SELECTION OF BUSINESS FUNDING PROPOSALS OF MICRO, SMALL, AND MEDIUM ENTERPRISES USING ANALYTIC NETWORK PROCESS AT PT SARANA JATIM VENTURA

Kevin Karmadi Wirawan, Stefanus Eko Wiratno, S.T., M.T., and Effi Latiffianti, S.T., M.Sc.
Industrial Engineering Department, Faculty of Industrial Technology,
Institut Teknologi Sepuluh Nopember (ITS)
Jl. Arief Rahman Hakim, Surabaya 60111 Indonesia
e-mail: mailto:kevin.karmadi.wirawan@gmail.com, sekowiratno@gmail.com, latiffianti@gmail.com

Abstract— PT Sarana Jatim Ventura (SJV) is a financing company that regularly faced with decision-making in the business process. SJV is required to actively participate in supporting Micro, Small, and Medium Enterprises (MSMEs) development. This includes a financial support for business expansion and competitiveness improvement. Under this scheme, SJV is challenged to carefully choose the right MSMEs as it will greatly affect their financial performance. Thus, the current selection process that heavily relies on discussion and interview results, should be improved. Analytic Network Process (ANP) is deemed suitable to support decision-making in such situation, especially because the decision criteria in SJV case are not independent to each other. Two critical criteria are initially employed as a filter to reduce the number of proposals. The selection process is then continued by applying ANP for the ten selected criteria from which ranking of each alternative is produced. One-by-one elimination rank is also used as an approach in analysis. Sensitivity analysis on criteria significance is also performed. The result showed that funding amount and rate of profit sharing are the most significant criteria to affect the ranking. When several alternatives are removed from the calculation, the resulted ranking also changes. When using budget constrained scenario, the best result of rank is produced by one-by-one elimination approach.

Key Words— **ANP, Buffa & Sarin Principle, Decision Making, One-by-one Elimination, Ranking**

I. INTRODUCTION

As one of pillars of Indonesia economy, MSMEs role are critical. Government's commitment to improve potency and competitiveness of MSMEs can be seen in enterprises related policies in the past five year. One of them is Regulation of the Minister of Finance of the Republic of Indonesia (Peraturan Menteri Keuangan) number 18/PMK.010/2012. This regulation defines venture capital company (VCC) as one of sources of fund for MSMEs

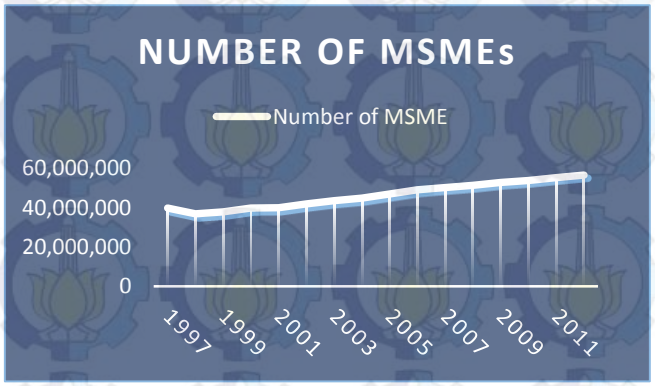

Figure 1 Number of MSMEs from 1997 until 2012 (Source: Indonesian Statistics, 2014)

VCC is expected to support MSMEs in term of financial capital, especially with the incoming ASEAN Economic Community (AEC) at the end of 2015. One of AEC principles is single market and production base, which allow five-core elements: free flow of goods, free flow of services, free flow of investment, free flow of capital, and free flow of skilled labor (ASEAN Secretariat, 2014). This condition is a big challenge for the current MSMEs, and those that are not ready for this will surely suffer losses.

These losses are the most undesired thing not only for MSMEs, but also for VCCs as one of capital sources for MSMEs. VCC's business schemes, as stated in Regulation of the Minister of Finance number 18/PMK.010/2012 Chapter II Clause 2, are equity participation, quasi equity participation, and revenue sharing. Because of this, anything that affect MSMEs will also affect VCC as well.

PT Sarana Jatim Ventura (SJV), as one of VCCs, has done several preventive actions to avoid losses that might be suffered in MSMEs. One of the preventive actions is a strict selection process. Currently, selection is done by investment committee' meeting, held once a week. Because of the equity participation program instructed by the government, SJV wants to prolong the period of waiting time. The longer period needs to be implemented because SJV needs a better grasp of MSMEs' real condition before approving the funding. This condition leaves one problem. If in one-week period, they reviewed only several proposals, when the period is extended, greater amount of proposals should be reviewed than before.

President Director of SJV, Mr. Fadjar Hutomo, has done a research about selecting business-funding proposals using Analytic Hierarchy Process (AHP) and Goal Programming. Seven main criteria are used in his research; management, finance, market, technical, social, collateral, and external. These criteria are not fixed, it can be changed depend on the situation. Some of these criteria are connected and influencing each other. For example, market will affect finance, whilst management will affect market. Thus, AHP is not the best approach to this selection process.. It is because AHP works under assumption that every criteria are considered independent, cannot affect or be affected by others.

Looking at the gap between SJV's desire with current condition of MSMEs, and considering the drawback of the previous research, this research, will use analytic network process (ANP). As suggested by Ishizaka and Nemery (2013), ANP is capable of producing ranking, while at the same time accommodating dependent criteria, which AHP is

not capable. However, if the large number of criteria and alternatives involved in ANP calculation, amount of time needed to do the pairwise comparison will be long. In addition, pairwise comparison value might be inconsistent due to massive number of comparison (Lesmes, 2009). Therefore, Buffa & Sarin Principle is used to reduce the number of alternatives first before the pairwise comparison. ANP will produce rank for each proposal, and the rank will be used as a basic measurement to determine which proposal is better than the others.

II. LITERATURE REVIEW

Literature review explains about scientific resources as the basis of this research. There is also explanation about several methods used in this research.

A. Decision Problem

Every day, people deal with various decision. Each of decision have different characteristic. Roy (1981), as cited by Ishizaka and Nemery (2013), classify four main groups of decision type: choice problem, sorting problem, ranking problem, and description problem.

B. Multi Criteria Decision Analysis (MCDA)

MCDA, known as multi-attribute decision analysis (MADA) is discipline that encompasses mathematics, management, informatics, psychology, social science and economics. (Ishizaka & Nemery, 2013). Whilst Department for Communities and Local Government London (2009) defines MCDA as a way to view complex problem, whether with monetary objective or not, divided into smaller parts to simplify decision making.

In MCDA, there are several methods to solve the problem; AHP, ANP, MACBETH, PROMETHEUS, ELECTRE, TOPSIS, Goal Programming, Data Envelopment Analysis (DEA), etc. Not every method is able to solve every problem. The one that fit to solve dependent criteria is ANP.

C. Analytic Network Process (ANP)

ANP is improved version of AHP. If AHP assume that every criterion is independent, ANP remove this assumption. AHP is a unique case in every decision problem. In reality, it is rarely to find independent criteria. ANP model is different from AHP. ANP use network like model whilst AHP use hierarchy model.

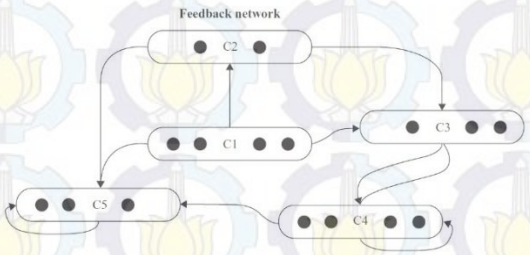

Figure 2 Five-Cluster ANP Network with Feedbacks (Source: Ishizaka & Nemery, 2013)

D. Buffa & Sarin Principality

One of methods that can be used for selecting alternatives is Buffa & Sarin method, developed in 1987. Although this method is often used in location problem, it does not rule out the possibility to use in SJV selection process. There are three factor in Buffa & Sarin method: critical factor (CF), objective factor (OF), and subjective factor (SF). In this research, only CF will be used as initial selection process. When proposal satisfy the factor, the value is 1, otherwise 0. It means that the proposal needs to meet the requirement factor to pass to the next stage.

E. Venture Capital Company (VCC)

One of business targets from VCC is MSME. This already regulated in Regulation of the Minister of Finance number 18/PMK.010/2012. VCC is a business entity, which did venture capital financing into a company that received financial aid (Investee Company) in certain period in the form of equity participation, quasi equity participation, and revenue sharing. Figure 3 below shows financing scheme in VCC.

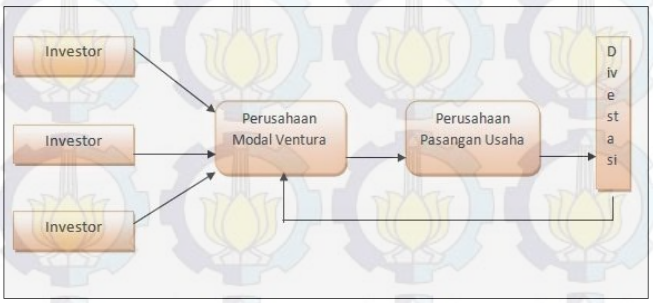

Figure 3 VCC Single Tier Approach Scheme

III. RESEARCH METHODOLOGY

Research methodology explains about overview of this research and step-by-step problem solving that will be performed. Research methodology is a guide to ensure that research can be carried out in systematic way.

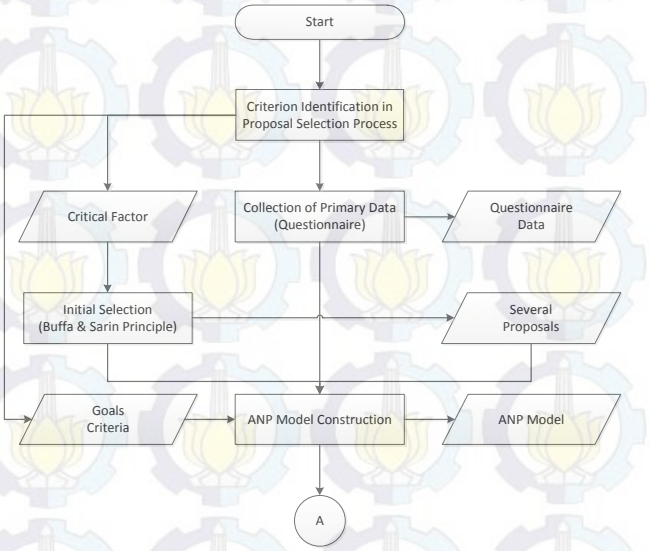

Figure 4 Research Flowchart

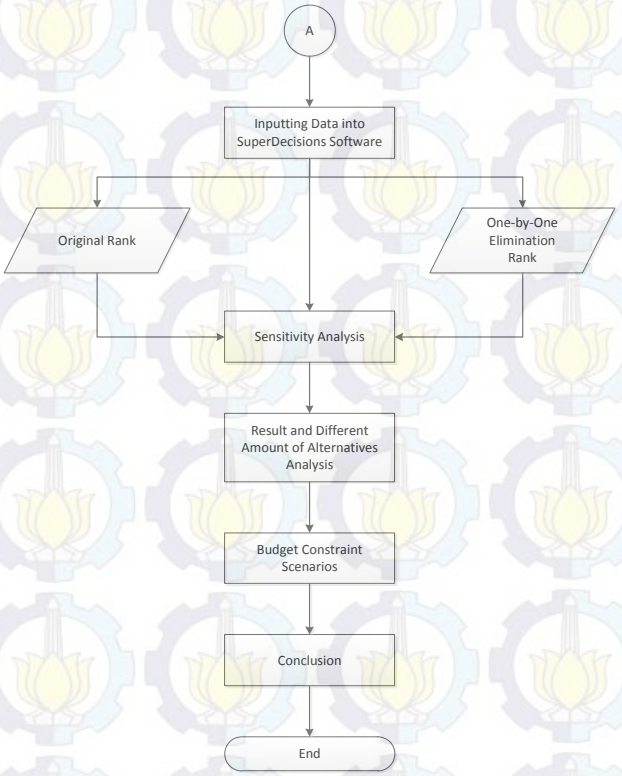

Figure 4 Research Flowchart (Cont.)

IV. DATA COLLECTION AND PROCESSING

Data collection and processing explains about data needed to solve problem in this research. List of MSMEs in 2014, result of questionnaires, and detail data in each MSME's proposal are explained below.

A. Data Collection

Author interviewed and discussed with representations of investment committee. From discussion, it is known that there are two critical factors in selection process of business funding proposals. The two factors are the legal status of enterprises and permission documents to establish enterprises. These requirements must be met before proceeding to ANP selection. Aside from these factors, author also obtained several important factors in selection process. Table 1 shown the important factors in selection process with its definition described in Table 2.

Table 1 Clusters and Criteria in Selection Process

Code	Cluster	Code	Criteria
A	Financial	A1	Funding amount
		A2	Rate of Profit Sharing
		A3	Equity
		A4	Profit
B	Management	B1	Workforce
		B2	Cooperation
C	Risk	C1	Debt Service Ratio (DSR)
		C2	Coverage
D	Market	D1	Market Type
E	Legal	E1	Legal Document

Table 2 Definition of Each Criterion

Criteria	Definition
A1	Total amount of funding needed by MSMEs
A2	Willingness MSMEs to share its profit with PT SJV (in percentage)
A3	MSMEs' total amount of equities
A4	Profit of each MSMEs
B1	Total workforce of MSMEs
B2	Previous cooperation with PT SJV
C1	Ability to pay
C2	Ratio of collateral's monetary value with amount of loan
D1	Market type of MSMEs, it might the captive one or not
E1	Legal document owned by MSMEs' in term of its businesses

Aside from this data, three types of questioner; criteria comparison questioner, cluster comparison questioner, and criteria rating questioner distributed among investee committee representatives. Author also collect data from MSMEs' proposals such as financial, risk, management, and etc.

B. Data Processing

After all the criteria known, the next step will construct a network model to accommodate relationship between criteria. Figure 5 shows the relationship diagram.

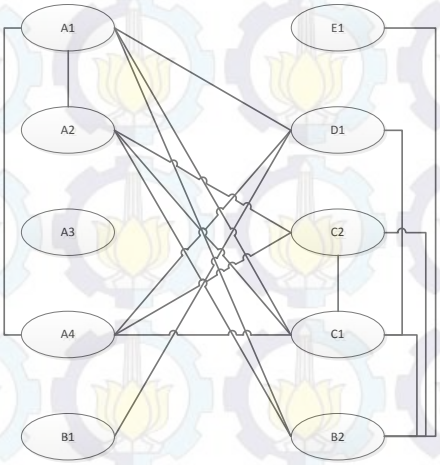

Figure 5 Criteria Relationship Diagram

Based on this diagram, ANP network model is built. After that, input every data needed to complete the ANP. Last thing to do is synthesize the network to obtain rank for each MSMEs' proposals.

Author also use different approach to rank criteria using ANP. One-by-one elimination is used to determine the appropriate rank. This process is done by removing the best alternative, and then calculate again to determine the best next alternative. This approach created to avoid inaccurate result because changes of the rank composition due to removal one or more alternative.

Table 3 Comparison of the Two Results of ANP

Ranking	MSMEs' Unique Code	
	One-by-One Elimination Rank	Original Rank
1	06	06
2	04	04
3	16	16

Ranking	MSMEs' Unique Code	
	One-by-One Elimination Rank	Original Rank
4	26	26
5	14	14
6	02	02
7	18	24
8	24	27
9	27	18
10	13	15
11	15	13
12	08	21
13	11	01
14	21	08
15	03	19
16	23	23
17	01	25
18	19	20
19	22	17
20	25	22
21	17	03
22	20	05
23	05	11
24	10	09
25	09	10
26	07	12
27	12	07

V. ANALYSIS AND DISCUSSION

Chapter 5 explains about data analysis from chapter 4 results. There will be also discussion about results, sensitivity analysis, different amount of alternatives effect, and budget constraint situation that might happened in the future.

1) *Changes in Criteria's Weight*

Some criteria might the critical one or not. To find out this, author needs to perform sensitivity analysis. The purpose of sensitivity analysis is to give author or another people read this research some clue which criterion is the most influenced the composition of ranking. Author does not have to perform sensitivity analysis manually, SuperDecisions software have the tool to do that. Section below will described the changes of each criterion and its effect to the overall ranking.

Because there is no way to measure changes in term of rank, author use how many rank changes from the original one. It calculated by counting how many rank it changes from original rank. Total amount of this will be used to determine which criteria is have the most and least effect to the composition of ranking.

Table 4 Total Changes of Each Criterion

Criteria	Total Changes
A1	320
A2	321
A3	177
A4	199
B1	216
B2	182
C1	137
C2	269
D1	165
E1	201

The highest number of total changes is A1 and A2, which means that these two criteria influence the rank the most. The lowest number of total changes is C1, which means C1 is the least factor that affect the ranking.

2) *Difference of Original Rank and 1-by-1 Elimination Rank*

The top rank of the two results is the same; however, most of the rest of the rank is in different order. To get the result of this different approach, author needs to do 26 iterations. In each iterations, the best choice will be excluded for the next iteration. This is done until there are only two alternatives. Section below will explain more about this and some scenario.

3) *Different Amount of Alternatives Effect to the Ranking*

ANP, which is the improved version AHP, might still have some weaknesses. One of weaknesses that might occur is changes happened when several alternatives remove from calculation. To discover whether it is true or not, author needs to perform this analysis. How much ranking order mess caused by removal one or several worst proposal will be done in this section. Author decides to exclude five proposal from highest ranking, lowest ranking, and middle part of ranking.

Table 5 Result of Exclusion of Several Proposals

Ranking	MSMEs' Unique Code			
	Original	5 Highest Rank Removal	5 Middle rank Removal	5 Lowest Rank Removal
1	6		6	6
2	4		4	4
3	16		16	16
4	26		26	26
5	14		14	14
6	2	2	24	2
7	24	18	15	24
8	27	24	27	27
9	18	27	2	15
10	15	15	18	18
11	13	13	13	13
12	21	21		21
13	1	8		8
14	8	1		1
15	19	23		19
16	23	19		23
17	25	25	25	25
18	20	3	20	20
19	17	20	22	17
20	22	22	17	22
21	3	11	3	3
22	5	17	5	5
23	11	5	11	
24	9	9	9	
25	10	10	10	
26	12	12	12	
27	7	7	7	

Small changes happened when some part of ranking were excluded from ANP calculation. So the author's hypothesis is proven right from this experiment.

4) *Budget Constraint*

The budget limit that will be used in this experiment is Rp. 10.000.000.000,00 (ten billion rupiah). There are four

scenario to be carried out; (1) Fund the highest original rank MSMEs' proposals, (2) Fund the highest 1-by1 elimination rank MSMEs' proposals, (3) Fund the lowest amount of funding needed, and (4) Fund the highest possible expected return. Return here means amount of money PT SJV received from profit sharing. It calculated by multiplying rate of profit sharing with profit.

First and second scenario is to fund MSMEs with the highest proposal rank. If some budget, remain or not enough for the next rank, the proposal from middle and lower rank will be chosen to spend the budget but still considering the higher rank available.

Table 6 Result of Scenario 1

No	ANP Rank	Code	Funding Amount	Expected Return
1	1	06	500,000,000	1,149,429,935
2	2	04	1,500,000,000	338,416,323
3	3	16	600,000,000	3,341,484
4	4	26	1,500,000,000	41,841,649
5	5	14	500,000,000	5,812,916
6	6	02	2,000,000,000	686,919
7	9	18	950,000,000	76,986,907
8	10	15	1,000,000,000	68,582,890
9	11	13	500,000,000	47,844,600
10	12	21	300,000,000	9,369,640
11	13	01	240,000,000	1,338,260
12	17	25	300,000,000	5,379,559
Total Expected Return				**1,749,031,082**
The Remaining Budget				**110,000,000**

Table 7 Result of Scenario 2

No	ANP Rank	Code	Funding Amount	Expected Return
1	1	06	500,000,000	1,149,429,935
2	2	04	1,500,000,000	338,416,323
3	3	16	600,000,000	3,341,484
4	4	26	1,500,000,000	41,841,649
5	5	14	500,000,000	5,812,916
6	6	02	2,000,000,000	686,919
7	7	18	950,000,000	76,986,907
8	10	13	500,000,000	47,844,600
9	11	15	1,000,000,000	68,582,890
10	12	08	500,000,000	235,229,120
11	14	21	300,000,000	9,369,640
Total Expected Return				**1,977,542,383**
The Remaining Budget				**150,000,000**

The one-by-one elimination rank gives total expected return and remaining budget more than the original rank. These two scenario indicate that the more preferred result is rank by one-by-one elimination.

Table 8 Result of Scenario 3

No	ANP Rank	Code	Funding Amount	Expected Return
1	20	22	200,000,000	3,537,211
2	13	01	240,000,000	1,338,260
3	12	21	300,000,000	9,369,640
4	17	25	300,000,000	5,379,559
5	22	03	339,653,842	11,677,841
6	18	20	350,000,000	6,357,437
7	26	12	400,000,000	750,080
8	19	17	400,000,000	8,776,303
9	1	06	500,000,000	1,149,429,935
10	14	08	500,000,000	235,229,120
11	25	10	500,000,000	25,872,166
12	11	13	500,000,000	47,844,600
13	5	14	500,000,000	5,812,916
14	15	19	500,000,000	68,851,440
15	24	09	600,000,000	41,272,796
16	3	16	600,000,000	3,341,484
17	9	18	950,000,000	76,986,907
18	10	15	1,000,000,000	68,582,890
19	16	23	1,000,000,000	14,015,234
Total Expected Return				**1,784,425,818**
The Remaining Budget				**320,346,158**

Table 9 Result of Scenario 4

No	ANP Rank	Code	Funding Amount	Expected Return
1	1	06	500,000,000	1,149,429,935
2	2	04	1,500,000,000	338,416,323
3	14	08	500,000,000	235,229,120
4	8	27	7,000,000,000	107,636,673
5	11	13	500,000,000	47,844,600
Total Expected Return				**1,878,556,651**
The Remaining Budget				-

From four scenarios above, the largest expected return PT SJV will get is from scenario 2. Nevertheless, the highest number of MSMEs funded and the highest remaining budget is scenario 3. The highest expected return in scenario 2 prove that profit sharing rate and MSMEs' profit criteria has already represent the value of expected return. These are just scenarios; the ultimate decision will be left in PT SJV hand.

VI. CONCLUSION

Conclusion, which can be drawn from this research, from the beginning to the end, and from the result, produced in Chapter 4 and 5 are:

1. There are several criteria in business funding proposal selection process. Some of them are very critical; such as legal status and MSMEs' business legal document. Others are not critical but important; (1) amount of funding, (2) rate of profit sharing, (3) MSMEs' equity, (4) MSMEs' profit, (5) total workforce, (6) previous relation with SJV, (7) debt service ratio, (8) collateral coverage, (9) market type, and (10) completeness of legal document.
2. Not all of criteria are related to each other; MSMEs' equity is the only criterion, which do not have relationship to other criteria.
3. Funding amount and rate of profit sharing are criteria that most significantly affect overall ranking. On the other hand, debt service ratio has the least impact to the ranking.
4. Exclusion of several proposals from ANP calculation does affect the ranking. However, the effect is very small, only a slight change in the rank composition.
5. In the scenario where budget is the constraint, one-by-one elimination rank performs better in

comparison with the initial rank. In addition, the initial rank of ANP produces the smallest expected return value.

6. In this research, rate of profit sharing and MSMEs' profit criteria are good representatives of the expected return value only for this case.

ACKNOWLEDGMENT

A gratitude is offered by author to people who help author to complete this research. This research is one of requirements to obtain Bachelor Degree in Industrial Engineering. Special thanks to my supervisor Mr. Stefanus Eko Wiratno and my co-supervisor Mrs. Effi Latiffianti for helping me getting through all of this. Not to forget my parents and my sister for cheering me when I was going to fall into despair. And also for my college friends, other lecturers, and every people who contribute in this research, author express his gratitude to all of you. Finally, author wants to apologize if there were any mistakes done by author in this research.

BIBLIOGRAPHY

ASEAN Secretariat. (2014). Thinking Globally, Prospering Regionally - ASEAN Economic Community 2015. Jakarta: ASEAN Secretariat.

BPS. (2014). Perkembangan UMKM pada Periode 1997 - 2012. Retrieved from: http://www.bps.go.id/linkTabelStatis/view/id/1322

Buffa, E. S., & Sarin, R. K. (1987). Modern production-operations management. New York: Wiley.

Crown. (2009). Multi-criteria analysis: a manual. (9781409810230). London: Communities and Local Government Publications Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7612/1132618.pdf

Ishizaka, A., & Nemery, P. (2013). Multi-criteria Decision Analysis: Methods and Software. Chichester: Wiley.

Kementerian Koperasi dan UMKM. (2012). Statistik Usaha Mikro, Kecil dan Menengah (UMKM) Tahun 2010-2011. Jakarta: Kementerian Koperasi dan Usaha Kecil dan Menengah.

Lesmes, D., Castillo, M., & Zarama, R. (2009). Application of the Analytic Network Process (ANP) to Establish Weights In Order To Re-Accredit a Program of a University. Proceedings of the International Symposium on the Analytic Hierarchy Process.

Peraturan Menteri Keuangan Nomor tentang Perusahaan Modal Ventura, 18/Pmk.010/2012 C.F.R. (2012).

Roy, B. (1981). The optimisation problem formulation: criticism and overstepping. Journal of the Operational Research Society, 32(6), 427-436.

Russell, N. F. (2007). Complexity of Control of Borda Count Elections. (Master), Rochester Institute of Technology, New York.

Saaty, T. L. (1999). Fundamentals of analytic network process. Paper presented at the Japan, Kobe: The International Symposium on the Analytic Hierarchy Process.

Saaty, T. L., & Vargas, L. G. (2006). Decision Making with the Analytic Network Process: Economic, Political, Social and Technological Applications with Benefits, Opportunities, Costs and Risks. New York: Springer.