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Technopreneurship Toward Sustainability in Perspective of Energy Trilemma

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Abstract:- Technology-based entrepreneurial mindset require regeneration in order to support the increasingly necessary energy transition. This challenge has been applied to electrical experts whose central role is complicated by the potential for stranded assets, intermittence paradigms, and new system planning patterns as well as electricity operational patterns. This paper uses quantitative methods to explain the importance of expert engineers' technopreneurial orientation to promote the sustainable use of electricity. The ability of expert engineers to collaborate by prioritizing dialogue that provides shared access and transparency in risk-taking is a critical aspect that strengthens the effect of the energy transition to sustainability. The experts' adoption of the three aspects of the modified trilemma index of energy, energy security, energy equity, and environmental sustainability reflects the increasing sense of achievement sustainability in the electricity sector.

Keywords:- *Sustainability, Technopreneurship, Engineering Management, Energy Transition, Expert Engineer.*

I. INTRODUCTION

The Covid 19 pandemic could represent a transition to greater use of new and renewable energy (NRE) [1]. As a result of reduced energy consumption, massive restrictions on activity have led to downward trends in global carbon emissions [2]. However, it is not easy to develop NRE in Indonesia. Social restrictions on the part of the supply chain and the interaction of workers with the financial situation are a challenge during a pandemic. Meanwhile, the competitive situation due to the decline in world oil prices which makes it more cost-effective also represents a challenge. Coal-fired power stations remain stagnant because of their investment agreements. Consequently, it is a priority for building up an energy transition framework for renewable energy in the new world, following the COVID-19 pandemic, towards the sustainability of electricity.

Indonesia also participates in the energy transition by promoting the Paris Agreement to reduce CO2 emissions worldwide. In the national energy mix Indonesia has an NRE usage target of 23 percent by 2025. While not sufficiently ambitious, Indonesia will be seen as an effort for a cleaner and longer-sustaining energy system to reduce emissions 29% by 2030. The total national capacity installed has reached 71 GW by 2020. But coal-fired power plants still dominate it, while NRE plants reach only 14.69% of the total installed capacity [3].

Next consideration is the changing pattern of electricity consumption in order to develop a framework for renewable energy in the new world after the pandemic. There is also a separate consideration to shift the electricity burden to the residential sector. We know that, depending on the activities of occupants and on the unique behavior of occupants, the characteristics of household electricity consumption are very unique [4]. The characteristics of the charge (consumption) of power also do not correspond fully to the characteristics which provide it (production), namely the majority of the types of coal-fired power stations with a population around 63.9% [5].

The transformation of energy to renewables must also take account of the characteristics of renewable energy plants, most of which depend heavily on their natural conditions. This has led to natural activities influencing the functioning of renewable energy plants [6]. Furthermore, Indonesia currently faces uncertain natural conditions due to global climate change, which is under a tropical climate [7], [8]. Therefore, if the aim of reliability of electricity generation is met, this will be very complicated.

The emergence of micro-scale power plants used in housing is another consideration. Roof-top, in fact, the generation of solar power can help to bring renewable energy use forward [9]. The characteristics of this generator type, however, also require different considerations. Due to its dependency on nature, its scattered location potential, unique patterns on household consumption and the emergence of small-scale domestic industries that must all be considered as important issues.

The active role of experts engineers in developing the solution is needed for all these complexities [10]. Since in almost all sectors the electricity sector relies on high-tech technology, this role should be increased [11]. Factors that must be addressed include technological developments which are economically challenged, the intermittent nature of NRE plants that are heavily affected by changes in weather and climate, the NRE power plants' dependence on the status of their local natural resources, environmental changes and the dynamics of the diversity of local people. Electricity planning a reliable energy system is a challenge for electricians. Thereby, the energy systems experts must be able to overcome this complexity to accommodate the energy transfer towards electricity sustainability.

Since sustainability is the central objective of the energy transition, and everything is based on three fundamental aspects, it will be necessary for people, profit, planet and harmonization to take place. Harmonization is essential in order to ensure the overall sustainability in the electricity sector by other parties also takes an active part [12]. The diverse complexities which occur above are therefore the beginning of this research: the management by electricity experts of the engineering activities to new horizons.

II. THEORETICAL BACKGROUND

A. *Sustainability Performance*

Sustainability performance will now be a widely accepted perspective as measured in a three-pillar sustainability approach (triple bottom line/TBL) [13]. The measurement of the achievement of sustainability has become the basis of business controls, one of which is used to evaluate the performance of businesses based on three indicators: economic, social and environmental, whether or not sustainability oriented [14]. The measurement of electricity, the last form of energy best suited to the energy transition to sustainability, will be conducted in support of this process [15]. Therefore, electricity sustainability cannot be separated from energy sustainability as a whole [16].

Sustainability can be evaluated in the energy context in the form of a more general index of sustainability [17], according to the World Energy Council. In the form of the Energy Trilemma Index, the World Energy Council sets the definition of energy sustainability that encompass three aspects: energy safety, energy equity and national environmental sustainability [18]. A country's capability to provide a sustainable power system through three balanced dimensions: energy security, accessibility and affordability and environmental sustainability, is the official indicator for the energy trilemma index [19]. This indicator provides the country with a sustainable energy supply.

The energy transition provides opportunities for different parties to change the electricity industry for better and harmonious purposes [20]. The technopreneurial orientation process can improve the performance of sustainability, which emphasize sustainability together. As a basis for shaping collectively the future, social, economic and environmental harmonisation is shaped as a common element in the creation of value [21]. The increase in sustainability resulting from increased technopreneurial orientation is due to the balance among the supplier and the recipient in a harmonious environment [22]. It needs greater technopreneurial orientation in achieving the sustainability of the energy transition together with renewable energy [23]. The increase in technopreneurial orientation to be followed by an increase in sustainability, is also supported by an affirmation that shared value creation has a significant impact on the success of sustainable development [24]. That sustainability is a values which are incorporated into the balance of the triple bottom line of society, economics and environment which can jointly be developed by the technopreneurial orientation, therefore the following paragraph describe about technopreneurial orientation.

B. *Technopreneurial Orientation*

Since expert engineers are used as research objects for this study, a combination of technology-based expertise and entrepreneurial-based skills is used in this study. The term technopreneurship is therefore used because it is still latent and not condensed under this term [25]. This term suggests the ability to establish and manage businesses and take financial risks in order to achieve their objectives and prospects [26], with innovative technical mastery, scientific insight and technical knowledge. So that the relation of influence on the variable innovation ecosystem in this study is felt compatible. The notion of business orientation that contains elements of competitive aggressiveness and a tendency to be independent refers to processes, practices and decisions that lead to innovative, risk-taking and a tendency to be proactive with market opportunities [27].

The argument for using the technopreneurship variable here is also based on the assumption that not every person who is technically intelligent (engineers) and has high technological knowledge has the skills to manage business ideas. It is also pointed out that there are high-technical experts with few business and entrepreneurial thinking skills [28]. The study therefore suggests the concept of technopreneurial orientation as a combination of business and technological know-how. In order to ensure three aspects: innovation, proactiveness, the courage to take constructive risks [29], two aspects: independence and competitive aggression [30] and additional technological aspects, that is, the understanding of modern technologies and the use of technology expertise [25].

In the presence of innovation and high-tech enterprises, entrepreneurship has a positive relationship to sustainable development [31]. Entrepreneurship based on technologies has a better role to play in fostering sustainability [32]. Thus, entrepreneurship based on technology is important when sustainable development issues arise [33]. A sustainability-based enterprise approach creates subjects closely linked to great uncertainty and ignorance [34]. This affects peoples' ability to effectively predict the future to avoid its degradation's effects [35]. In order to discover that sustainability is a manifestation of the balance between the three major pillars of sustainability, social, economic and environmental, influenced by the technological preneurial orientation, hence this research proposes hypothesis:

H1: Technopreneurial orientation has positif and significant effect on the performance of sustainability.

III. METHODOLOGY

A self-administered questionnaire was used to collect data from respondents using a convenient sampling technique. The criteria to be met are electric experts, who have worked for the sustainability energy transition program on the electricity sector in Indonesia and who are ongoing with more than ten years of experience in electricity industry. In accordance with the research context, measures of 14 indicators were adopted to ensure the reliability and validity of the survey instrument, representing all the constructed,

technopreneurial orientation and sustainability. Due to the respondent's unknown population, a 5-10 times sample of indicators is taken (14 items) [36]. Those were therefore distributed electronically (online) for a total of 140 questionnaires. The indicator uses a 7-point Likert scale response, ranging from strongly disagree to strongly agree. The indicator employs a 7-point Likert scale response, with a score of 1 indicating strong disagreement and a score of 7 indicating strong agreement. A Likert scale in the data collection phase of seven categories guarantees a higher quality of information [37]. Scale 7 also offers a more accurate electronically circulated and unmonitored survey measure [38] and is more suitable for use in highly cognitive respondents [39]. The explanatory research investigates the determination of characteristics. The research object identified from a number of analytical activities and research samples to be carried out by this study [40].

The Adanco software is used in this study to perform structural equation modeling analysis with a partial least-squares approach (PLS-SEM). The first stage involves conducting confirmatory factor analysis (CFA) to determine the validity and reliability of the constructs and their associated indicators. The second stage looks into the variable relationship's structural model. The coefficient of determination (R^2) is used to calculate the influence of the exogenous latent variable on the endogenous latent variable. The value of the path coefficient (β) is then used to determine the pattern of exogenous latent variable effects on the endogenous latent variable.

IV. RESULT

The received response have 84 percent of male experts are in the electricity sector with ages between 35 and 65. The Adanco output leads to Figure 1, which makes it possible to analyze the value and determining factor of the path that can be immediately indicated. Figure 1 shows the coefficient of determination (R^2) of 0,411 explain the variance of the sustainability variable indicated by the technopreneurial orientation variable at 41,10 percent.

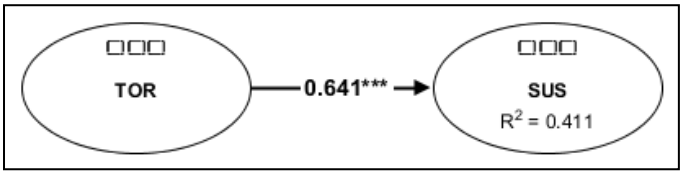

Fig. 1. The Adanco software output from the research model

All indicators that measuring the technopreneurial orientation variable as well as the sustainability variable are valid and reliable. As shown in Table I, all loading factor (LF) value of the reflective indicator is higher than 0.5 explain the significance of the respective construct. Also, all of VIF value is lower than 0.5, explain there is no multicollinearity of each indicator [36].

TABLE I. DESCRIPTIVE STATISTIC AND LOADING FACTOR OF INDICATORS TABLE STYLES

Var.	Items	Mean	[a]VIF (< 0.5)	[b]LF (> 0.5)
TOR	Innovation improvement	6,1208	4,0440	0,8551
	Opportunuty identification	6,1879	3,1170	0,8386
	Technological opportunity	6,1812	3,2891	0,8549
	Technological profitability	5,9703	2,7361	0,8512
	Risk calculation	5,9938	2,9988	0,8507
	Quick solution expressiveness	6,1007	2,9840	0,8643
	Independent mindset	6,0336	2,0645	0,7234
SUS	Electrification mindset	6,4027	3,3782	0,8072
	High quality electricity	6,4094	4,6030	0,8625
	Affordable electricity	6,3826	3,6155	0,8114
	Futuristic electricity requirement	6,3893	4,1750	0,8330
	Independent recovery mechanism	6,4228	4,1414	0,8621
	Prosperous electrification	6,3490	3,7816	0,8426
	Decarbonization mindset	6,2148	4,0583	0,8319

[a] VIF: Variance inflation factor
[b] LF: Loading factor

The validity and reliability of the construct variables are shown in Table II. The Cronbach's α (Cr-α) value is higher than 0.7 explain the validity of the respective construct. The average variance extracted (AVE) values are higher than 0.5 as well as the Dijkstra-Henseler's coefficient (ρA) values are higher than 0.7 explains the reliability of the measurement model [36].

TABLE II. CONSTRUCT VALIDITY AND RELIABLITYB

Constructs	[c]AVE (>0.5)	[d]ρA (>0.7)	[e]Cr-α (>0.7)
TOR	0.6971	0.9359	0.9272
SUS	0.7140	0.9356	0.9332

[c] AVE: Average variance extracted
[d] ρA: Dijkstra-Henseler's coefficient
[e] Cr-α: The Cronbach's α

The results of the structural model from Adanco software output show values like Table III. The results for this model's path coefficient (β) value of the tests are 0,6410, which show the higher technopreneurial orientation among expert engineers, so that sustainability increases by 64,10 percent. Table III also show the Cohen's (f^2) value. In this study, the Cohen's (f^2) value is shown to indicate the effect size between exogenous variable to endogenous variable. The value of 0.02, 0.15, and 0.35 interpreted as a small, medium, and large effect respectively. The Cohen's (f^2) value of 0.6985 between technopreneurial orientation and the sustainability explain large effect respectively between them [36].

TABLE III. OUTPUT OF STRUCTURAL MODEL

Path	[f]β	[g]Cohen (f^2)
TOR – SUS	0.6410	0.6985

[f]β : Path Coefficient
[g]Cohen (f^2) : Effect size

The ADANCO software executed bootstrap of 2999 samples and 5 percent of significant level to confirm the path coefficient (β) between the relationship. This step indicate the significance of the impact between them, as shown in Table IV. The β value between the relationship of technopreneurial orientation and sustainability, has strengthen by the t-value of 11,2204, that confirmed to be higher than 1,96 and the p-value of 0,0000, that confirmed to be lower than 0,05. That indication explain that the technopreneurial orientataion among expert engineers significantly influence the sustainability [36].

TABLE IV. BOOTSTRAP OUTPUT OF STRUCTURAL MODEL

Path	[f]β	t-value (t >1.96)	p-value (p < 0.05)
TOR – SUS	0.6410	11.2204	0.0000

[h]β : Path Coefficient

The acceptance of the hypothesis demonstrates the important role of technopreneurial orientation in strengthening the achievement of sustainability. The results of this research therefore suggest that expert engineers with a strong technopreneurial orientation can achieve the high value of sustainability performance.

V. DISCUSSION

The report confirms in practice, the importance of successful sustainability in the electricity sector, preceded by technologically based expert orientation, or technopreneurial orientation [31]. Different electricity and other energy organizations and companies focusing on the three global and regional sustainability pillars often experience difficulties when carrying out activities which involve all parties in an active role, despite the fact that they are held together. This was because the expert engineers lacked of entrepreneurial orientation. As we all know, high-tech energy industry always involves high efficiency [41]. Through parameters that can be interpreted from something complicated to easy to understand for ordinary society, the success of each phase of its activities should be ensured. Thus, in the entrepreneurial orientation from the start of its program of activities, the role of an expert engineer who understands the technical aspects must be improved in order to become the key to long-term success.

Sustainability aspects of energy trilemma, which was then used in investigating expert engineers' behavior in the direction of sustainability, were successful in this research. The operational implications of these aspects should thus be based on the perception of the technical engineers of how to plan business activities which contain a business attitude so that they can work with others in the electricity sector to achieve energy sustainable goals. The compatibility of energy security objectives can be clearly demonstrated by efforts to reach important electrification targets. Efforts are also being significantly implemented to make electrical energy fairly accessible to remote areas. Likewise, quality energy provision has always been a common goal. This is also in line with the joint action of all parties reflected in the strong relationship between good and the local community at all levels. It seems that a purpose of meeting future energy needs is to imply strong efforts by the expert engineers to be able to continue create value for electricity sustainability in achieving energy equity. Likewise, the efforts to eliminate long-term and frequency systemic disorders. Also guarantees from all parties must be obtained by the recovery mechanism quickly and independently. If the previous three aspects are successfully implemented, then the consumption of electricity could have implications for increasing the well-being of people. Effectiveness can have the impacts of efforts for achieving environmental sustainability and decarbonisation of the entire electricity system through an energy mix, and the use of renewable energy can minimize losses due to the decomposition of build-up coal power plant assets.

The evidence supports for achievement of sustainability in theoretically, previous research which states that the balance between social, economic and environmental issues is shaped by the value creation [21], as the basis for forming the future. A balance between the provider and the recipient components in a harmonious environment determines the increase in sustainability caused by technopreneurial orientation [22]. The statement that the energy transition's sustainability performance can be directed to renewable energy together and thus require more unity in achieving it [23]. The increase in technopreneurial orientation and a further rise in sustainability are also supported by the statement that technopreneurial orientation affects the high success of sustainable development [24].

It is clear that the expert engineers are extremely excited to spend their time on every electricity technology event by confirmation of the desire of key interactive contributions. On the occasion, it was shown that expert engineers always took the time to satisfy their curiosity about the progress and evolution of modern electricity technology [42]. The strong desire of the engineer to further scientific and technological progress was also reflected in the reason with technology activists [43]. Initiating enterprise from a value-based creation perspective is also very proactive and productive [44]. This study also shows that previous research has shown that technopreneurship can create new values that support economic growth [45], [46]. Because technology can lead the market to become a network that allows value to be created [47]. This research will lead to mutually advantageous creation for the sustainability of the energy sector in entrepreneurial attitudes, which can participate in all social and cultural organizations.

Expert engineers' technopreneurship has proved to support the achievement of sustainability of electricity. However, several factors require more in-depth investigation in order to improve the energy sector's sustainability. The first proposal that can be proposed as a recommendation for the

management of energy engineering is the need to take action on the part of management in order to improve the situation of cohesion which offers reciprocal access to minimize perceptions of risk. The second suggestion for management, in particular for the strategic electricity industries, is that the aspects used to indicate the sustainability model should be taken into consideration in this study. The third suggestion in the study is consideration in making experts to their respective fields that able to contribute towards the three pillars of sustainability.

VI. CONCLUSION

This study shows, that the characteristics of expert engineers who perform national strategic planning can perform well in achieving sustainability by strengthening their orientation of technopreneurship. This research has demonstrated empirically the management model in a national strategic company, which gives priority to sustainable development as a criterion for their performance. In order to achieve this sustainable electricity in Indonesia, the importance of the role of expert engineers cannot be separated from the difficulty and dynamic. We therefore need a good technological approach from expert engineers to achieve sustainability of electricity.

The development of the concept of triple-bottom-line sustainability, which uses indicators from the energy trilemma index to assess the behavior of electricity experts, was among the theoretical findings. This study also demonstrated the importance of technopreneurship in achieving sustainability. This research also introduces the concept of technopreneurship, which is defined as an entrepreneurial mindset combined with technologically savvy behavior. Future research is needed to broaden the concept of behavior that supports the achievement of sustainability in the triple bottom line by including technology-based entrepreneurial orientation as antecedents.

Before generalizing results, this study has limitations to be taken into account. The interviewees who took part in this study were restricted to working years of ten years, so that the millennial generation was not included. Although the data collection process is anonymous, self-report behavior measurement permits social preferredness, because people tend to react improperly.

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