Lexicography and Linear Mathematical Model Combined Method by Stability Criterion Due to Select Project Portfolio

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Abstract: *This thesis is about portfolio selection by consider stability criteria. First of all, by lexicography technic which couple compare has considered in it periodically and non-finality took into account in getting decision. Impact of criteria will be calculated so by mean of mathematical planning appropriate project will be selected. Project base entity competitive privilege is capability in executing of projects. Organizations for achieve their goals and strategies should use influential method and tools in project management. Portfolio selection is an efficient decision in project base entities. Life of organization is depending on modeling method and attitude on project selection. Guiding corporations to stability need severe change in social, economic and environmental perspective.*

Keywords: *Mathematical planning method, lexicography technic, stability criteria, project portfolio selection*

1. Introduction

Project base organization competitive is capability in executing of projects. Entities should use efficient tools and methods to achieve their goals and strategies in project management field. Portfolio selection is one of the strategical decisions in project base organizations. Life of entities have close relation with modeling method and attitude in project selection. Now a day stable development in project planning science is so emphasis. Project planning is getting to an important path for development to obtain more efficiency in projects (). Social-economic and environmental problem have got complicated and organization have to renovate managing changes (). Stability concept have three dimension: environmental, economic and social () it means that depend on triple linear concept (). Based on triple concept on this direction, organizations which are going to achieve better standard, should find how to decrease social and environmental negative impact. in spite of this, based on Elkington (1998) guide of corporation to stability needs severe change in social economic and environmental dimension (Elkington 1998). Projects managers focus on time, cost and quality always and they do not focus on long term impact on project which is so harmful for project stability (Mishra …) stability has mentioned in body knowledge of management three times. Project managers should be aware about this issue as an important factor and as policy and stability rule can affected on project. Precautions always considered out of projects but may evaluate success of project by organization entity.

2. Literary Review

Tang et al (2017) by customize technic study on oil and gas project selection by consider low price of oil. Suggested model in one case study which have contract flexibility and increase efficiency have implemented.

Debnas et al (2017) by combination attitude study on multi criteria decision method in strategic project portfolio selection. Rathi et al (2016) with phase multi criteria combined decision method studied about ranking six sigma project selection. In this study always 7 criteria in project selection and suggested attitude in implementation of a case study.

Yousefi and Hadi-Venche with multi criteria combined decision studied about ranking six sigma projects. Used methods was hierarchy analysis, TOPSIS and data sweep. At first they study on value of criteria and suggested project at last the select project with better priority (more valuable).

Taylan et al (2014) with combined hierarchy cycle analysis method and phase TOPSIS work on civil project ranking. Studied criteria was cost, time, quality, security, stability. They prioritize 30 civil project by consider these criteria.

Many of researchers have found out that civil projects cause some bad effects on environment include Griffith et al (2005) which focused on it and in order to avoid these bad effect they use stability system in these type of projects. Now a day, more than 70 tool, technic and method are used to categorized and evaluate civil projects base on stability factor criteria.

In many researches civil project effects on environment have detected include Chen et al (2002), Tam et al (2002), Chen Li et al (2000) and Shen et al (2005). Some of these factors are air pollution, voice pollution, garbage, energy consumption, harmful gas spreading, non-renewable energy misuse and water source misuse.

Grimenez et al (2012) and Kleindorfer et al (2005) categorize stability factors to economical-social and environmental which now a days combined for rational source use.

Project management subject is one of individual subjects that work on it separately. More over vast issues have defined on stability subject but in rare cases these two subjects studied mutually in literary review. Past strives on combining project management and stability concept have mentioned below:

Nevertheless, targeting for future researches should develop technics and methods. This issue has been discussed in some cases which has the possibility of execution base on project management concept is available and benchmark in system stability perspective will be experienced. For instances, Cole et al (2005), Thomson et al (2011) and Deakin et al research on it.

Nilashi et al (2015) evaluate successes factor in civil projects by using Demtil network analysis method. They suggest that model to develop influential factor detection on civil industries project.

This thesis is going to achieve number of influential stability factor in portfolio selection and finally you can find the literary review on found factors as below:

TABLE I: Stability Criteria

Factors	Criteria	Reference
Economical	Profitability	(Yung & Siew, 2016)- (Mauro Luiz Martens & Carvalho, 2016)
	Risk	(Yung & Siew, 2016)
	Direct expenses	(Xing, Horner, El-Haram, & Bebbington, 2009)
	developmental	(Fernández-Sánchez & Rodríguez-López, 2010)
Environmental	Ecological value	(Fernández-Sánchez & Rodríguez-López, 2010)
	Air ventilation	(Fernández-Sánchez & Rodríguez-López, 2010) ‹(Yung & Siew, 2016) - (Mauro Luiz Martens & Carvalho, 2016)
	Energy consumption	(Yung & Siew, 2016)
	Environmental effect	(Fernández-Sánchez & Rodríguez-López, 2010) - (M. Wang, Xu, & Wang, 2014)- (Yung & Siew, 2016) - (Mauro Luiz Martens & Carvalho, 2016)
Social	Worker safety & health	(Fernández-Sánchez & Rodríguez-López, 2010)
	Social satisfaction	(Mauro Luiz Martens & Carvalho, 2016)

3. Suggested Model

Suggested model in this thesis is combination of a multi criteria decision method and mathematical model with some limits. Lexicography decision method has used in order to evaluate each criteria and project and afterward evaluate each project, proper projects base on restriction on mathematical model will be chosen. In following the detail has shown.

3.1. Lexicography Method

It's possible to i criterion priority than j be in l_{ij} & u_{ij} range thus, l_{ij} & u_{ij} is real Non-negative number $l_{ij} \leq u_{ij}$ applies. Hence:

$$A = (a_{ij})_{n \times n} = \begin{bmatrix} 1 & [l_{12}, u_{12}] & \cdots & [l_{1n}, u_{1n}] \\ [l_{21}, u_{21}] & 1 & \cdots & [l_{2n}, u_{2n}] \\ \vdots & \vdots & \vdots & \vdots \\ [l_{n1}, u_{n1}] & [l_{n2}, u_{n2}] & \cdots & 1 \end{bmatrix}$$

So that: $l_{ij} = \dfrac{1}{l_{ji}} \quad u_{ij} = \dfrac{1}{u_{ji}} \quad \& \quad l_{ij} \leq a_{ij} \leq u_{ij}$

By consider Ariel & Wargus research on $A = (a_{ij})_{n \times n}$ matrix, this matrix is about compatible range compare and just below assumption shall be applied:

$$\max(l_{ik}, l_{kj}) \leq \min(u_{ik}, u_{kj}) \qquad \forall i, j, k = 1, \ldots, n.$$

a Priority than b (or a>b) as below:

$$p(a > b) = \frac{\max(0, a_2 - b_1) - \max(0, a_1 - b_2)}{(a_2 - a_1) + (b_2 - b_1)}$$

If $a = [a_1, a_2], b = [b_1, b_2]$ as range value, you can realize the relation on below figure:
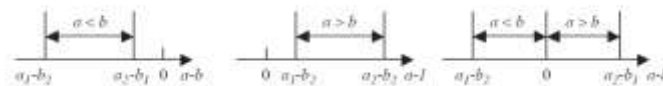

Fig.1: Range Value Relation

Restrict judgment can be considered as range value. Hence defined as below:

$$l_{ij} \leq \frac{w_i}{w_j} \leq u_{ij}, \quad i, j = 1, \ldots, n.$$

Below inequality holds compatible judgment. In case of any incompatible judgment p_{ij}, q_{ij} divergent variation can be defined for below equation:

$$l_{ij} w_{ij} - p_{ij} \leq w_i \leq u_{ij} w_{ij} + q_{ij}, \qquad i, j = 1, \ldots, n.$$

p_{ij}, q_{ij} both are real and non-negative numbers, but, simultaneously can't be positive. It mean $p_{ij}.q_{ij}=0$ applies. It's better to p_{ij}, q_{ij} variation have little value in order to use ideal lexicography model method as below (Y.-M. Wang, Yang, & Xu, 2005):

$$M \text{ in } j = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} (p_{ij} + q_{ij})$$

$$s.t : w_i - l_{ij} w_j + p_{ij} \geq 0, \quad i = 1, \ldots, n-1; \quad j = i+1, \ldots, n.$$

$$w_i - u_{ij} w_j - q_{ij} \leq 0 \quad i = 1, \ldots, n-1; \quad j = i+1, \ldots, n.$$

$$\sum_{i=1}^{n} w_i = 1$$

$w_i, p_{ij}, q_{ij} \geq 0; \forall i, j.$

3.2. Mathematical Model:

Presented mathematical model in this thesis is about project portfolio selection by using stability criterion. A binary model will be presented for modeling in this section. More over this mathematical model by defining project scoring criterion, define a linear stability criterion in project selection. Some of other suggested subject in this model is fiscal & non fiscal source limits.

By below equation scouring criterion on each project which is combination of linear stability criterion on project selection can be calculated:

$$P_i = \sum_{i=1}^{10} a_i C_i$$

TABLE II: Parameters & Variables of Model

P_i	i th project scoring criterion
a_i	i th value
C_i	Estimated expense i th project
B	Organization available budget
h_i	Evaluated persons for i th project execution
H	Organization Human resources
x_i	Decision variation for i th project selection
$x_i = 1$	If i th project selected
$x_i = 0$	If i th project not selected

By consider model defined decision variations and parameters, this question described with remember fiscal & human resource limits. Therefore, below model suggested.

$$\text{Max} \sum_{i=1}^{n} P_i x_i \tag{1}$$

$$s.t$$

$$\sum_{i=1}^{n} c_i x_i \leq B \tag{2}$$

$$\sum_{i=1}^{n} x_i \leq m \qquad (m < n) \tag{3}$$

$$\sum_{i=1}^{n} h_i x_i \leq H \tag{4}$$

$$x_i = 0 \sqcup 1 \tag{5}$$

In this section model, goal function and limits will be illustrated. Recommended model is a linear and single target which has written by GAMS 24.1.2 software.

Goal function tries to lift up amount of selected project stability score in organization. As a matter of fact, each selected project has a stability score which entities is going to maximize this score. Restrictions: 1st budget limit in compare of each project expenses. In deed by consider evaluated expenses for each project by experts organization should select a combination of these projects which is not more than organization budget.2nd

maximum amount of project which organization obliged to select. 3rd organization resource limits by consider each project take a determined percent of human resource. 4th also implies to human resource limits and each project should assign how many percent of human resource. 5th also considered each variation binary zero or one.

4. Mathematical Example

In interview with reporters and survey, proper criterion of project portfolio selection by consider stability factor have detected and results have been shown in table 3:

TABLE III: Proper Criterions

Tag	Criterion
C1	profitability
C2	Risk
C3	Direct expense
C4	Energy consumption
C5	Ecological value
C6	Air ventilation
C7	Conduciveness
C8	Effects on environment
C9	Workers Safety & health
C10	Social satisfaction

By lexicography method in case study each selected criterion value determined which is presented on table 4 & 5 & 6.

TABLE IV: Lexicography decision method lower range matrix

l_{ij}	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	1	1	2	2	3	3	4	2	5	5
C2	1	1	1	2	3	2	3	3	4	4
C3	0.5	1	1	4	2	2	2	3	2	2
C4	0.5	0.5	0.25	1	0.33	3	2	2	3	5
C5	0.33	0.33	0.5	3	1	4	4	2	3	2
C6	0.33	0.5	0.5	0.33	0.2	1	2	3	4	3
C7	0.25	0.33	0.5	0.5	0.25	0.5	1	1	2	4
C8	0.5	0.33	0.33	0.5	0.5	0.33	1	1	3	4
C9	0.2	0.25	0.5	0.33	0.33	0.25	0.5	0.33	1	2
C10	0.2	0.25	0.5	0.2	0.5	0.33	0.25	0.25	0.5	1

TABLE V: Lexicography decision method upper range matrix

u_{ij}	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
C1	1	3	4	4	4	5	6	5	7	7
C2	0.33	1	3	5	5	4	5	6	5	8
C3	0.25	0.33	1	7	6	5	4	4	6	7
C4	0.25	0.2	0.14	1	0.2	6	5	5	4	5
C5	0.25	0.2	0.16	5	1	7	8	6	5	5
C6	0.2	0.25	0.2	0.16	0.14	1	5	4	8	5
C7	0.16	0.2	0.25	0.2	0.125	0.2	1	4	6	7
C8	0.2	0.16	0.25	0.2	0.16	0.25	0.25	1	6	8
C9	0.14	0.2	0.16	0.25	0.2	0.125	0.16	0.16	1	5
C10	0.14	0.125	0.14	0.2	0.2	0.2	0.125	0.125	0.2	1

TABLE VI: Each criterion value by lexicography method

C1	0.3294
C2	0.2026
C3	0.2018
C4	0.0842
C5	0.063
C6	0.009
C7	0.02
C8	0.01
C9	0.035
C10	0.045

Now by interview of organization reporters each stability criterion has scored in each 10 studied projects. Final result is average of reporters comments which is presented in table7.

TABLE VII: Stability Score for each project in different criterion

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
P1	1	1.3	2.4	2	3	3.2	3.5	6.1	5.5	8
P2	1.25	4	2	5	1	5.5	2	1	4	9.23
P3	2	5	8.2	8.65	8	3.12	7	1	9	7
P4	2.1	9	7	5	8	5	2	2.1	5.5	2
P5	5.5	8	5.5	4	6	4.33	3.2	2	4	3
P6	3.4	4	7	3	8	7	5	6	7	2.1
P7	5	8.2	8.98	5.15	3.12	4	2.1	5.66	1	9.54
P8	4.89	4.65	5.89	5	2.123	2.5	9	4.33	8.5	9
P9	7	5	3.2	4.5	5.9	4	6	7	7	5.99
P10	10	7	2	3.65	2.1	3.12	10	3.2	4	9

Now by achieved values for each criterion, total stability score of each project can be calculated as below table.

TABLE VIII: Each project stability score

P1	2.1468
P2	2.7646
P3	5.36697
P4	1.25182
P5	5.24124
P6	5.65517
P7	6.349574
P8	5.244507
P9	5.45571
P10	6.36051

After value designation by lexicography method, suggested mathematical model has run on GAMS software and therefore organization projects (10 projects) selected by existed limits, which is shown on table 9.

TABLE IX: Acceptance or reject of projects

Accept or Reject	Project Number
0	1
0	2
1	3
0	4
1	5
1	6
1	7
1	8
1	9
1	10

By GMAS (24.1.2) below output is shown below:

Customize amount of Z is 39,674 & also $x_3, x_5, x_6, x_7, x_8, x_9, x_{10}$ value is 1 which implies to accepted and x_1, x_2, x_4 is zero which mean the project number 1,2 & 4 is rejected. In fact, combination of selected project gets more stability score (39,674) for organization.

5. Conclusion

Project portfolio selection and long term effect is one of most important issues in usage of project management in project base organizations. Project portfolio management is great tool in decrement of efficiency in organizations. Organization restrictions is one of organizations obstacle in project selection. Hence this is unavoidable to select projects by consider organization limits. In this thesis a combined decision and mathematical model by consider stable development factor illustrated. By lexicography method, pair compared in range and non-certainly in making decision has considered which decrease reporters pair compare error. In conclusion this thesis suggests to use lexicography method by using the mathematical model and with consider organization limits in select project portfolio.

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