Novel Optimization Model to decision making to investment in the industry with regard to the role of Unique Value-added to optimizing the total expected cost

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Abstract

The main aim of this study, introduce a model to determine the optimal values of the index value to minimize the total expected cost index and also the best decision making in selecting the industry and the region for investment by investors. For this purpose, the technique of linear programming to determine the optimal values of the index value is used. Finally, Fuzzy TOPSIS technique to prioritize alternatives to determine the optimal industry and region to investment is used. Furthermore, a case study that includes two regions and two industries is presented to show applicability and performance of the proposed model. The results show that fourth alternative (region2 and industry 2) is the best decision to investment.

Key Words: Unique value-added, Investment, Decision Making, Fuzzy TOPSIS, Industry

Introduction and Problem Statement

Industrial value added is calculated by taking the spread between the rate of return on total capital and the cost of capital, and then multiplying by the value of capital committed in the business, as is shown in equation (1) below (Stewart, 1991: 136):

$$IVA=\left(q - c^*\right)\left(capital\right) \tag{1}$$

Where q is the rate of return on total capital, and c^* is the cost of capital of the firm.

According to Stewart (1991: 85-86) the return on capital employed (q) can be calculated by dividing the firm's net operating profits after taxes (NOPAT) by the total capital employed. Stewart (1991: 91) calculates NOPAT from the income available to common shareholders. He adds back preferred dividends, provisions for minority interest, interest expenses, and what he terms "increases in equity equivalents". The adjustments for an increase in equity equivalents is meant to "make NOPAT a more realistic measure of the actual cash yield generated for investors" (Stewart, 1991: 112). It includes adjustments to correct for the effects of reserving for deferred taxes, valuing inventory by means of the last-in-first-out instead of the first-in-first-out method, amortizing goodwill, not capitalizing intangibles resulting from research and development and similar expenditures, and creating other precautionary reserves. Stewart also makes corresponding adjustments to the capital figures. These are designed to "gross up the standard accounting book value for common equity to its industrial book value."

Stewart also proposes an alternative and equivalent formulation of the IVA. This is obtained from equation (1) by multiplying through by capital:

$$IVA=NOPAT-c^*\left(capital\right) \tag{2}$$

where *NOPAT* is the net operating profit after tax of the firm.

Stewart (1991: 167) recognises that the absolute value of IVA generated is not always an appropriate measure of profitability, especially when comparing business units not of the same size. He therefore proposes that a standardised IVA be calculated, expressing IVA as a percentage of the beginning of period capital. This then provides an indication of the return in excess of the cost of capital that is generated by the firm.

This paper studies the distortion in NOPAT caused by depreciation schedules, a distortion not considered or corrected for by Stewart. The paper starts by comparing the the discounted IVA and the NPV of projects, and the extent to which this comparison is influenced by depreciation schedules.

LITERATURE REVIEW

Unique Value-added

In business, the difference between the sale price and the production cost of a product is the unique profit. In industrials, the sum of the unit profit, the unit depreciation cost, and the unit labor cost is the unique value added. Summing value added per unit over all units sold is total value added. Total value added is equivalent to revenue less outside purchases (of materials and services). Value added is a higher portion of revenue for integrated companies, e.g., manufacturing companies, and a lower portion of revenue for less integrated companies, e.g., retail companies. Total value added is very closely approximated by total labor expense (including wages, salaries, and benefits) plus "cash" operating profit (defined as operating profit plus depreciation expense, i.e., operating profit before depreciation). The first component (total labor expense) is a return to labor and the second component (operating profit before depreciation) is a return to capital (including capital goods, land, and other property). In national accounts used in macro industrials, it refers to the contribution of the factors of production, i.e., capital (e.g., land and capital goods) and labor, to raising the value of a product and corresponds to the incomes received by the owners of these factors. The national value added is shared between capital and labor (as the factors of production), and this sharing gives rise to issues of distribution. Outside of industrials, value added refers to "extra" feature(s) of an item of interest (product, service, person etc.) that go beyond the standard expectations and provide something "more" while adding little or nothing to its cost. Value-added features give competitive edges to companies with otherwise more expensive products.

Investment

Investment is time, energy, or matter spent in the hope of future benefits actualized within a specified date or time frame. Investment has different meanings in industrials and finance. In industrials, investment is the accumulation of newly produced physical entities, such as factories, machinery, houses, and goods inventories. In finance, investment is putting money into an asset with the expectation of capital appreciation, dividends, and/or interest earnings. This may or may not be backed by research and analysis. Most or all forms of investment involve some form of risk, such as investment in equities, property, and even fixed interest securities which are subject, among other things, to inflation risk. It is indispensable for project investors to identify and manage the risks related to the investment.

Decision Making

Decision-making can be regarded as the cognitive process resulting in the selection of a belief or a course of action among several alternative possibilities. Every decision-making process produces a final choice that may or may not prompt action. Decision-making is the study of identifying and choosing alternatives based on the values and preferences of the decision maker. Decision-making is one of the central activities of management and is a huge part of any process of implementation.

Proposed model

Step1: The General Decision Matrix

In this stage of the research, the proposed model is presented. For this purpose, consider a decision matrix that includes (N) regions, (M) industries and (6) main index value-added in industry is to invest. This matrix is shown in Table 1.

Table 1: Total decision matrix

	Region i= 1			Region i= n		
Main index value-added (k)	**Industry J=1**	**Industry J=2**	**Industry J= m**	**Industry J=1**	**Industry J=2**	**Industry J= m**
Logistics						
Energy						
Human Resource						
Maintenance						
Material						
Environment						

Step2: The General Model

In this stage of the research, the general proposed model is presented. This model is a linear programming model. Variables in the model are given in Table 2.

Table 2: Variables in model and their concepts

Variables	Concept
Z	Total Expected Cost Index
I_{ijk}	The cost index based on the main index value-added (k), the industry (j) and the region (i) per production unit
P_{iJ}	The production index, if selection the industry (j) and the region (i)
π_{iJ}	The Benefit index, if selection the industry (j) and the region (i)
C_K	Expected Cost of investors based on the main index value-added (k)

The model below is a general linear planning model that its aim is minimizing the total expected cost index. One constraint of this model is that it represents the total amount of the cost index should be smaller or equal to the sum of the values of benefits. This is the prerequisite for investment in an industry (Industry activities in profits). The second to seventh constraint indicates that the total cost index values for main index value-added must be equal to 1.

$$\min z = \sum_{i=1}^{n}\sum_{j=1}^{m}\sum_{k=1}^{6} I_{iJk} \times P_{iJ}$$

$S.t$

$$\sum_{i=1}^{n}\sum_{j=1}^{m}\sum_{k=1}^{6} I_{iJk} \le \sum_{i=1}^{n}\sum_{j=1}^{m}\sum_{k=1}^{6} \pi_{ijK}$$

$$\sum_{i=1}^{n} \quad \sum_{J=1}^{m} I_{iJ1} \le C_1$$

$$\vdots$$

$$\sum_{i=1}^{n} \quad \sum_{J=1}^{m} I_{iJ6} \le C_6$$

Research Methodology

In figure1, an overview of the research process is presented step by step

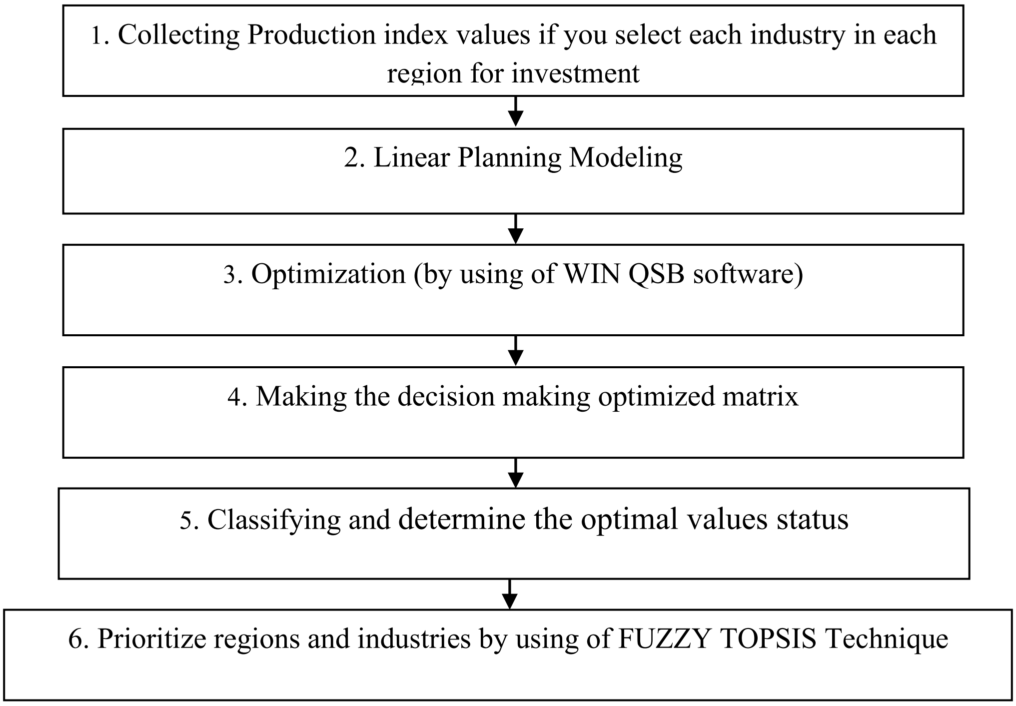

Figure 1: Research Practical Model

Case Study

The case study in this research includes two regions and two industries, is presented to show applicability and performance of the proposed model. Data based on manufacturing and benefits indexes (ratio) of investors are given in Tables 3 - 4.

Table 3: Data based on production index (Ratio)

	Region i= 1		**Region i= 2**	
Main value-added indexes (k)	**Industry J=1**	**Industry J=2**	**Industry J=1**	**Industry J=2**
Logistics	0.88	0.74	0.63	0.76
Energy	0.81	0.72	0.6	0.65
Human Resource	0.74	0.7	0.68	0.61
Maintenance	0.77	0.84	0.82	0.66
Material	0.91	0.81	0.67	0.62
Environment	0.73	0.78	0.64	0.85

Table 4: Data based on Benefit index (Ratio)

Main value-added indexes (k)	Region i= 1		Region i= 2		$\sum_{i=1}^{n}\sum_{j=1}^{m}\sum_{k=1}^{6}\pi_{ijK}$
	Industry J=1	Industry J=2	Industry J=1	Industry J=2	
Logistics	0.88	0.74	0.63	0.76	1.6
Energy	0.81	0.72	0.6	0.65	1.9
Human Resource	0.74	0.7	0.68	0.61	1.7
Maintenance	0.77	0.84	0.82	0.66	2
Material	0.91	0.81	0.67	0.62	1.6
Environment	0.73	0.78	0.64	0.85	1.8
					$\sum$=10.6

Expected lower bound and upper bound of each I_{iJk} by decision makers (Ratio), for optimal decision making, is presented in table5.

Table 5: expected lower bound and upper bound of each I_{iJk} by decision makers (Ratio)

Main value-added indexes (k)	Region i= 1				Region i= 2				C_K
	Industry J=1		Industry J=2		Industry J=1		Industry J=2		
	L.B	U.B	L.B	U.B	L.B	U.B	L.B	U.B	
Logistics	0.3	0.64	0.24	0.65	0.36	0.51	0.2	0.6	1.53
Energy	0.22	0.42	0.36	0.78	0.2	0.55	0.34	0.63	1.42
Human Resource	0.15	0.47	0.28	0.65	0.18	0.5	0.3	0.7	1.38
Maintenance	0.33	0.7	0.24	0.6	0.4	0.6	0.38	0.66	1.47
Material	0.25	0.65	0.3	0.7	0.2	0.6	0.3	0.65	1.66
Environment	0.25	0.64	0.15	0.6	0.35	0.75	0.23	0.67	1.51

L.B: expected **lower bounded** of the each I_{iJk} by decision makers **U.B**: expected **upper bound**ed of the each I_{iJk} by decision makers

Modeling

In this part of the research, according to the values in Tables 3 - 5, the research model is constructed.

The above model is solved by using of the Win QSB software, the optimal values of I_{iJk} are obtained. These values are given in Table 6.

Table 6: the optimal values of I_{iJk} by using of the Win QSB software (Ratio)

	Region i= 1		Region i= 2	
Main value-added indexes (k)	**Industry J=1**	**Industry J=2**	**Industry J=1**	**Industry J=2**
Logistics	0.3	0.24	0.36	0.2
Energy	0.22	0.36	0.2	0.34
Human Resource	0.15	0.28	0.18	0.3
Maintenance	0.33	0.24	0.4	0.38
Material	0.25	0.3	0.2	0.3
Environment	0.25	0.15	0.35	0.23
Optimal Total Expected Cost index = 4.755				

Making the decision making optimized matrix

In this part of the research, the combination of industries and regions to investment, are as decision making alternatives. The decision making optimized matrix based on values of table 6, is presented in table 7:

Table 7: Decision making optimized matrix (Ratio)

Main indexes / Alternatives	Logistics (L)	Energy (EG)	Human Resource (H)	Maintenance (MN)	Material (MT)	Environment (EN)
R1 & I1	0.3	0.22	0.15	0.33	0.25	0.25
R1 & I2	0.24	0.36	0.28	0.24	0.3	0.15
R2 & I1	0.36	0.2	0.18	0.4	0.2	0.35
R2 & I2	0.2	0.34	0.3	0.38	0.3	0.23
R: Region I: Industry						

Classifying the optimal values of I_{iJk} based on obtained data in table 7

In this step of Research, by using of the obtained optimal values of I_{iJk} for each main index, data classification is done. The main aim of this data classification, adjustment the calculated values of each optimal values of I_{iJk} with fuzzy weights. In fact, determination the levels that calculated values of each main index, be placed in it. The number of levels in this classification is seven levels. In fact, the number of levels is the same of number of fuzzy weights. (based on ratio index, the max data is: 1(100%) and min data is: 0 (0%)).

$$levels\ length = \frac{\text{max data} - \text{min data}}{\text{number of levels}} = \frac{1-0}{7} = 0.143$$

Table8. Classifying optimal values of I_{iJk} based on obtained data in table 7

Level	Classifying of I_{iJk}	Status	Trapezoidal fuzzy numbers
1	$0 \le I_{iJk} \le 0.143$	Very low	(8, 9, 10, 10)
2	$0.143 < I_{iJk} \le 0.286$	Low	(7, 8, 8, 9)
3	$0.286 < I_{iJk} \le 0.428$	Lower than average	(5, 6, 7, 8)
4	$0.428 < I_{iJk} \le 0.57$	Average	(4, 5, 5, 6)
5	$0.57 < I_{iJk} \le 0.713$	Mora than average	(2, 3, 4, 5)
6	$0.713 < I_{iJk} \le 0.856$	High	(1, 2, 2, 3)
7	$0.856 < I_{iJk} \le 1$	Very high	(0, 0, 1, 2)

Table9. Linguistic variables to determine the weight (trapezoidal fuzzy numbers) (Chen, 2000)

For negative index		For positive index		Trapezoidal fuzzy numbers
Very low	VL	Very High	VH	(8, 9, 10, 10)
Low	L	High	H	(7, 8, 8, 9)
Lower than average	LA	Mora than average	MA	(5, 6, 7, 8)
Average	A	Average	A	(4, 5, 5, 6)
Mora than average	MA	Lower than average	LA	(2, 3, 4, 5)
High	H	Low	L	(1, 2, 2, 3)
Very High	VH	Very low	VL	(0, 0, 1, 2)

Adjustment optimal values of I_{iJk} with fuzzy weights

In this step of study, be adjusting values of transportation main indexes in each area with fuzzy weights. In fact, the average of transportation standard times and also the average of transportation cost in each area, be adjusting with fuzzy weights.

Table10. Adjustment optimal values of I_{iJk} with fuzzy weights

Alternatives	Logistics	Level	Status	Triangular fuzzy numbers	Energy	Level	Status	Triangular fuzzy numbers
R1 & I1	0.3	3	Lower than average	(5, 6, 7, 8)	0.22	2	Low	(7, 8, 8, 9)
R1 & I2	0.24	2	Low	(7, 8, 8, 9)	0.36	3	Lower than average	(5, 6, 7, 8)
R2 & I1	0.36	3	Lower than average	(5, 6, 7, 8)	0.2	2	Low	(7, 8, 8, 9)
R2 & I2	0.2	2	Low	(7, 8, 8, 9)	0.34	3	Lower than average	(5, 6, 7, 8)

Alternatives	Human Resource	Level	Status	Triangular fuzzy numbers	Maintenance	Level	Status	Triangular fuzzy numbers
R1 & I1	0.15	2	Low	(7, 8, 8, 9)	0.33	3	Lower than average	(5, 6, 7, 8)
R1 & I2	0.28	2	Low	(7, 8, 8, 9)	0.24	2	Low	(7, 8, 8, 9)
R2 & I1	0.18	2	Low	(7, 8, 8, 9)	0.4	3	Lower than average	(5, 6, 7, 8)
R2 & I2	0.3	3	Lower than average	(5, 6, 7, 8)	0.38	3	Lower than average	(5, 6, 7, 8)
Alternatives	**Material**	**Level**	**Status**	**Triangular fuzzy numbers**	**Environment**	**Level**	**Status**	**Triangular fuzzy numbers**
R1 & I1	0.25	2	Low	(7, 8, 8, 9)	0.25	2	Low	(7, 8, 8, 9)
R1 & I2	0.3	3	Lower than average	(5, 6, 7, 8)	0.15	2	Low	(7, 8, 8, 9)
R2 & I1	0.2	2	Low	(7, 8, 8, 9)	0.35	3	Lower than average	(5, 6, 7, 8)
R2 & I2	0.3	3	Lower than average	(5, 6, 7, 8)	0.23	2	Low	(7, 8, 8, 9)

Table11. Make the decision making matrix

Main Index / Alternative	Logistics (L)	Energy (EG)	Human Resource (H)	Maintenance (MN)	Material (MT)	Environment (EN)
R1 & I1	(7, 8, 8, 9)	(7, 8, 8, 9)	(7, 8, 8, 9)	(5, 6, 7, 8)	(7, 8, 8, 9)	(7, 8, 8, 9)
R1 & I2	(7, 8, 8, 9)	(5, 6, 7, 8)	(7, 8, 8, 9)	(7, 8, 8, 9)	(5, 6, 7, 8)	(7, 8, 8, 9)
R2 & I1	(7, 8, 8, 9)	(7, 8, 8, 9)	(7, 8, 8, 9)	(5, 6, 7, 8)	(7, 8, 8, 9)	(5, 6, 7, 8)
R2 & I2	(5, 6, 7, 8)	(5, 6, 7, 8)	(5, 6, 7, 8)	(5, 6, 7, 8)	(5, 6, 7, 8)	(7, 8, 8, 9)

Decision making about selection of the best region and industry for investment by using of Fuzzy TOPSIS Technique

In this step of research, final decision making about selection of the best region and industry for investment by using of fuzzy Topsis technique is done.

Technique for order performance by similarity to ideal solution (TOPSIS), one of known classical MCDM method, was first developed by Hwang and Yoon (1981) for solving MCDM problems. TOPSIS is known as one of the most classical MCDM methods, which is based on the idea, that the selected alternative should have the shortest distance from the positive ideal solution and on the other side the farthest distance of the negative ideal solution (Chen and Hwang, 1982). The TOPSIS-method will be applied to a case study, which is described in detail. In classical MCDM methods, the ratings and the weights of the criteria are known precisely (Jahanshahlou et al, 2006), Decision making process steps by fuzzy TOPSIS technique are shown below:

Step 1: calculating weights vector w~j

Step 2: normalizing the calculated matrix:

$$\tilde{R} = \left[\tilde{r}_{ij} \right]_{m \times n} \quad (1)$$

$B \subseteq \{1, ..., n\}$ Is related to benefit-based indices and $C \subseteq \{1, ..., n\}$ is related to cost-based indices.

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{d_j^*}, \frac{b_{ij}}{d_j^*}, \frac{c_{ij}}{d_j^*}, \frac{d_{ij}}{d_j^*} \right), \quad j \in B \quad (2)$$

$$\tilde{r}_{ij} = \left(\frac{a_j^-}{d_{ij}}, \frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}} \right), \quad j \in C \quad (3)$$

Step 3: so normalized weighted matrix is calculated as formula 4:

$$\tilde{V} = \left[\tilde{v}_{ij} \right]_{m \times n}, \quad i = 1, 2, \ldots, m, \;\; j = 1, 2, \ldots, n \quad (4)$$

$$\tilde{v}_{ij} = \tilde{r}_{ij} \otimes \tilde{w}_j$$

Step 4: determining the fuzzy positive ideal solution $\tilde{v}_j^*$ (FPIS) and fuzzy negative ideal solution $\tilde{v}_j^-$ (FNIS) (formulas 5, 6):

$$\tilde{v}_j^- = \begin{cases} \min\limits_{i=1,\ldots,m} \tilde{v}_{ij} ; j \in B \\ \max\limits_{i=1,\ldots,m} \tilde{v}_{ij} ; j \in C \end{cases}$$

(5)

$$\tilde{v}_j^* = \begin{cases} \max_{i=1,\ldots,m} \tilde{v}_{ij} \; ; \; j \in B \\ \min_{i=1,\ldots,m} \tilde{v}_{ij} \; ; \; j \in C \end{cases}$$

$$FNIS = \{\tilde{v}_j^- \mid j = 1, \ldots, n\}$$ (6)

$$FPIS = \{\tilde{v}_j^* \mid j = 1, \ldots, n\}$$

Step 5: calculating the alternatives from positive and negative ideal by applying formulas 7 and 8:

$$d_i^* = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_j^*), \mathrm{i} = 1, \ldots, m \quad (7)$$

$$d_i^- = \sum_{j=1}^{n} d(\tilde{v}_{ij}, \tilde{v}_j^-), \mathrm{i} = 1, \ldots, m \quad (8)$$

Step 6: Calculating the relative closeness to the ideal solution:

$$Cc_i = \frac{d_i^-}{d_i^- + d_i^+} \quad (9)$$

In real-world situation, because of incomplete or non-obtainable information, the data (attributes) are often not so deterministic, there for they usually are fuzzy /imprecise. So, we try to extend TOPSIS for fuzzy data to categorize the driving factors affecting on intellectual capital.

Making the Fuzzy weights matrix

In this step of research, the fuzzy weights matrix is made by using of the experts and decision makers opinion.

Table12. Fuzzy weights matrix

Main Index	Status	Fuzzy weight
Logistics	Very high	(8, 9, 10, 10)
Energy	Very high	(8, 9, 10, 10)
Human Resource	high	(7, 8, 8, 9)
Maintenance	high	(7, 8, 8, 9)
Material	high	(7, 8, 8, 9)
Environment	high	(7, 8, 8, 9)

Table13. Fuzzy weighted normalized matrix

Main Index / Alternative	Logistics (L)	Energy (EG)	Human Resource (H)	Maintenance (MN)	Material (MT)	Environment (EN)
R1 & I1	(5.7, 5.7, 6.2, 5.5)	(5.7, 5.7, 6.2, 5.5)	(4.97, 4.96, 4.96, 4.95)	(7, 6.6, 5.7, 5.6)	(4.97, 4.96, 4.96, 4.95)	(4.97, 4.96, 4.96, 4.95)
R1 & I2	(5.7, 5.7, 6.2, 5.5)	(7, 6.64, 5.7, 5.6)	(4.97, 4.96, 4.96, 4.95)	(4.97, 4.96, 4.96, 4.95)	(7, 6.6, 5.7, 5.6)	(4.97, 4.96, 4.96, 4.95)
R2 & I1	(5.7, 5.7, 6.2, 5.5)	(5.7, 5.7, 6.2, 5.5)	(4.97, 4.96, 4.96, 4.95)	(7, 6.6, 5.7, 5.6)	(4.97, 4.96, 4.96, 4.95)	(7, 6.6, 5.7, 5.6)
R2 & I2	(7, 6.64, 5.7, 5.6)	(7, 6.64, 5.7, 5.6)	(7, 6.6, 5.7, 5.6)	(7, 6.6, 5.7, 5.6)	(7, 6.6, 5.7, 5.6)	(4.97, 4.96, 4.96, 4.95)

Final indices ranks

And finally by applying formulas 7, 8 and 9, fuzzy positive ideal solution, negative ideal solution and the relative closeness to the ideal solution were calculated which are shown in table 14:

Table 14: final indices ranks

Alternative	d_i^+	d_i^-	Cc_i	Ranks
R1 & I1	5.76	0.248	0.248	4
R1 & I2	3.83	0.39	0.39	3
R2 & I1	2.96	0.527	0.527	2
R2 & I2	1.9	0.8	0.753	**1**

Based on table 14, fourth alternative (region2 and industry 2) is the best decision to investment.

Conclusion and suggestion

According to the results obtained in this research, the role of determination the optimal region and type of industry to investment and establishing, to on time, optimum supplying of Raw material required for production, supply the enough energy and environmental pollution control , is very importance. The optimum selecting and establishing of industry in region, cause to increasing efficiency of supplying, handling, productivity and reduce the total expected cost and increasing the value- added per production unit. In this research, there are four alternative (combination the regions and industries) to optimal decision making by investors. According to the results obtained in this research, fourth alternative (region2 and industry 2) is the best decision to investment. This results of research, is obtained based on opinions of industrial experts and experience investors in fields of industrial engineering and management and also supply main indexes (logistics, energy, human resource, maintenance, material and environment). Because of variety of variations, it is not possible to control the total variations that mean that some impressive variations on the result of research are out of control. So, it is suggested that the related researches in this filed should be done by all impressive variations. As for the optimization of value-added in industry and how to selecting and establishing the industry in region, how to locating it and it's relating to the costs is a new issue in Iranian organizations, so in considering of its indexes and in organizations, this research has been faced with the previous researches limitations. Also it is suggested that research in this field should be done by impressive various main indexes that effective on value- added and different organizations.

References:

Khamisabadi, Javad, eds.2013. Introducing a Model in Order to Logistics Balance with the Aim of Improving for Total Expected Cost (Case Study: Tondar 90 Assembly shop, Iran khodro Co; Journal of Basic and Applied Scientific Research 3(3): 285-292.

Ahmad, N and S. Araujo (2011).“Measuring Trade in Value-Added and Income using Firm-Leveldata”.

Johnson, R.C. and G. Noguera (2011). “Accounting for intermediates: Production sharing and trade in value added”, Journal of International Industrials, forthcoming.

Koopman, R., Z. Wang and S.-J.Wei (2008). “How much Chinese exports is really made in China –Assessing foreign and domestic value-added in gross exports”, NBER Working Paper No. 14109.

Koopman, R., W. Powers, Z. Wang and S.-J.Wei (2011). “Give credit to where credit is due: tracing value added in global production chains”, NBER Working Papers Series 16426, September 2010, revised September 2011.

Lee, H.L., V. Padmanabhan and S. Whang (1997).“The bullwhip effect in supply chains”, Sloan Management Review, 38(3), 93-102.

WTO and Commission des Finances du Sénat (2011). Conference proceedings 'Globalization of industrial production chains and measurement of trade in value added', Geneva.

WTO and IDE-JETRO (2011).Trade Patterns and Global Value Chains in East Asia: From trade in goods to trade in tasks, Geneva.

Fisher, F.M. and J.J. McGowan. 1983. On the misuse of accounting rates of return to infer monopoly profits. *American Economic Review* 73(1)(March): 82-97.

Harcourt, G.C. 1965. The accountant in a golden age. *Oxford Economic Papers* 17(1): 66-80.

Hotelling, H. 1925. A general mathematical theory of depreciation. *Journal of the American Statistical Association* 20(151) (September): 340-353.

Stewart, G. 1991. *The Quest for Value: A Guide to Senior Managers*. New York: Harper Business.