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Evaluating Academic Staff Development Strategies in A Higher Education Institution Using Hybrid SWOT, ISM, and ANP

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Abstract

Human resource development has been an interesting topic to be discussed since it strategically improves the overall organizational performance. Moreover, the industrial era 4.0 which has been growing rapidly also demands the need for agile human resources. Universities as educational institution have a vital role to contribute to this development. A good academic staff development practice will bring positive impact to the quality of students so that it is strongly required to build a better capacity building system for younger generation. On the other hand, human resource development is a domain which can be solved using the MCDM approach as it involves multiple factors as well as decision-makers (DMs) to make an effective strategic decision. Accordingly, this study aims to develop an evaluation model for human resource development strategies in the education sector. Specifically, an academic staff development case in terms of research policy is selected and then the model is tested at a private university in Indonesia. In this study, the integration of three methods – SWOT matrix, interpretative structural modeling (ISM), and analytic network process (ANP) – is applied where a SWOT matrix focuses on identifying the relevant strategies, the ISM method is to model causal relationships among the strategies, and the ANP method is to prioritize the strategies using the importance weights obtained based on the ISM structure. Finally, this study has identified the 18 academic staff development strategies and presented a fundamental and a target strategy that can be recommended to the DMs.

Keywords
Academic staff development, SWOT, ISM and ANP

1. Introduction

In today's industrial revolution 4.0, a higher education institution has a vital role in preparing skilled and agile future generations. Further, an integrated research and education activities possessed by universities provides more benefits to enhance student capacity with the required competencies (Maaded and Ponnamma 2020). The relevant industrial 4.0 competence can also be achieved with new teaching and learning practices known as the concept of Education 4.0 (Neaga 2019). The concept digitized the education practices in higher education institutions in order to response the human resource needs in today's digital era. Another approach can also be reached by redesigning multi-disciplinary nature-based curriculum as proposed by Mokhtar and Noordin (2019) highlighting Malaysian National Policy on Industry 4.0. Although it has been critical issues in most parts of the world, the future supply of human resources can significantly be addressed through the role of education.

At universities, building qualified and competent academics have become a key decision to express the contribution in teaching and learning activities, research, and community service (Nguyen 2016, Salesho and Naile 2014,

Abdulsalam and Mawoli 2012). Once the quality of human resources in particular academic staff is managed effectively, the quality of graduates can also be improved. To accelerate its improvement, Masron et al. (2012) proposed the universities' key indicators in order to evaluate academic staff performance. Specifically, Nguyen (2016) even recommended several strategies such as hiring the right people with PhD qualification from/or with overseas working experience, facilitating staff development, providing both financial and non-financial rewards. Therefore, it is important to evaluate the academic staff development strategies in universities. The purpose of this study is to evaluate the strategies of academic staff development in a higher education institution in terms of research policy. A developing private university situated in Indonesia is selected to apply the developed model.

Based on the literature review, multi-criteria decision-making (MCDM) techniques are obviously effective to evaluate the strategies for human resource development in various industries. However, there were very limited studies evaluating the issue in the education sector by using the MCDM method. In fact, evaluating human resource in the education sector especially the academic staff as well as the students is very necessary to produce the excellent generation. Accordingly, this study proposes a new procedure to map and to prioritize the development strategies for human resource in particular academic staff in the education sector. In this paper, there are two MCDM techniques selected which are interpretative structural modelling (ISM) and analytic network process (ANP). These two methods are employed to evaluate the strategies for academic staff development at in an Indonesian private university. Initially, the strategies are identified using a SWOT matrix taking into account the internal and external factors. Then, the ISM is applied to model the causal relationship among strategies in the form of priority order (Chang et al. 2013 and Bhadani et al. 2016), while the ANP is utilized to calculate the strategies' weights based on the structural model obtained from ISM. The integrated ISM-ANP method has been widely applied in various domains and therefore, this study may provide an extended application of this integration combined with SWOT to identify the strategies.

2. Literature Review

Prior to this study, several papers have developed both models and frameworks to evaluate human resource development in many organizations. The proposed models integrating MCDM approaches, moreover, were well established to this issue since the approaches involves the role of decision-makers (DMs) to consider a set of factors for the strategic decision-making process. It is often that the DMs also find conflicting attributes that can be solved using the MCDM methods. For instance, Shakerian et al. (2016) evaluated human resource strategies using a combination of SWOT and fuzzy TOPSIS (Technique of Order Preference Similarity to the Ideal Solution). In the research, human resource strategies were identified using a SWOT matrix considering competitive and business strategy indicators, while the fuzzy TOPSIS method ranked the strategies. Another integration was also proposed by Shahanipour et al. (2020) using the SWOT matrix to identify the strategies and ANP to prioritize the strategies taking into account creativity aspect tested to employees in the administration of documents and properties registration departments. Due to the superiority of ANP which is able to prioritize criteria with different types of interactions, Gürbüz and Albayrak (2014) also combined the method with the Choquet Integral (CI) to measure employee performance in the marketing department in a pharmaceutical industry.

There were several popular MCDM methods which may be relevant for evaluating the human resource development strategy such as AHP (analytic hierarchy process) and DEMATEL (decision-making trial and evaluation laboratory). In general, the AHP method was utilized to determine the weight of criteria and the DEMATEL method was to investigate the causal relations between criteria (Chou et al. 2012). In that study, the both methods were applied in a fuzzy environment to evaluate human resource for science and technology. Apart from it, Abdullah and Zulkifli (2015) proposed the hybrid fuzzy AHP and interval type-2 fuzzy DEMATEL for the human resource management problem. The improved IT2 fuzzy DEMATEL, in the paper, was considered to be able to solve the less effective problem in visualizing the causal relations which was previously illustrated using the fuzzy DEMATEL. Another DEMATEL integration was also carried out by Estiri et al. (2021) to evaluate the interaction and weight the criteria of human resource practices. In the research, the MABAC (multi-attributive border approximation area comparison) was then employed to rank the alternative of practices. The framework was implemented in the banking industry.

This study combines the SWOT, ISM, and ANP to evaluate and to prioritize the human resource development strategies. A case study to evaluate the academic staff development in a private university situated in Indonesia is demonstrated. Previously, the ISM and the ANP have been applied by several researchers in various sector. For example, Natalia et al. (2020) described the criteria relations to obtain the key criteria for supplier selection problem in a construction company. Besides, Digalwar et al. (2020) evaluated the critical criteria affecting the success of sustainable supply chain practices in lean-agile manufacturing companies. Another integrated ISM-ANP method was

also developed by Ren et al. (2018) to identify the success factor of green shipping. Although the integration of these two methods has been widely carried out, it is very rare to find the integration in education sector particularly for human resource evaluation. Therefore, this study is filling the gap. With the same procedure, this research applies an integration of ISM and ANP for human resource evaluation in the education sector. Furthermore, a SWOT matrix will be firstly included to identify the development strategies.

3. Method

Figure 1 describes the conceptual framework comprising of the three main steps taken to address the issue. This study integrates ISM and ANP to construct a hierarchical causal relationship model among the strategies for academic staff development and also prioritize the strategies based on the obtained weights. Previously, a SWOT matrix is utilized to identify academic staff development program by classifying into four main strategies, namely the strengths-opportunities (SO) strategy, the strengths-threats (ST) strategy, the weaknesses-opportunities (WO) strategy, and the weaknesses-threats (WT) strategy. This method is selected as it is able to generate more effective academic staff development strategies based on internal and external situations (Susilo et al. 2019).

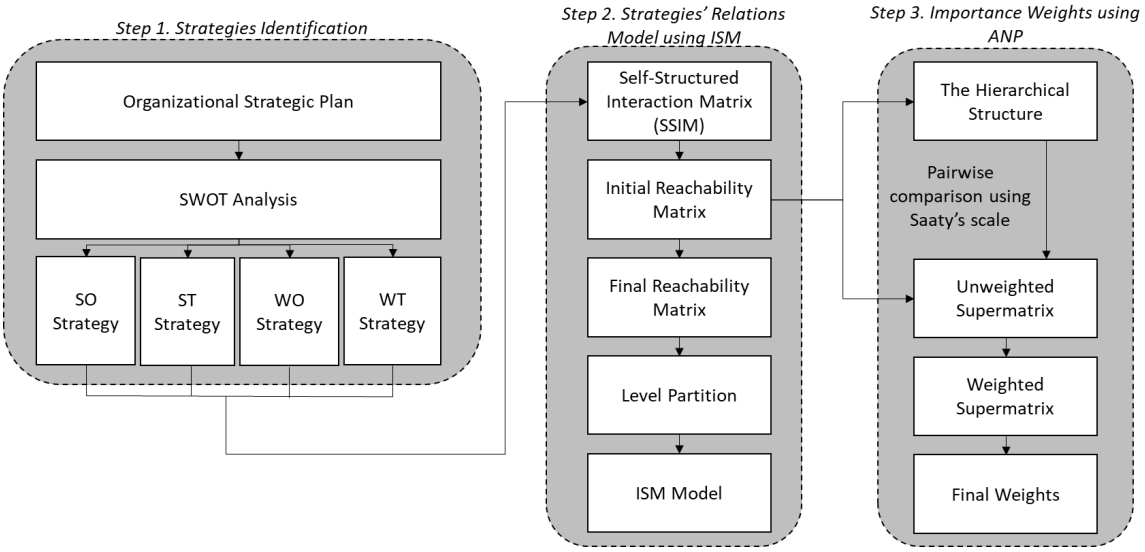

Figure 1. The conceptual framework to model and to prioritize the academic staff development strategies

The ISM method introduced by Warfield (1974) is able to visualize the causal relationship among factors in a complex system in the form of a hierarchical structure (Bhadani et al. 2016 and Chang et al. 2013). In this study, the ISM is utilized to establish a directional relationship of academic staff development strategies which have been identified using the SWOT matrix (Figure 1). However, the hierarchical structure modeled using ISM may not be able to completely determine the key strategies which has to be prioritized so that the ANP method is considered to be integrated as the method quantify the importance weights to obtain the priority (Bhadani et al. 2016). The ANP method developed by Saaty (1996) is able to quantify the dependence feedback relationships between higher-level strategies and lower-level strategies as well as the strategies within a level (Bhadani et al. 2016 and Chang et al. 2013). Accordingly, the integration of SWOT – ISM – ANP is a three-step process, which are: step 1 is to identify the academic staff development strategies using SWOT analysis, step 2 is to build a structural model of strategies using ISM, and step 3 is to prioritize the strategies using the ANP supermatrix algorithm based on the ISM structure obtained.

4. Result and Discussion

4.1. Step 1: Identifying the academic staff development strategies using a SWOT matrix

The first step is to identify the academic staff development strategies at the university. Before, some possible strategies have been collected in a SWOT matrix based on the organizational strategic plan 2021-2025 in terms of research policy. According to the matrix, there are 18 strategies identified which are categorized into four main strategy groups namely the strengths-opportunities (SO) group, the weaknesses-opportunities (WO) group, the strengths-threats (ST) group, and the weaknesses-threats (WT) group. The SO group includes four sub-strategies, which are: 1) international

joint research (SO1), 2) winning research grants (SO2), 3) optimizing the lecturer-student collaborations in a research-based community service (SO3), and 4) encouragement of doctorate studies by winning scholarships (SO4). The WO strategy includes five sub-strategies, which are: 5) commercializing the applied research (WO1), 6) providing a facility for academic staff to become national research reviewers (WO2), 7) increased reward for international publications (WO3), 8) increased research output (WO4), and 9) laboratory assistant certification to support the research (WO5). The ST strategy includes four sub-strategies, which are: 10) improving the quality and the quantity of internal research grants (ST1), 11) increase in indexed articles (ST2), 12) increased partnership to support research activities (ST3), and 13) policy to support doctorate studies (ST4). The WT strategy includes five sub-strategies, which are: 14) building a research growth mindset (WT1), 15) increased indexed national journals (WT2), 16) providing training and workshop for laboratory staff (WT3), 17) increased academic staff recognition (WT4), and 18) implementing off-campus activities (WT5).

4.2. Step 2. Modeling the directional relationships of the strategies

In this section, the 18 strategies identified using a SWOT matrix will be firstly utilized to develop a structural self-interaction matrix (SSIM). The SSIM matrix as presented in Table 1 contains the result of pairwise comparisons describing the contextual relationship between strategies and is denoted by the symbols of V, A, X, and O. Previosuly, the DMs have been involved in the entire analysis process. They are the head of quality assurance, the head of human resource development, and the technical coordinator for human resource development. The symbols of V, A, X, and O represents as follows: V indicates that the strategy *i* influences the strategy *j*, A indicates that the strategy *j* influences the strategy *i*, X is used to show that strategy *i* and *j* influence each other, and O indicates there is no relation between two strategies (Bhadani et al. 2016). Then, the initial reachability matrix is built by transforming all elements in the SSIM matrix into binary values. To transform the SSIM matrix into the binary matrix, we comply the following rules: 1) the cell (*i*,*j*) entry becomes 1 and the cell (*j*,*i*) entry becomes 0 for V, 2) the cell (*i*,*j*) entry becomes 0 and the cell (*j*,*i*) entry becomes 1 for A, 3) the cell (*i*,*j*) entry becomes 1 and the cell (*j*,*i*) entry also becomes 1 for X, and 4) the cell (*i*,*j*) entry becomes 0 and the cell (*j*,*i*) entry also becomes 0 for O (Bhadani et al. 2016).

After the initial reachability matrix is developed, the final reachability matrix can be obtained with the transitivity check as shown in Table 2. The table also provides information about two variables, namely driving power and dependence, which are able to be included in the MICMAC analysis. However, the ISM used in this study emphasis the strategic relationship modeling shown in Figure 2. From the final reachability matrix, there are 12 iterations which have been run to execute the level partitioning. The level partitioning matrix comprises three sets, which are: reachability sets (Ri), antecedent sets (Ai), and intersection sets (Ci). The reachability sets include each strategy that can be achieved, the antecedent sets include the contributing elements, and the intersection sets are the intersection elements between two sets. These three sets determine the level of strategies as shown in Table 3. Finally, the causal relationships of strategies can be depicted into the ISM model. As can be seen in Figure 2, the academic staff development strategy is related each other both at the same level and the different level. For instance, the WO3 strategy – increased reward for international publication – is reached by two strategies at the second level, namely the SO4 strategy (encouragement doctorate studies with scholarships) and SO1 strategy (international join research). The WO3 strategy as a target strategy is believed to have a very high score in university performance rank which is considered by the researchers' contribution to write in reputable international journals. This confirms the result carried out by Nguyen (2016) which also recommended the rewarding staff strategy to improve the university performance. In the second level, the SO4 strategy is influenced by both the ST4 strategy and the ST3 strategy, while the SO1 and the ST3 strategies are mutually influencing each other. In addition, Figure 2 also describes that the WO4 strategy as a fundamental strategy which means that the policy of academic staff development at the university is to increase the number of research outputs achieved by providing rewards for excellent academic staff's research performance especially for those who publish articles in reputable international journals. On the other hand, the strategy to develop laboratory staff's capacity should also be considered as the WO5 and the WT3 strategies occupied the second level in ISM model although these strategies were separated from the main direction due to different research object (Table 1-3).

Table 1. The Structural Self-Interaction Matrix (SSIM)

	SO1	SO2	SO3	SO4	WO1	WO2	WO3	WO4	WO5	ST1	ST2	ST3	ST4	WT1	WT2	WT3	WT4	WT5
SO1	X	A	A	O	A	A	V	A	O	A	A	X	O	A	A	O	A	A
SO2		X	V	O	A	V	V	A	O	V	A	V	O	A	A	O	A	A
SO3			X	O	A	O	O	O	O	A	A	V	O	O	O	O	A	A
SO4				X	O	O	V	O	O	O	A	A	X	A	O	O	O	O
WO1					X	V	V	A	O	V	A	V	O	A	A	O	A	V
WO2						X	O	A	O	X	A	O	V	A	A	O	A	A
WO3							X	A	O	A	A	O	O	O	A	O	A	O
WO4								X	O	V	V	V	O	V	V	O	V	O
WO5									X	O	O	O	O	O	O	X	O	O
ST1										X	A	V	O	A	A	O	A	A
ST2											X	V	O	V	V	O	V	O
ST3												X	O	A	A	O	A	A
ST4													X	A	O	O	A	O
WT1														X	V	O	V	V
WT2															X	O	A	V
WT3																X	O	O
WT4																	X	V
WT5																		X

Table 2. The Final Reachability Matrix

	SO1	SO2	SO3	SO4	WO1	WO2	WO3	WO4	WO5	ST1	ST2	ST3	ST4	WT1	WT2	WT3	WT4	WT5	Driving Power
SO1	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	3
SO2	1	1	1	0	0	1	1	0	0	1	0	1	1*	0	0	0	0	0	8
SO3	1	0	1	0	0	0	1*	0	0	0	0	1	1*	0	0	0	0	0	5
SO4	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	3
WO1	1	1	1	1*	1	1	1	0	0	1	0	1	1*	0	0	0	0	1	11
WO2	1	0	0	1*	0	1	1*	0	0	1	0	1*	1	0	0	0	0	0	7
WO3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
WO4	1	1	1*	1*	1	1	1	1	0	1	1	1	1*	1	1	0	1	1*	16
WO5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2
ST1	1	0	1	1*	0	1	1	0	0	1	0	1	0	0	0	0	0	0	7
ST2	1	1	1	1	1	1	1	0	0	1	1	1	1*	1	1	0	1	1*	15
ST3	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
ST4	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
WT1	1	1	1*	1	1	1	1*	0	0	1	0	1	1	1	1	0	1	1	14
WT2	1	1	1*	1*	1	1	1	0	0	1	0	1	1*	0	1	0	0	1	12
WT3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2
WT4	1	1	1	1*	1	1	1	0	0	1	0	1	1	0	1	0	1	1	13
WT5	1	1	1	1*	0	1	1*	0	0	1	0	1	1*	0	0	0	0	1	10
Dependence	13	8	10	12	6	10	14	1	2	10	2	13	12	3	5	2	4	7	

Table 3. The Partitioning Level Result

Levels	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}	L_{12}
Factors	WO3	SO4, WO5, ST4, WT3, SO1, ST3	SO3	WO2, ST1	SO2	WT5	WO1	WT2	WT4	WT1	ST2	WO4

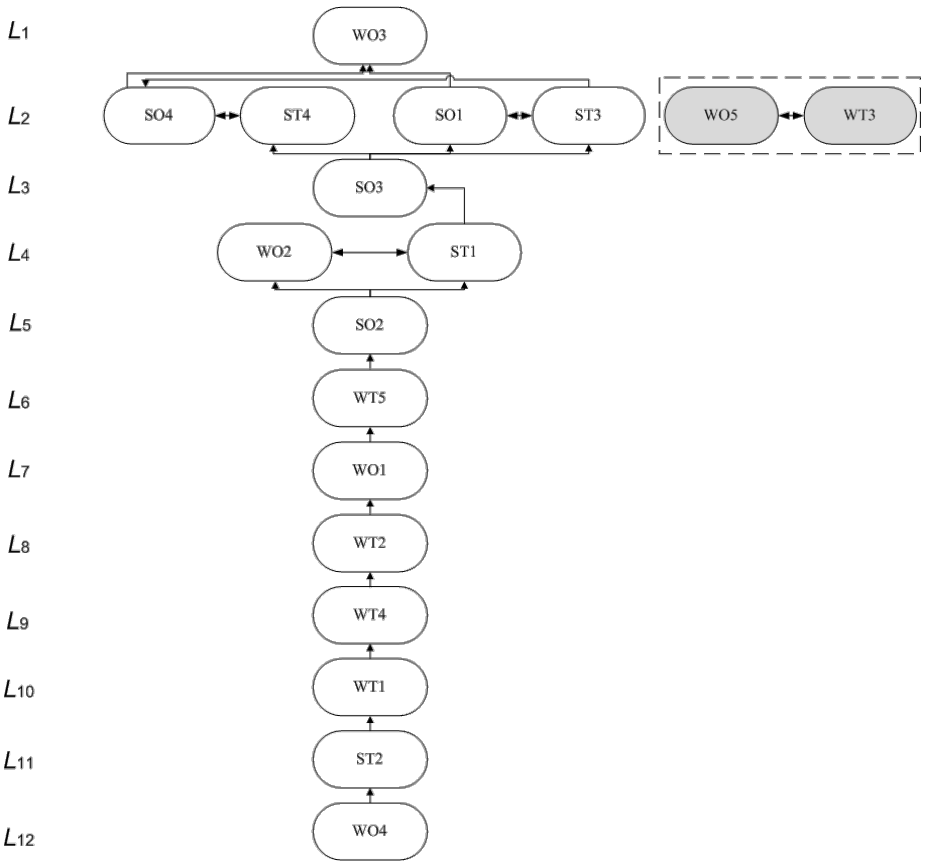

Figure 2. The ISM model of 18 strategies for academic staff development

4.3. Step 3. Prioritizing the strategies based on the ISM structure

In this section, the strategies will be weighted using the ANP method. Firstly, the ANP structure is constructed describing the interaction between goal and strategy (IW21), between strategies (IW22), between sub-strategy and strategy (IW32), and between sub-strategies (IW33) as illustrated in Figure 3. The ANP structure also indicates four strategies and 18 sub-strategies deployed in different level.

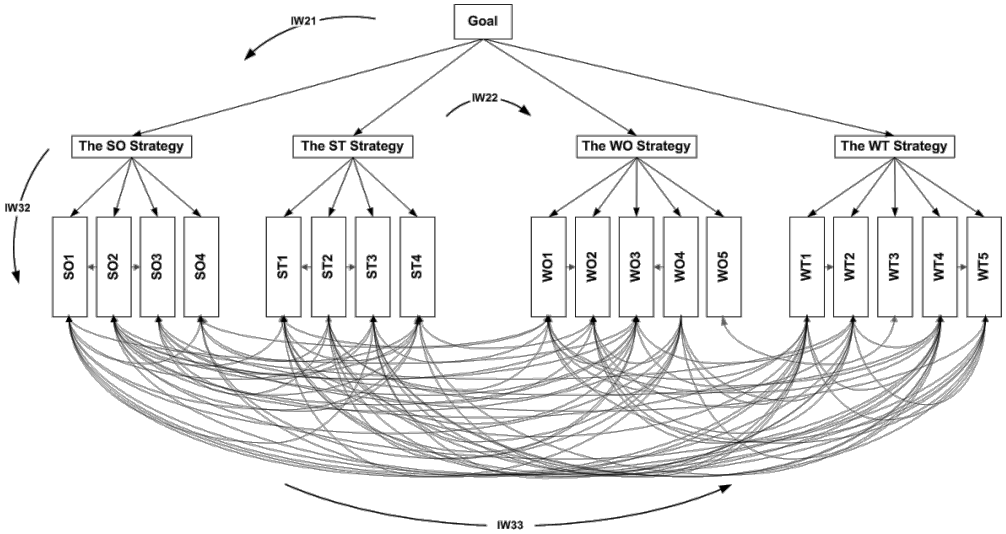

Figure 3. The ANP structure

Table 4. The Unweighted Supermatrix

	Goal	Categories				Strategies																
		SO	ST	WO	WT	SO1	SO2	SO3	SO4	WO1	WO2	WO3	WO4	WO5	ST1	ST2	ST3	ST4	WT1	WT2	WT3	WT4	WT5
Goal																							
SO	0.04		0.05	0.06	0.07																		
ST	0.1	0.05		0.21	0.22																		
WO	0.61	0.76	0.76		0.7																		
WT	0.25	0.2	0.19	0.72																			
SO1		0.14										0.05					0.03						
SO2		0.52				0.06		0.06			0.05	0.08			0.05		0.06						
SO3		0.27				0.04											0.04						
SO4		0.07										0.04						0.05					
WO1			0.25			0.05		0.04			0.04	0.07					0.05						0.6
WO2			0.45			0.14	0.2	0.4	0.52	0.24	0.18	0.17			0.18		0.15		0.1	0.26		0.24	
WO3			0.19			0.03			0.16														
WO4			0.1						0.06														
WO5				0.23		0.08	0.08	0.15			0.07	0.1			0.07		0.08						0.04
ST1				0.17		0.05									0.04			0.1					
ST2				0.08		0.17																	
ST3				0.38			0.28			0.4	0.24	0.22			0.24		0.19		0.9	0.5		0.68	
ST4				0.13																			
WT1					0.55	0.12	0.16		0.3	0.17	0.14				0.14		0.13	0.57		0.15		0.08	
WT2					0.12	0.09	0.1			0.07	0.09	0.12			0.1		0.09						0.1
WT3					0.02																		
WT4					0.26	0.1	0.13	0.25		0.12	0.12	0.14			0.12		0.11	0.28		0.08			0.25
WT5					0.05	0.07	0.06	0.1			0.06				0.06		0.07						

Secondly, the DMs are invited to develop pairwise comparison matrices based on hierarchical interactions using the Saaty's scale. The weights calculated using geometric mean computation and the ISM structure are then used as input to construct the unweighted supermatrix as shown in Table 4. Lastly, the unweighted supermatrix is normalized to obtain a weighted supermatrix so that the importance weights for all strategies can be determined. Table 5 presents the final weights and the rank of the 18 strategies (Table 5).

Table 5. The final weight and ranking of 18 strategies

Categories	Weights	Strategies	Limit Weights	Final Weights	Ranking
SO	0.060	SO1	0.0053	0.0003	17
		SO2	0.0204	0.0012	15
		SO3	0.0108	0.0007	16
		SO4	0.0028	0.0002	18
ST	0.189	ST1	0.0238	0.0045	11
		ST2	0.0420	0.0079	9
		ST3	0.0181	0.0034	12
		ST4	0.0103	0.0019	14
WO	0.283	WO1	0.1422	0.0402	3
		WO2	0.1064	0.0301	5
		WO3	0.0482	0.0136	8
		WO4	0.2348	0.0664	1
		WO5	0.0795	0.0225	6
WT	0.468	WT1	0.1405	0.0657	2
		WT2	0.0297	0.0139	7
		WT3	0.0063	0.0029	13
		WT4	0.0652	0.0305	4
		WT5	0.0135	0.0063	10

Overall, based on the weights of strategy obtained, the development strategy order is WT>WO>ST>SO. Although the WT strategy has the greatest weight of 0.468, the sub-strategy's priority is WO4 where in the ISM model is plotted to be the fundamental strategy. In particular to the WO strategy, the DMs should pay more attention to WO4, WO1, and WO2 which are in the top important strategies representing the first rank, the third rank, and the fifth rank, respectively. Although there are some different results between ISM model and ANP rank, the importance weight obtained by using the ANP method describes more relevant situation as the weights are calculated based on the ISM structure, while the ISM method can merely visualize the leveling model. This result may ease the DMs to consider the best development strategy over the others thoroughly taking into limited resources when executing several development programs simultaneously. In this case, the integrated ISM-ANP method emphasizes the importance of WO4 strategy to become fundamental strategy, and thus the strategy should be prioritized by the DMs at the university. As indicated in the ISM model that the rewarding system can be set as a final or goal strategy after the others are accomplished.

5. Conclusion

This study integrates three methods, namely SWOT analysis, ISM, and ANP for academic staff development strategies applied in a private university in Indonesia. A SWOT analysis is selected to identify the strategies taking into account both internal and external factors. Then, the integration between ISM and ANP is proposed to evaluate a more effective and thorough academic staff development policy since it may not only model the causal relations, but also finding a key strategy by taking into account the importance weight based on the strategies' relationship. In this study, it is considered that the WO4 strategy – increased research outputs – has become a fundamental strategy for the others. Although this paper has developed a new evaluation model for human resource development strategies demonstrated by selecting academic staff, it is encouraged to investigate another subject such as student development since these two entities are main asset for the educational institution. Furthermore, the interaction between academic staff development strategies and student development strategies can be elaborated in follow-up studies.

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