facilitates the answering of pair-wise comparison questions. The preference of one measure over another was decided by the experience of the experts.

Expert used the linguistic variables to compare the criteria with respect to the main goal. Then the linguistic variables were converted to numbers. Table 2 shows the linguistic variables and the rating scale for AHP. The standard rating scale first proposed by Saaty (1980) and continues to be used in all AHP works [1].

The pairwise comparisons for the criteria were carried out by using the Super Decisions software. After the pairwise comparison matrices were formed, the consistency of the pairwise judgment of each comparison matrix was checked, for consistency and revised if necessary until the maximum inconsistency was below ten percent, which is considered the minimum standard level in the literature. Table 3 shows the criteria weight and consistency ratio (CR).

The final weights for Geographical Proximity (GP), Sectorial Concentration (SC), Market Potential (MP), Support Services (SS), Resource Potential (RP) and Potential Entrepreneurs (PE) were found to be 0.44, 0.25, 0.11,0.12, 0.05and 0.03, respectively. It has been concluded that the most important criteria in MSEs cluster identification process is geographical proximity criteria as it has the highest priority weight. Sectorial concentration is the next preferred criteria. This result is supported by Porter's (1998, 1990) cluster definitions.

Table 2. Rating scale for AHP [25]

Linguistic Scale	Rating	Reciprocal Rating	Explanation
Equally important	1	1	Two elements contribute equally
Equally to Moderately important	2	1/2	One element is equally to moderately favored over another
Moderately Important	3	1/3	One element is moderately favored over another
Moderately to strongly important	4	1/4	One element is moderately to strongly favored over another
Strongly important	5	1/5	One element is strongly favored over another
Strongly to very strongly important	6	1/6	One element is Strongly to very strongly favored over another
Very strongly important	7	1/7	An element is very strongly favored over another
Very strongly to extremely important	8	1/8	One element is very strongly to extremely favored over another
Extremely important	9	1/9	One element is extremely favored over another

Table 3. Criteria weights and consistency ration (CR)

Criteria	Weight	CR
Geographical Proximity (GP)	0.44	0.04124
Sectorial Concentration (SC)	0.25	
Market Potential (MP)	0.11	
Support Services (SS)	0.12	
Resource Potential (RP)	0.05	
Potential Entrepreneurs (PE)	0.03	

C. Case for cluster identification

Studies show that bamboo harvest in Ethiopia constitutes 67 percent of the total production in Africa [10]. But the production and consumption of bamboo and bamboo products are very limited [8]. The main challenge for the bamboo sector is how to break out of the low level equilibrium trap and realize its potential of becoming competitive, and play a major role in the development process of the country [13]. To solve this and other related problems, cluster based approach for bamboo micro and small enterprise is an alternative solution.

Clustered micro and small enterprises have a potential to eliminate substantial part of disadvantage when MSEs work in isolation, and help give unexpected benefit that would widen market access, encouraging specialization and innovation which eventually may lead to industrial development.

To identify bamboo-processing cities in Ethiopia, experts from East Africa Bamboo Project (EABP) and potential bamboo product manufacturers are interviewed. It has been used also secondary data from East Africa bamboo project to support our assessment. As a result three principal bamboo processing cities; Addis Ababa, Hawassa, and Bahir Dar were selected. Entrepreneurs found in three principal bamboo-processing cities are used for analysis. These cities are identified as a major center for bamboo products processing and marketing in Ethiopia. From these three bamboo-processing cities the best city for bamboo MSEs cluster using AHP methodology is identified.

Bamboo Entrepreneurs in Addis Ababa

Addis Ababa is the capital city of Ethiopia and also the largest city in Ethiopia. The city is fully urban. Unemployment is the biggest economic challenge in Addis Ababa. Encouraging micro and small enterprises can solve this problem. There are some privately owned bamboo entrepreneurs' workshops in city. In bamboo workshops, various types of bamboo furniture such as sofa chairs, tables, bookshelves, partitions, baskets, fruit-trays and lampshades are produced. Most of the entrepreneurs received training from the Ethiopian Federal Micro and Small Scale Enterprises Development Agency. They have also good market opportunity as compared to other bamboo processing cities. However, all of them do not have enough workshop facilities, working and selling places and access to raw material.

Bamboo Entrepreneurs in Hawassa

Hawassa is the capital of South People's Nations and Nationality Regional State. It is located 271 km to south of Addis Ababa. Hawassa is one of the tourist areas in the country. However, only few bamboo entrepreneurs are found in the city. Bamboo entrepreneurs in Hawassa are producing various types of bamboo furniture such as chairs, tables, bookshelves, dressing tables partitions, baskets, fruit-trays and lampshades. However, the quality of bamboo furniture products in Hawassa is lower than those produced in Addis Ababa. Most of bamboo entrepreneurs are processing and selling their products in their houses. Hawassa entrepreneurs have easy access to bamboo raw material as compared to Addis Ababa entrepreneurs.

Bamboo Entrepreneurs in Bahir Dar

Bahir Dar is the capital of Amhara Regional State. It is located 550 km to northwest of Addis Ababa. Bahir Dar is located near Lake Tana (the biggest lake in Ethiopia) and it is very near to the source of Blue Nile. Many tourists are traveling every year to Bahir Dar to visit the Blue Nile falls, churches and monasteries in the region. There is no any modern bamboo products processing and selling shop in the city. There are few traditional bamboo craftsmen associations in the city which produce low quality chairs, stools, dry-mats and baskets for keeping food. They are processing and selling their products under the shades along the roadsides in the city. Bahir Dar bamboo entrepreneurs have access to bamboo raw material as compared to Addis Ababa entrepreneurs.

To select best city for bamboo MSEs cluster, AHP approach is introduced. The method allows a complex decision to be structured into a hierarchy descending from an overall objective to various criteria, sub-criteria and so on until the lowest level.

First, the overall goal of the MSEs cluster identification problem has been identified which was ‘‘best city for MSEs cluster”. To identify the best cluster, as explained above, six criteria are selected by experienced experts. Finally, the three bamboo processing cities are laid down at the last level of the hierarchy. Fig. 3 shows the hierarchical structure of the objective, criteria and alternatives.

D. Prioritize and rank the alternatives

The same method were applied to the other pairwise comparison matrices and the priority weights of the three alternatives with respect to Geographical Proximity (GP) , Sectorial Concentration (SC), Market Potential (MP) , Support Services (SS), Resource Potential (RP) and Potential Entrepreneurs (PE) criteria. Table 4 shows the synthesized priorities of the alternatives with each criterion.

The priority weights of the alternatives with respect to the criteria were combined and the priority weights of the alternatives were determined. As shown in Table 5, the priority weights for the alternatives were found to be (0.57, 0.17, 0.26). According to the final score, Addis Ababa is the most preferred MSEs cluster city as it has the highest priority weight, and Hawassa is the next recommended alternative MSEs bamboo cluster.

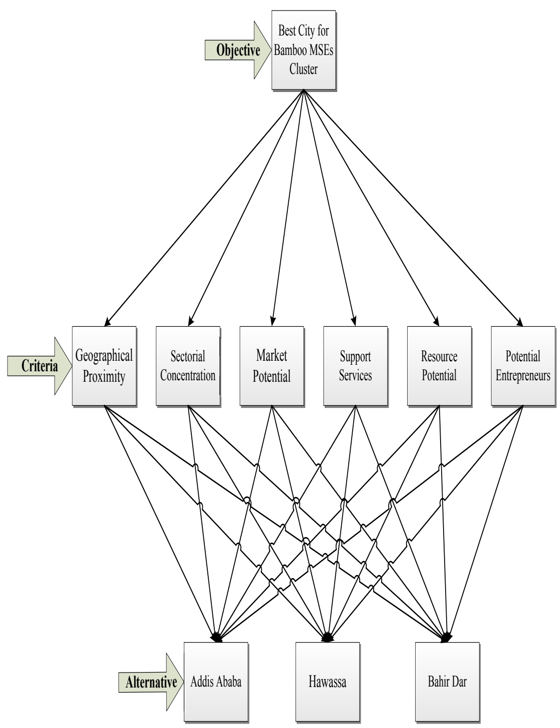

Figure 3. The hierarchical structure the alternatives and the criteria

Table 4. Synthesized priorities of the alternatives with each criterion

Criteria	Alternatives	Alternative weights	C.R
Geographical Proximity(GP)	Addis Ababa	0.58	0.00355
	Bahir Dar	0.11	
	Hawassa	0.31	
Sectorial Concentration (SC)	Addis Ababa	0.60	0.00533 0
	Bahir Dar	0.13	
	Hawassa	0.27	
Market Potential (MP)	Addis Ababa	0.72	0
	Bahir Dar	0.14	
	Hawassa	0.14	
Support Services (SS)	Addis Ababa	0.50	0
	Bahir Dar	0.25	
	Hawassa	0.25	
Resource Potential (RP)	Addis Ababa	0.10	0.00191
	Bahir Dar	0.71	
	Hawassa	0.19	
Potential Entrepreneurs (PE)	Addis Ababa	0.60	0.00533
	Bahir Dar	0.27	
	Hawassa	0.13	

Table 5. Overall synthesized priorities of the alternatives

Name	Graphic	Ideals	Normals
Addis Ababa		1.000000	0.565057
Bahir Dar		0.303330	0.171399
Hawassa		0.466403	0.263544

E. Sensitivity analysis

A sensitivity analysis is conducted in order to monitor the robustness of the preference ranking among the alternative cities by changing the priority weights of the criteria. In our case, sensitivity is performed by varying the priority of the Geographical Proximity (GP) criterion, by moving the vertical line and determining the corresponding alternative priorities

Figures 4 and 5 show a graphical representation of sensitivity for the Geographical Proximity (GP) criterion. Criterion priorities are read from the x-axis; the alternatives’ priorities are read from the y-axis.

In Figure 4, the priority of the Geographical Proximity (GP), indicated by the vertical line, is set to its original priority of 0.58. This current situation indicates that Addis Ababa is the most preferred bamboo cluster city then Hawassa and finally Bahir Dar. These are the original overall synthesized priorities for the alternatives shown in Table 5. In Fig. 5, it has been moved to the left to a priority of about 0.1 and the rank of; Bahir Dar stayed the same but the ranking between Addis Ababa and Hawassa is exchanged.

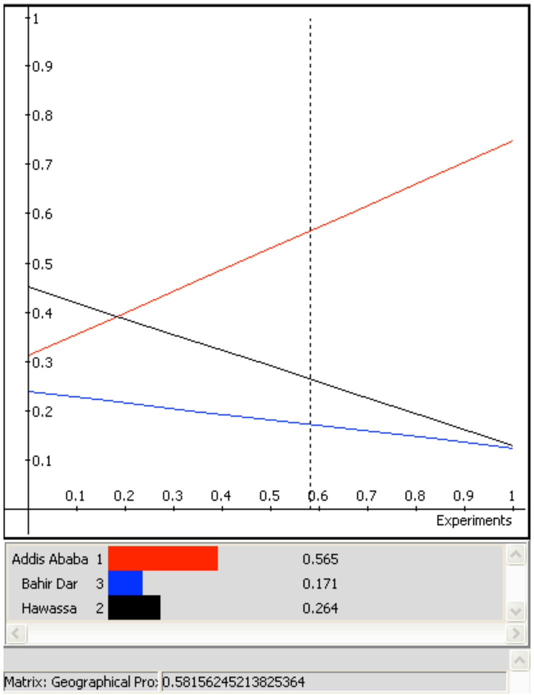

Figure 4. Sensitivity graph with Geographical Proximity criterion priority set to 0.58

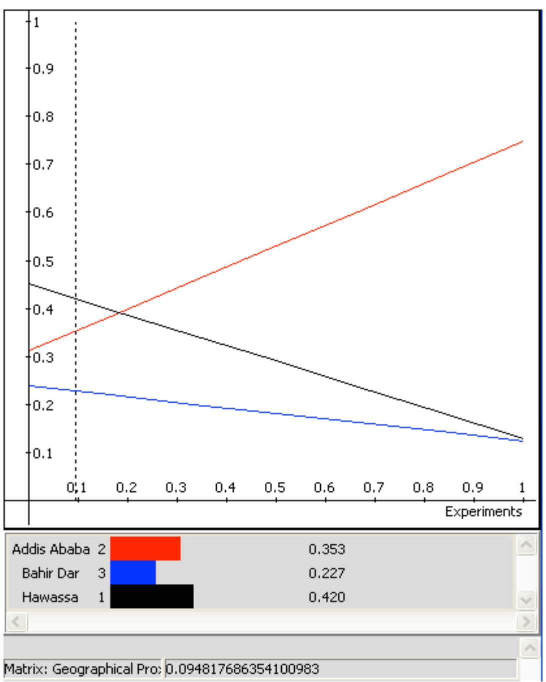

Figure 5. Sensitivity graph with Geographical Proximity criterion priority set to 0.1

Performing sensitivity on the criteria of Sectorial Concentration (SC), Market Potential (MP), Support Services (SS), Resource Potential (RP) and Potential Entrepreneurs (PE) did not affect the first ranked alternative, but in some cases the second and third ranked alternatives switched places. Therefore, this analysis reveals the fact that Addis Ababa is the most suitable city for bamboo cluster then Hawassa and at last Bahir Dar.

V. Conclusions

Cluster identification process is a complex process that involves both qualitative and quantitative, often conflicting criteria. From the existing cluster identification methods, there is no single method, which incorporates the two criteria together. To solve this limitation of the methods, this paper proposed AHP-based methodology for identifying best location for MSEs cluster. Then, the proposed methodology was tested on a real-world data and was found that it functions satisfactorily. Here, sensitivity analysis is also performed to discuss and explain the results. Thus, the contribution of this paper is to propose an efficient and effective decision framework for identifying MSEs clusters. As a future study we plan to use other methods for MSEs cluster identification.

Appendix A

The questionnaire

The questionnaire form used to capture experts knowledge and judgments. Experts are asked to put check marks on the pairwise comparison matrices (see table 6). The table shows pairwise comparison matric for Geographical Proximity (GP) criteria; the same were done to Sectorial Concentration (SC), Market Potential (MP), Support Services (SS), Resource Potential (RP) and Potential Entrepreneurs (PE) criteria. To do so, if a criterion is more important than the one matching on the right, he/she will tick the importance level in the left part of the table. If a criterion on the left is less important than the one matching on the right, he/she marks the importance level preferred to the right of the importance level.

Questions

With respect to the overall goal “best city for bamboo MSEs cluster”
Q1. How important is GP when it is compared with GP?
Q2. How important is GP when it is compared with SC?
Q3. How important is GP when it is compared with MP?
Q4. How important is GP when it is compared with SS?
Q5. How important is GP when it is compared with RP?
Q6. How important is GP when it is compared with PE?
The same questions were asked to Market Potential (MP), Support Services (SS), Resource Potential (RP) and Potential Entrepreneurs (PE) criteria. Similarly, experts are asked to compare each criterion with each alternative also.

Acknowledgment

The article was supported by the framework of the IT4Innovations Centre of Excellence project, reg. no. CZ.1.05/1.1.00/02.0070 funded by Structural Funds of the European Union and state budget of the Czech Republic.

Importance (or preference) of one criterion over another
1, Equally important 2, Equally to Moderately important 3, Moderately Important 4, Moderately to strongly important
5, Strongly important 6, Strongly to very strongly important 7 ,Very strongly important 8, Very strongly to extremely important
9, Extremely important

Questions	Criteria	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Criteria
Q1	GP																		GP
Q2	GP																		SC
Q3	GP																		MP
Q4	GP																		SS
Q5	GP																		RP
Q6	GP																		PE

Table 6. The relative importance of one criterion over another

REFERENCES

[1] B. Fazleena, W. Ken, and M. Phillip,"An analytical hierarchy process-based tool to evaluate value systems for lean transformations," Journal of Manufacturing Technology Management, Vol. 22, pp. 46 – 65,2011.

[2] C.O. Pedro, M.T. Hélcio, and L.P. Márcio, "Relationships, cooperation and development in a Brazilian industrial cluster," International Journal of Productivity and Performance Management, Vol. 60 , pp.115 – 131, 2011.

[3] D. Choudhary, and R. Shankar,"An STEEP-fuzzy AHP-TOPSIS framework for evaluation and selection of thermal power plant location: A case study from India," Energy, Vol. 42, pp. 510-521, 2012.

[4] D. Rinku, and K. D. Ashim, "Industrial Cluster: An approach for rural development in North East India," International Journal of Trade, Economics and Finance, Vol. 2, pp.161-165, 2011.

[5] E. J. Feser and E. M. Bergmann, "National industry cluster templates: a framework for applied regional cluster analysis," Regional Studies, Vol.34, pp.1–19. 2000.

[6] E.M. Bergman, and E.J. Feser,"Industrial and regional clusters: concepts and comparative applications,"Virginia: WVU Regional Research Institute, 1999.

[7] G. Zheng, N. .Zhu, Z. Tian, Y. Chen, and B. Sun, "Application of a trapezoidal fuzzy AHP method for work safety evaluation and early warning rating of hot and humid environments," Safety Science,Vol. 50, pp. 228-23, 2011.

[8] H.Bereket, and K. Daniel, "Study on establishment of bamboo processing plant in Amhara Regional state", Addis Ababa: AAiT, Post graduate program research,2008.

[9] H. Khalid, and A.E. Essmail,"Evaluating organisation core competences and associated personal competencies using analytical hierarchy process,",Management Research News, Vol. 30, pp. 530 – 547,2007.

[10] H. Tesfaye, "Technical report on bamboo resource management," Addis Ababa: 2006.

[11] J.C. Pomerol, and R.S. Barba, "Multicriterion decision in management: principles and practice," Kluwer Academic Publishers, 2000.

[12] J. Jijiao, and C. Junheng, "Identification and empirical analysis of Shaanxi industrial cluster," Proc. IEEE Symp. Software Engineering and Service Science (ICSESS), IEEE Press, pp. 579-582, 2012.

[13] J. Netsanet, G. Gulilat, and K. Daniel K.,"Cl;uster approch for competativeness of Micro and small Enterprises, case of ethiopian bamboo MSEs," Addis Ababa: AAiT,post graduate program research, 2009.

[14] J. Stejskal, "Comparison of often applied methods for industrial cluster identification,"Development, Energy, Environment, Economics, pp.282-286,2010.

[15] J. Stejskal and P. Hajek, "Competitive advantage analysis: a novel method for industrial clusters identification," Journal of Business Economics and Management, vol. 13, pp. 344-365, 2012.

[16] K.Y. Yoo, " Method for identifying industry clusters: assessment of the state of the art," Chapel Hill; University of North Carolina,2003.

[17] M.E. Porter, "Clusters and the new economics of competition," Harvard Business Review,Vol. 76 , pp. 77-90,1998.

[18] M. Shakya, "Clusters for competitiveness:A practical guide & policy implications for developing cluster initiatives,"International Trade Department.Prem the World Bank, 2009.

[19] M. T. Isaai, A. Kanani, M. Tootoonchi, and H. R. Afzali,"Intelligent timetable evaluation using fuzzy AHP," Expert Systems with Applications, Vol. 38, pp. 3718-3723, 2011.

[20] M. Titze, M.Mrachert, A. Kubis, "The identification of regional industrial clusters using qualitative input-output analysis (QIOA), "Regional Studies, Vol. 45, pp. 89–102, 2011.

[21] N. Kazuo, and C. Ta-Tao, "A web analytics tool selection method: an analytical hierarchy process approach," Internet Research, Vol. 21, pp. 171 – 186,2011.

[22] R. V. Hofe, and S. D. Bhatta, "Method for identifying and domestic industrial clusters using interregional commodity trade data," The Industrial Geographer ,vol. 4, pp. 1-27,2007.

[23] S.Tetsushi, and O. Keijiro,"Strategy for cluster-based industrial development in developing countries," Foundation for advanced studies on international development and national graduate institute for policy studies,2006.

[24] T.Andersen, M.Bjerre , and W.H. Emily, "The cluster benchmarking project: pilot project report-benchmarking clusters in the knowledge based economy,"Nordic Innovation center,FORA, 2006.

[25] T.L.Saaty, "The Analytic Hierarchy Process", McGraw-Hill, New York, NY,1980.

[26] Y. C. Choua, C.C. Sunb, and H.Y.Yenc, "Evaluating the criteria for human resource for science and technology (HRST) based on an integrated fuzzy AHP and fuzzy DEMATEL approach," Applied Soft Computing,Vol. 12, pp. 64–71, 2011.

[27] Y. Ching-Chow, and Chen. Bai-Sheng,"Supplier selection using combined analytical hierarchy process and grey relational analysis," Journal of Manufacturing Technology Management, Vol. 17, pp. 926 – 941,2011.