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EFFECTIVITY GREEN PRODUCTIVITY BASIS TRIPLE HELIX IN TOFU CENTRAL INDUSTRY

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Abstract

Tofu central industry is an association of Small and Medium Enterprises (SMEs) are located in one area together producing tofu to improve the welfare of the surrounding community by utilizing natural resources. The SMEs is one of the leading economic powers. Purpose of this study was to assess effectively green productivity basis triple helix in tofu central industry with Analytical Hierarchy Process (AHP) approach under the laws Republic of Indonesia no.20 on Small and Medium Enterprises. The result is the contribution academic in development aspect = 0.048 and less contribute in empowerment aspect = 0.072, climate = 0.041, costs = 0.033 and warranty = 0.032, while the contribution business in empowerment aspect = 0.115, climate = 0.81, and guarantee = 0.064, but less contribute in development aspect = 0.038, and partnership = 0.033. While contribute government superior in cost aspect = 0.052, guarantee = 0.064 and partnerships = 0.052, but less in climate aspect = 0.041.

Keywords: AHP; Green Productivity; Triple Helix; Central Industry

INTRODUCTION

Small and Medium Enterprises (SME) is one of the leading economic power (van Song et al., 2020; Le, 2020; Yasa et al., 2020). Therefore, SME have an important role in economic development. In the state policy has clearly illustrated the role of the people's economy based SME. (Febrian et al., 2020; Ben Mabrouk et al., 2020; Ngo et al., 2020). SME has a strategic role in national economic development, including a role in economic growth and employment as well as play a role in the distribution of development outcomes. Results SME ministry of industry the total SME in 2011 as many as 3.9 million units. The existence of SME able to absorb the labor force as much as 9.14 million people, But over time many of the problems faced by SME offender (Trang & Vu, 2020; Xuan, 2020; Diep & Anh, 2020). Now days Indonesia facing the Asean Economic Community (AEC), with the implementation of the ASEAN Free Trade Agreement (AFTA) in 2015 so the businesses are required to be innovative in the operations, the involvement of academic, business and government (ABG) are required to be actively involved, so the source abundant natural resources and attached to an area can be optimized to create economic industries resilient and reliable. So it needs the involvement of various stakeholders (triple helix) consisting of ABG can be a sustainable SME in business (Suzabar et al., 2020; Sarma et al., 2020). Triple helix is an approach that describes how an innovation arises from the existence of a balanced relationship, business, and government (Munir et al., 2020; Febrian et al., 2020; Helmy & Wiwoho, 2020). The role of government and academic with more emphasis on knowledge in other words the lack of knowledge on the

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role of SME can be bridged by the government and academic, so that the productivity of SME can grow and develop (sustainable), not only productivity but also on the environment to create green productivity in SME, so green productivity SME based on the triple helix is needed. (Handiwibowo et al., 2020; Yasa, Ketut Giantari, et al., 2020) One SME that need to be linked green productivity basis triple helix is tofu central industry which is one of the leading centra industry in Sidoarjo. This area there are many entrepreneurs tofu. Venture out in this area are home industry. Therefore it is necessary to conduct research toassessment the green productivity basis triple helix green in industrial centers know (Ha, 2020; Munir et al., 2020).

METHOD

Analytical Hierarchy Process (AHP) is an approach that is used to help solve complex any problems with a hierarchy of criteria structuring, stakeholders, result and attract a variety of considerations in order to develop a weight or priority Dulange (Golghamat Raad et al., 2020; Gupta, 2019; Purnamawati & Adnyani, 2020). AHP is a method decision making for assigning a priority to when multiple criteria must be considered (Amit et al., 2015). For research instance, productivity evaluation, transportation and supplier provider selection used AHP technique to assess resistant structures (Tuan et al., 2020; Achatbi et al., 2020;Astanti et al., 2020). AHP technique to assess contracts technique in the technology of quality (Dulange et al., 2014). AHP technique in strategies prioritized, reconstructing damaged areas in crises natural and developed through researches of techniques (Nguyen et al., 2020; Mallick et al., 2019; Wichapa & Khokhajaikiat, 2018). AHP for assess criteria strategy manufacturing system. AHP for Supplier selection for social sustainability. (Yusof & Salleh, 2013).

(Wichapa & Khokhajaikiat, 2019; Teniwut et al., 2019; Goswami & Mitra, 2020) Hierarchy is a fundamental tool of the human mind which involves identifying the elements of a problem, grouping elements into a set of homogeneous, as well as arranging the sets are at different levels (Figure 1).

Basically the steps in AHP method include:

a) Problems must be defined and determine the desired solution.
b) Create and make a hierarchical structure with a general purpose, followed by sub-objectives, criteria and allow alternatives to the bottom level criteria.
c) Illustrates the relative contribution with make a pairwise comparison matrix or influence of each factors on each goal level or above criteria.
d) Perform pairwise comparisons in order to obtain a judgment entirely as nx ((n-1) / 2) pieces, with n is the number of elements being compared.
e) Calculating the value of eugen and tested for consistency, if not inconsistent data retrieval is repeated.
f) Repeating steps c, d, and e for all levels of hierarchy.
g) Calculating eigenvectors and eigenvector value. This step is to synthesize judgment in determining priority elements on the lowest hierarchy level to the achievement of objectives.

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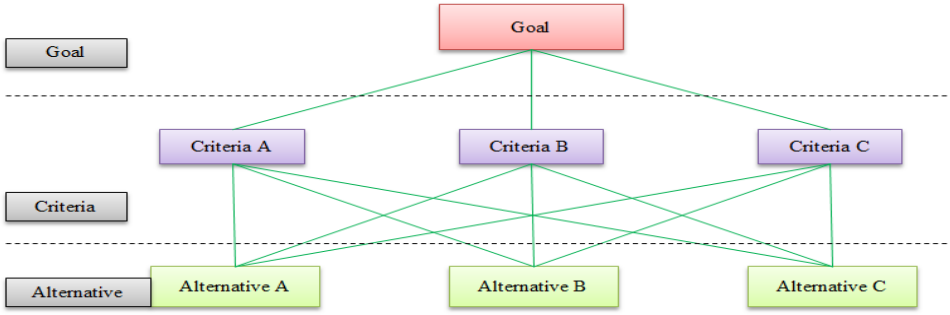
h) Check the consistency value of the hierarchy. the value cannot be more than 10%, if more then it must be corrected.

Figure 1: Hierarchy structure



set a quantitative scale of 1 to 9 to compare the level of interest of an element to another element.

Table 1: Pairwise Comparison Scale

Intensity Interests	Information
1	The elements are equally important
3	Elements that one a little more important than other elements
5	Elements which one is more important than other elements
7	One element is obviously more important than the absolute other elements
9	An element is absolutely important
2, 4, 6, 8	Values adjacent consideration
Reverse	If for activities/get one point compared with the activity j, then j has the opposite value compared to the value of i

Weight Calculation Element

Mathematical formulation on the AHP model is done by using a matrix. Suppose that in an operation subsystems are n elements of the operation, the operating elements A_1, A_2, A_3, ..., A_n, then the results of pairwise comparisons of these elements will form the matrix comparison.

Table 2: Pairwise Comparison Matrix

C	A_1	A_2	...	A_n
A_1	a_{11}	a_{21}	...	a_{1n}
A_2	a_{12}	a_{22}	...	a_{2n}
...	...	...	...	...
A_n	a_{n1}	a_{n2}	...	a_{nn}

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A matrix with a matrix reciprocal nxn size. And it is assumed that there are n elements w_1, w_2, ..., w_n, which will be assessed by comparison. Value (judgment) pairing comparison between (w_i, w_j) may be presented as the matrix.

$$\frac{w_i}{w_j} = a_{(i,j)}; \quad i,j = 1, 2, \ldots, n \quad \ldots\ldots\ldots (1)$$

A comparison matrix in this case is the matrix A by the elements is $a_{(i,j)}$, with i, j = 1, 2, ..., n. If Ci is the number of scale comparison column i, so it can be expressed as in the equation below:

$$C_i = \sum_{i=1}^{n} a_{ij} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

When the elements of the weighting vector operations A_1, A_2,..., An expressed as a vector w = (w_1, w_2, ..., w_n), then the value of the intensity of the interest of the operating elements A_1 than A_2 can be expressed as the ratio of the weight of the operating elements A_1 towards $A_2$is w_{12} the same A_{12}.

Table 3: Comparison Matrix Preferences

C	**A_1**	**A_2**	**...**	**A_n**	**Normal Weights**
A_1	w_{11}	W_{21}	...	w_{1n}	w_{1n}
A_2	w_{12}	W_{22}	...	w_{2n}	w_{2n}
...	...	...	...	...	...
A_n	w_{n1}	w_{n2}	...	w_{nn}	w_{nn}

Values w_{ij} with i, j = 1, 2, ..., n explored of participants/ respondents, is people who are competent in the issues analyzed.If the number of pairwise comparison scale on the column i is Ci, then the weight of each element in each column can be expressed as in the equation below.

$$w_{ij} = \frac{a_{ij}}{C_i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where:

w_{ij} = weight of the priority elements row i and columnjthat has to be normalized.

While the normal weight of a matrix of pairwise comparison of each level in the structure of the decision is the average of the value of each line as shown in the following equation:

$$W_i = \sum_{j=1}^{n} \frac{w_{ij}}{n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where:

w_{ij} = normal weight (relative) which shows the priority order of elements of a level in the structure of the decision.

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Consistency Calculation

Perform hierarchical synthesis is to calculate the eigenvalues of the existing attribute weights and summing the total weight eigenvector of the results of the respondents.

$$\lambda_{max} = \sum_{j=1}^{n} C_i . W_i \quad \text{..... (5)}$$

Where:

λ_{max} = Maximum eigen value.
n = Order number matrix.
C_i = Number comparison scale column matrix i.
W_i = Relative weight that shows the priority order matrix element.

After making the overall pairwise comparison, next determine consistency using the maximum eigen value (λ_{max})to calculate the consistency index (consistency index/CI) as follows:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad \text{..... (6)}$$

Where:

λ_{max} = Maximum eigen value
N = Size of matrix

Determination of consistency can be checked via the ratio of consistency/consistency ratio (CR):

$$CR = \frac{CI}{RI} \quad \text{..... (7)}$$

Where:

RI = random index value

If the value CR does not exceed 0.1 (CR < 0.1), the results of assessment are acceptable or accountable, but if exceeding 0.1 is not consistent comparison matrix should be reviewed and corrected again. Consistency index obtained by subtracting maximum eigen value towards n (number of elements) and dividing by (n-1).

RESULTS

Focus (goal) this study is assessment Green productivity to triple helix for sustainability at tofu center industry, while the criteria under the Ordinance. No. 20 about SMEs include: Empowerment, Conditions of Business, Development, Financing, Guarantee, and partnerships, while as the actors involved (stakeholders) that academic, business, and government. These elements can be grouped into 1) the objectives is green productivity to triple helix at tofu center industry, 2) a group of green productivity aspects is empowerment, Conditions of Business, Development, Financing, Guarantee, and partnerships, and 3) groups of actors (actor or decision maker) is academic, business, and government (ABG) (figure 2).

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Pair wise Comparisons

Pair wise comparisons used to consider the purpose and alternatives with attention to the relationship between aspects and criteria (figure 3).

Figure 2: Structure of green productivity hierarchys

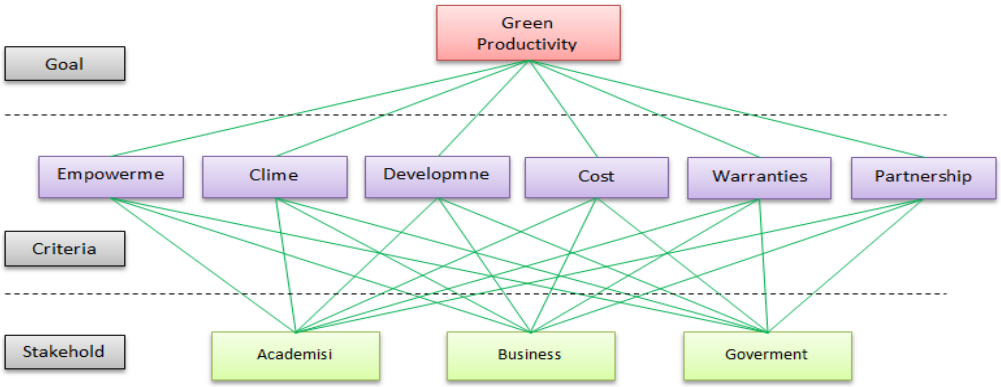
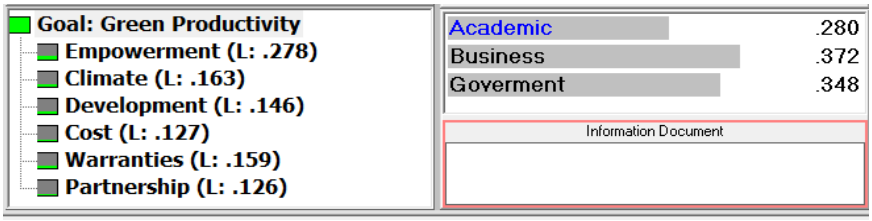


Figure 3: Comparison pairs



Consistency

Consistency performed to check pair wise comparisons were made by decision-makers is still within the limits of acceptance or rejection control. Value consistency should not be more than 10%. Results obtained data processing inconsistency value ratio of 0.03 (3%), it tells us that that the existing data is consistent and valid (figure 4).

Figure 4: Value Consistency

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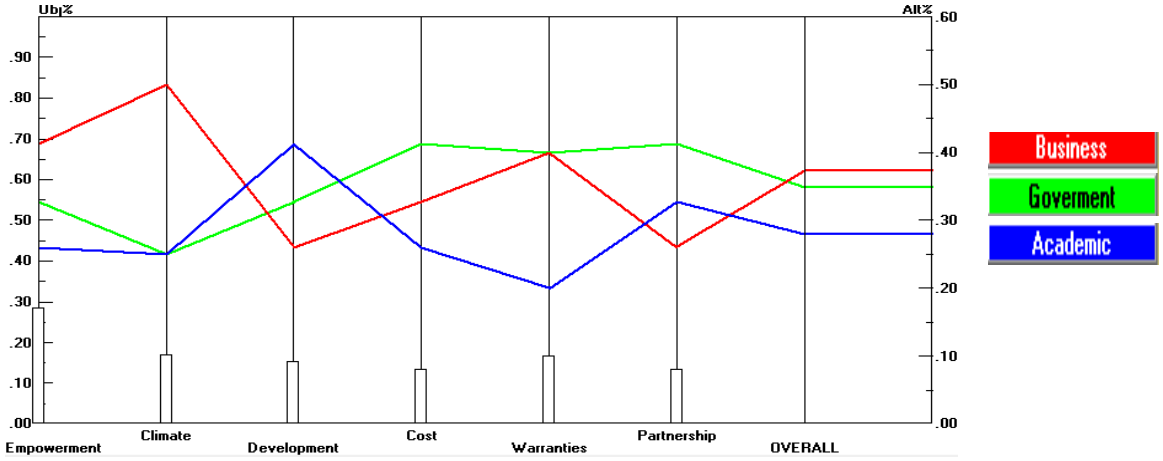
Weighting

Assessment is the synthesis of the model using the weighting san adding process to determine the weight of the entire alternative. Normalized weights for each pair wise comparison matrix. The best alternative is an alternative which has the highest weight is selected as the best priority in decision making.

Weighting results obtained analog models in which the academic superior contribute in development aspect = 0048 and less contribute in empowerment aspect = 0.072, climate = 0.041, warranty = 0.033 and costs = 0.032, whereas the business superior contribute in empowerment aspect = 0.115, climate = 0.81, and guarantee = 0.064 but less contribute in development aspect = 0.038 partnership = 0.033. While the government superior contribute in aspect cost = 0.052, guarantee = 0.064 and partnerships = 0.052, but less in aspect climate = 0.041.

Figure 5: Model Analog



Overall the businesses have the highest priority compared with the other party in the amount of 37.2%, while government 34.8% and academic 28% (figure 6).

Specifically, a comparison between academic and businesses more dominated business, where business dominat in four aspects is empowerment, climate, costs, and assurance. While the academic priority in aspects empowerment and partnership (figure 7).

Comparison of weighting between the government and academic are dominated by government, covering aspects of empowerment, costs, warranties, and partnerships. While the college priority on aspects of development, while the climate aspects of government and academic are equally contributing (figure 8).

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Figure 6: Comparison of priorities

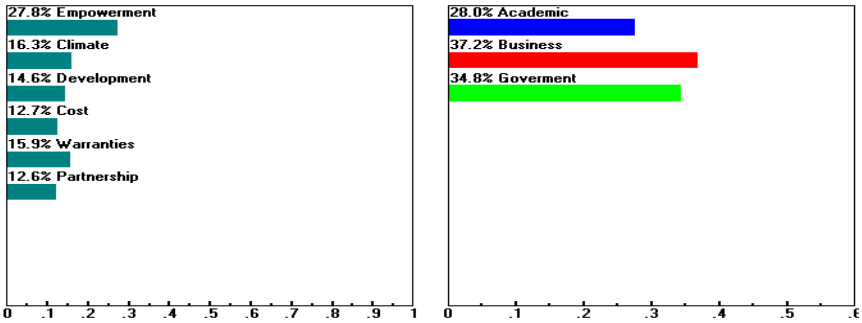


Figure 7: Comparison Academic with Business

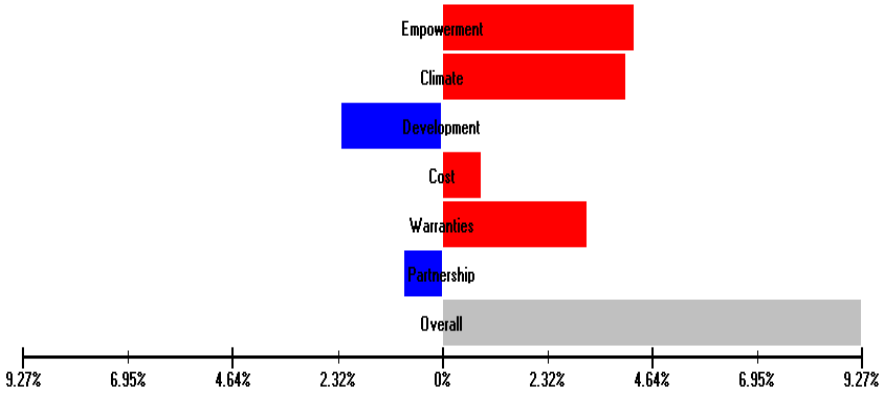
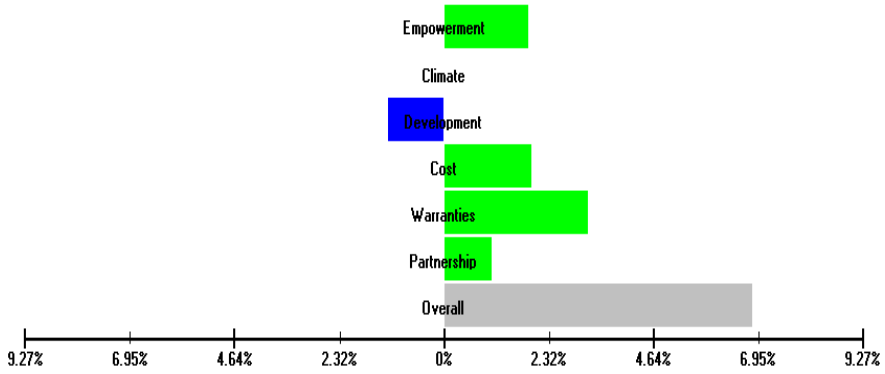


Figure 8: Comparison Academic with Government



Between government with business, government dominates empowerment aspects, and costs, and businesses dominates development, cost, and partnerships aspects. The assurance aspects both governments and businesses same contribute (figure 9).

Ratings

Results assessment obtained empowerment = 0278, where academics contribute = 0.072, businesses= 0.115, and government = 0091. Climatic aspect = 0163, where the academics

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contribute = 0.041, businesses = 0081, and the government = 0.041. Development aspects = 0146, where academics contribute = 0:06, businesses = 0038, and government = 0048.

Cost aspects = 0127, where academics = 0.033, business = 0.052, and government = 0.032. Guarantee aspects = 0159, where academics = 0.032, business = 0.064, and government = 0.064. Partnership aspects = 0129, where academics contribute = 0.041, business = 0.033, and government = 0.052.

Table 4: Assessment

Aspect	Stakeholder	Value
Empowerment [L:0.278]	Academic	0.072
	Business	0.115
	Government	0.091
Climate [L:0163]	Academic	0.041
	Business	0.081
	Government	0.041
Development [L:0.146]	Academic	0.060
	Business	0.038
	Government	0.048
Cost [L:0.127]	Academic	0.033
	Business	0.042
	Government	0.052
Warranties [L:0.159]	Academic	0.032
	Business	0.064
	Government	0.064
Partnership [L:0.126]	Academic	0.041
	Business	0.033
	Government	0.052

Sensitivity Analysis

Sensitivity is a model response to the stimulus intended to change or performance of the model. The main objective to find fairly important decision variables (leverage point) for further review on the application of the model. Type of sensitivity test conducted in this study of functional intervention. Functional intervention is intervention against a particular variable or a combination. Any changes in the value of the intervention variable (increased or reduced) will demonstrate the performance of different models of the value of the primary variable.

Results model is known that every stakeholder has the advantage in respective fields, such as academic superior only in development aspect, the business superior at empowering and climate aspect, while the government superior in cost and partnerships aspect, for guarantee aspect between business and governments same overall superior and the overall superior is businesses comparison with government and academic, and government superior comparison with academic (figure 10).

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At development aspect the flagship academics from 28% increased to 37.3% government positions become dominant (Figure 4.13), and increased to 47.5% the position academic increase in second (figure 11), and if increase to 53.0% stakeholder positions dominated by academic (Figure 12).

Figure 9: Comparison Governmentwith Business

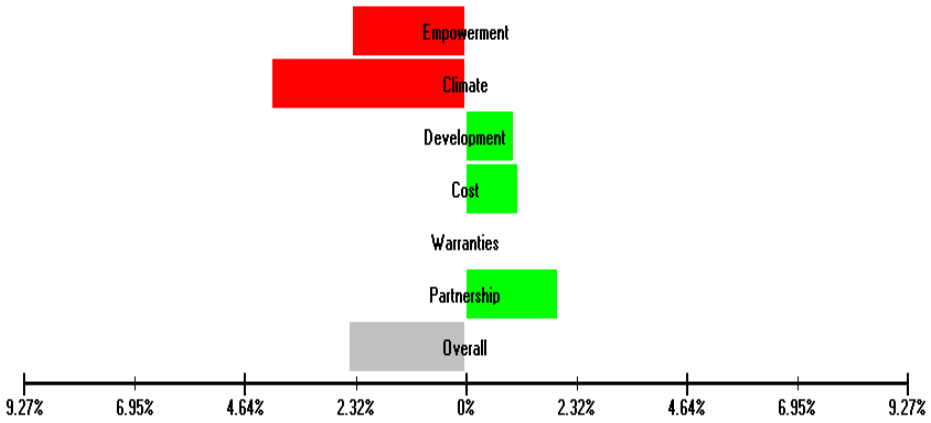

Figure 10: Sensitivity I

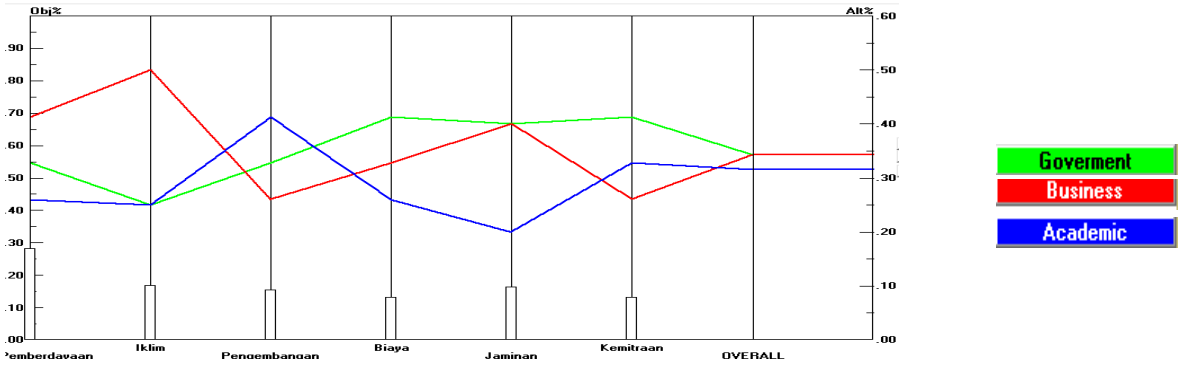

Figure 11: Sensitivity II

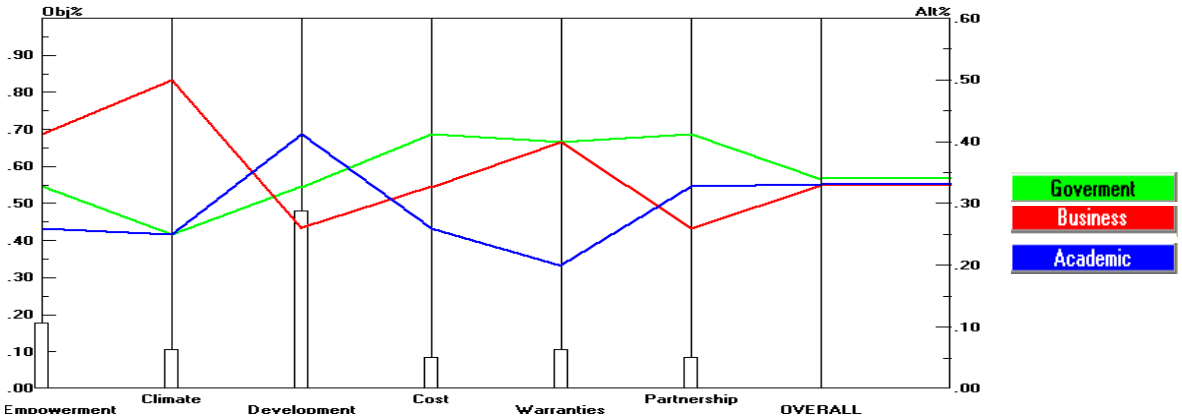

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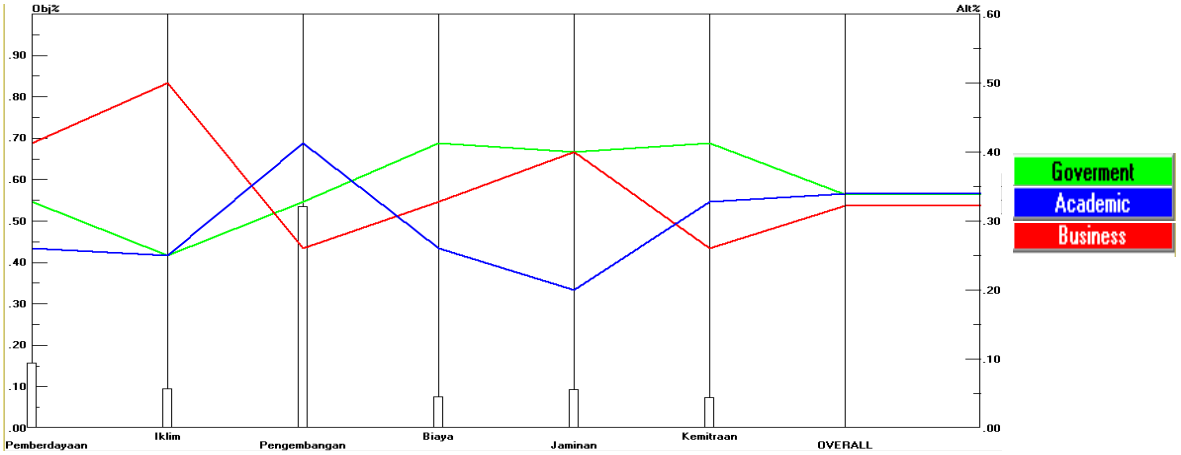
Figure 12: Sensitivity III



CONCLUSION

Priority green productivity to triple helix in tofu central industry that the academic superior contribute in development aspect = 0.048 and less contribute in empowerment aspect = 0.072, climate aspect = 0.041, cost aspect = 0.033 and guarantee aspect = 0.032, while business superior contribute in empowerment aspect = 0.115, climate aspect = 0.81, and guarantee aspect = 0.064 but less contribute in development aspect = 0.038 and partnership aspect = 0.033. While the government contribute superior in cost aspect = 0.052, guarantee aspect = 0.064 and partnerships aspect = 0.052, but less superior in climate aspect = 0.041.

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