Model to Measure the Success of Climate Change Mitigation Performance through the Knowledge Management Systems

Wahyu Sardjono, Widhilaga Gia Perdana, Erna Selviyanti, Astari Retnowardhani, Ditdit Nugeraha Utama

Abstract: Scientific descriptions of climate change are officially recognized at the international level is organized by the Intergovernmental Panel on Climate Change (IPCC). The IPCC compiles Assessment Reports which every five years on scientific, technical and aspects socio-economic, causes, potential impacts and coping strategies climate change. IPCC findings prove that the problem of climate change will affect ecosystems and humans in all parts of continents and oceans world. Climate change can pose great risks to health human, global food security, and economic development. Action to reduce emissions is very important and urgent to do in order to avoid the danger of climate change. Adaptation is very necessary to deal with the risks of climate change. Tiers the adaptation needed depends on the success of the mitigation activities. This paper aims to provide an overview of how mitigation in dealing with climate change can be done optimally through a knowledge management system with reference to the SECI theory (Socialization, Externalization, Combination, and Internalization). The factor analysis method is used to find the success factors of mitigation in the face of climate change, and subsequently through a regression analysis a model can be built involving a number of variables formed in the factor analysis. The results of the study provide a number of new factors that can be represented as variables of public awareness of climate change, mitigation socialization processes, availability of knowledge management systems, and governance systems. The conclusion obtained from this study is that the built model is used to measure climate change mitigation performance and can be simulated for optimal achievement based on the local wisdom of the local community.

Keywords: climate change, mitigation, knowledge management systems, SECI, performance measurement

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I. INTRODUCTION

Related to the impact of climate change in Indonesia, Indonesia is a country that is vulnerable to the climate change.

With an island number of more than 17,000, and most of the capital city provinces and almost 65% of the population live in coastal areas, territories Indonesia is vulnerable to the effects of climate change, especially those caused by rising sea levels and flooding due to flooding in the coastal area or rob. Sea level rise, besides causing direct impact in the form of reduced area due to sinking by water the sea, the damage to the coastal ecosystem due to tidal waves, too have an indirect impact in the form of loss or change community livelihoods, especially the people who live in seaside, decreasing lowland rice fields nearby beach which will affect food security, disturbance inter-island transportation, as well as damaged or lost island attractions and coastal [1].

Based on the provisions of article 1 of the Presidential Regulation of the Republic of Indonesia No.46 of 2008 concerning the National Council on Climate Change that climate change is changing the average climate conditions and/or climate diversity from the condition of ongoing human activity, adaptation Climate Change is a process to strengthen and develop strategies to anticipate the effects of climate change and implement them so that they can reduce negative impacts and take positive benefits and Mitigate Climate Change is a control effort to prevent climate change through activities that can reduce emissions/increase the absorption of greenhouse gases from various emission sources. Climate change which causes this uncertain season shift is theoretically the most influential is the area around the coast and watersheds. The increase in the earth's temperature is getting hotter, rainfall is changing drastically, the escalation of forest fires, storms and floods, this all makes the climate and weather extreme. The temperature of the earth that reaches a certain hot point will make the ice at the poles melt and cause symptoms of sea water blooming, rising sea levels and will drown lowlands, coastal areas, and small islands like those in Indonesia. Discussion and seriousness of the government in the issue of Climate Change in Sustainable Development can be seen in Figure 1.

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2261

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Figure 1. The Urgency of Climate Change in Sustainable Development [1]

and Indonesia's active participation and contribution to the global community in relation to climate change globally are presented in points as can be seen in Figure
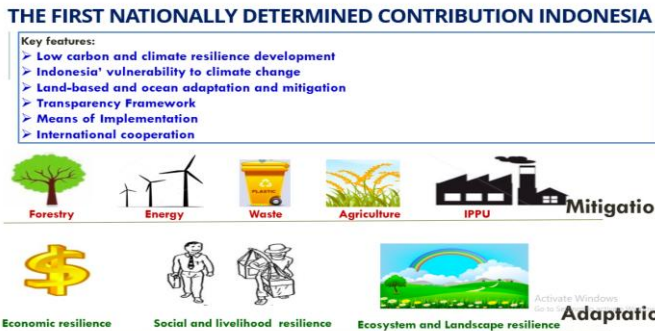

Figure 2. The First Nationally Determined Contribution Indonesia [1]

Climate change adaptation is a variety of adjustments to the conditions of climate change that occur, Adjust economic activities in vulnerable sectors so that it supports sustainable development. Until now, adaptation activities have focused on areas that are considered vulnerable to climate change, namely coastal areas, water resources, agriculture, human health and infrastructure [2].

Adaptation to climate change is very important and must be done immediately, given Indonesia's vulnerability of climate change and low capacity to adapt. Adaptation strategies to climate change must be immediately compiled and adopted in national development strategies. The design requires mainstreaming within the framework of cross-sectoral (interdepartmental) sustainable development goals. The direction and adaptation activities require consistency from all levels of relevant government agencies. Figure 3.
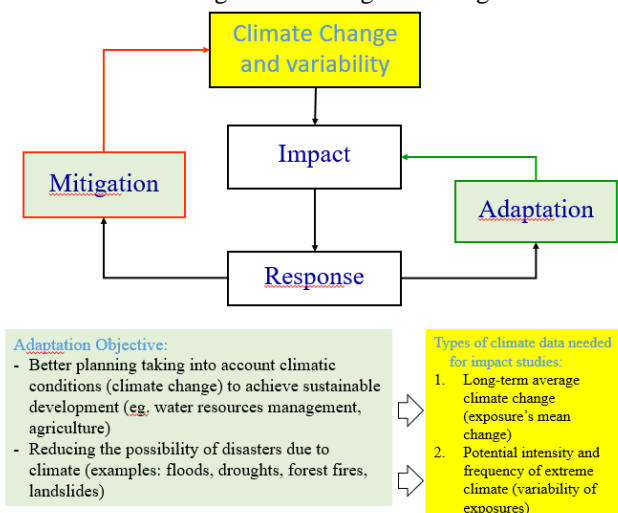

Figure 3. Climate Change and variability

By seeing the importance of understanding climate change, it is necessary to look for alternatives so that all levels of society can know correctly and appropriately, and knowledge management models can be collaborated to achieve this goal so that they are easily disseminated. [3] have put forward that the knowledge management process in an organization consists of the following stages: 1) Knowledge Creation, 2) Knowledge Storage or retrieval, 3) Knowledge Transfer, 4) Knowledge Application. [4] has proposed a knowledge management process model in two important parts, co-ordination and operational process. According to his proposition, co-ordination processes are fundamental to the operational processes. The coordination process takes place in a four stage cycle, where knowledge is to be analysed, defined, a framework has to be identified and implemented through a pilot project. The operational process presents the carrying out knowledge management and is performed in the following steps, first it is identified that there is a need for knowledge, followed by searching for knowledge by a person who needs the knowledge ("knowledge pull") and the feeding of knowledge to recipients who are known to be in need of it ("knowledge push") [4].

When it is determined that the needed knowledge is not available the process of knowledge creation is initiated followed by collecting this knowledge and storing it. The knowledge stored is updated whenever new knowledge is shared or created. In a field where knowledge is new or limited, knowledge creation becomes an immediate need. The most reputed knowledge creation model is the SECI model proposed by [5. 6, 7]. The SECI mode consists of four processes, i.e., socialization (S), externalization (E), combination (C), and internalization (I). Socialization transforms or converts new tacit knowledge, such as new experiences, skills, mental models, which occurs through an internship or apprenticeship. Here theoretical knowledge is transformed through practical exposure and application of skill. Externalization transfers tacit knowledge into explicit concepts, which is initiated by debate, consultation or collective reflection leading to concept creation.

Combination divides or breaks down explicit knowledge to create new knowledge by collecting information from within and outside an organization. An example of combination is a financial report, which is the end result of knowledge extracted from different ends of the organization. Internalization assimilates explicit knowledge into tacit knowledge, i.e. it converts explicit knowledge to an individual's tacit knowledge [8, 7]. SECI is a four-stage process of knowledge creation that starts with converting explicit or theoretical knowledge to tacit knowledge by giving practical exposure to an individual who is able to supplement theoretical knowledge with practical experience. This practical knowledge is then discussed and debated upon to arrive at a consensus that is codified to create explicit knowledge, which is further subdivided and collected to create a unit of standard knowledge which when accepted by an individual becomes tacit knowledge. This process has been shown in Figure 4.
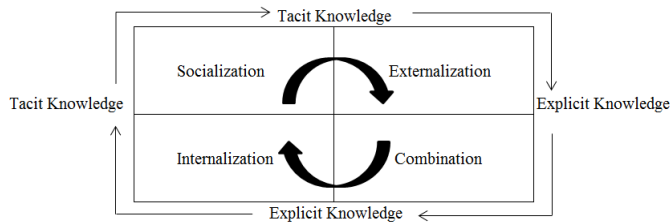

2262

Figure 4. SECI, Source : Nonaka dan Takeuchi, Dalkir, and Liebowitz (2011)

The United Nations Development Program (UNDP) follows a unique framework.

It is an organization, which requires knowledge management to share and create new knowledge. The knowledge management framework followed by the UNDP is a cyclical one, distinguished from the other strategies that follow a 'top down approach'. [9, 10] provides the following pillars as its knowledge management framework:

1. Data collection and mining by information systems: The first step of data collection and mining takes place via global web-based database and tracking tool, which any member of the organization in the UNDP can access to extract any information in relation to projects being run under it.

2. Generation of knowledge products and services: The UNDP-GEF produces several knowledge products and services according to the target audience and key objectives, which include among others, lessons learned publications, project learning networks, resource kits, project publications, etc.

3. Dissemination of knowledge: The UNDP uses knowledge dissemination mechanisms such as an online resource known as the Energy and Environment workspace where members can share resources, experiences, ideas and lessons learned, an energy and environment virtual network, GEF section on the UNDP intranet which provides country office staff access to information and tools, and the GEF Section on the internet where the public have access to information.

By looking at the development of information systems and technologies that have entered the era of media convergence, namely the merging of various technology platforms on one media or equipment owned by all levels of society, then to accelerate the process of climate change preparedness and mitigation dissemination can also be done by utilizing these equipment and knowledge transfer carried out in various ways, including through skills training, courses, seminars, workshops that will take place effectively and efficiently using modalities based on community participation and local wisdom by utilizing media convergence [11]. In its implementation, this activity in general is in the form of knowledge transfer and community capacity building that plays a role in efforts to build preparedness and mitigation, so that the community can be better monitored and measured in terms of their understanding of climate change issues [12]. Optimizing the dissemination and development of data and information on sustainable development in mitigation activities related to climate change will be more effective and efficient [13]. The

results of community service activities in the form of a Knowledge Management System (KMS) for climate change preparedness and mitigation can be used to support socialization and internalization of climate change preparedness and community-based climate change mitigation activities, including the development of dissemination and performance measurement of community preparedness and mitigation preparedness. The implementation of the concept of knowledge management has objectives to create, disseminate knowledge, and produce explicit knowledge that can be followed up for all fields and jobs [14]. Through the process of internalizing knowledge, users can practice a range of management knowledge and put experience in practice, which enables them to gain higher levels of expertise [15]. However, this needs to be controlled and monitored, taking into account that users will be responsible for actively providing explicit knowledge that is packaged in the system, processing it and turning it into a key factor to improve people's skills and effectiveness in understanding climate change issues continuously. Based on these conditions, it is necessary to build a Critical Success Factor Measurement Model for the Implementation of climate change issues Knowledge Management Systems.

II. METHODOLOGY

The study was conducted by collecting data from already existent information, i.e.through secondary sources and from original sources, i.e. primary data. The secondary data was collected from already published articles, reports, books, book sections, as well as from websites. This was done through a literature review on the concepts of knowledge, knowledge management, and policy process and climate change adaptation. This method of data collection was chosen for the reason that such a study needed a theoretical framework in place before conducting any form of original research. A literature review was needed for the comparison of frameworks undertaken to show that a commercial concept like knowledge management has social benefits and to determine if there were any gaps in the Adaptation Knowledge Platform Framework [16].

The primary data was collected through communication, which took place via a self-administered questionnaire. The questionnaire was chosen to cover the large group of participants in a short span of time and avoid any bias. This method was chosen over the interview method to give the participants more freedom to respond. The questions were close-ended chosen due to the non-personal nature of the questionnaire.

III. RESULT AND DISCUSSION

From the results of data processing can be obtained optimal solutions with the formation of 4 (four) new variables in accordance with the description in table 1.

Table 1. Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	7.934	33.060	33.060
2	2.791	11.630	44.690
3	1.582	6.593	51.283
4	1.262	5.257	56.540

The first factor that is formed from the four factors is related to human factors and can be interpreted as *community awareness of climate change*. This relates to the role of human resources in dealing with climate change, the extent to which the community understands the importance of climate change issues will have an influence on people's mental readiness.

By utilizing all available resources, it is necessary to build a shared mindset related to the importance of climate change issues ,

so that a culture of awareness and awareness is formed to the potential of climate change.

The second factor that is formed from these four factors is related to the process or activity factor and can be interpreted as a *mitigation factor of socialization processes in the face of climate change.* This relates to socialization activities, which need to be known by the community related to the use of technology that is already very familiar, because the intended socialization activity is to utilize the technology, which so far has been understood that socialization is based on facilitators and will turn into socialization based on participant. This is where the importance of paradigm changes and mindset is very important to note and deliver the change process.

The third factor that is formed from the four factors is related to technological factors and can be interpreted as factors of *availability of indtrial revolution 4.0 tool*. This relates to the technology or tool that will be used. In the current era of the industrial revolution 4.0, all activities can be carried out by utilizing information systems and technology so that they become effective and efficient, including the socialization process of mitigating climate change. Things that need to be known by the public related to the use of technology that is actually very familiar, because the contribution of this technology can make an optimal contribution as long as the community's understanding is in line with the development of the technology itself. This is also very important to bring paradigm changes and mindset to be considered and delivered the process of change.

The fourth factor that is formed from these four factors is related to governance factors and can be interpreted as *governance of climate change issues* . This relates to the management of climate change issues knowledge that is relevant and accurate in its data, the process of collecting data related, processing it into appropriate information and based on reliable references, then disseminating to the public again in the form of climate change issues knowledge and preparing understanding evaluations for ensuring the extent to which the community can properly understand climate change issues . It needs to be correct and

dynamic governance in line with the changing patterns of climate change that occur.

After the discovery of new factors that influence the success of the socialization of climate change issues , then the next step is to use a regression analysis to see the relationship between the variables formed and get a model that is able to describe the level of success of respondents or the community in understanding climate change issues that socialization is done independently by using climate change issues knowledge management systems. Figure 4. And the regresion coefisien at the Tabel 2.
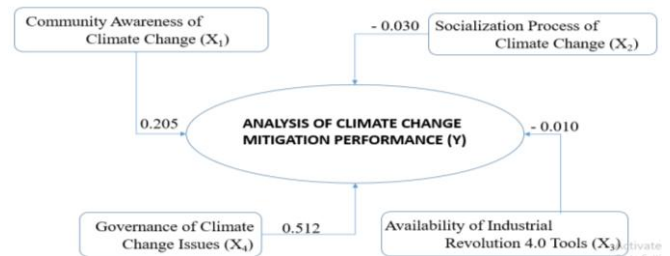

Figure 4. Factors that influence the success of climate change mitigation performance by utilizing a knowledge management systems

Table 2. Regresion Coefisien

Model	Predictive Sign	β	Minimum	Maximum
(Constant)	+	7.260	0.000	0.000
X_1	+	0.205	-2.724	3.036
X_2	-	-0.030	-2.529	2.757
X_3	-	-0.010	-2.380	2.006
X_4	+	0.512	-2.200	2.437

So, the Critical Success factor model of climate change issues sosialization can be formulated in the form of the following equations :

$$Y = 7.260 + 0.205\ X_1 - 0.030\ X_2 - 0.010\ X_3 + 0.512\ X_4$$

With the following conditions :
$$-2.724 \leq X_1 \leq 3.036$$
$$-2.529 \leq X_2 \leq 2.757$$
$$-2.380 \leq X_3 \leq 2.006$$
$$-2.200 \leq X_4 \leq 2.437$$

Where:
Y = Performance of climate change mitigation
X_1 = Community awareness of climate change
X_2 = Socialization process of climate change
X_3 = Availability of industrial revolution 4.0 tools
X_4 = Governance of climate change issues

From the factor analysis process that has been carried out and produce an optimal solution with the four factors above, it is also obtained the average minimum factor value and the average maximum factor value which is as a completeness to build a model and can be used to build simulations of the model. Model simulation results can be seen in table 3.

Table 3. Result of Simulation Model

Condition	(Constant)	X_1	X_2	X_3	X_4	Y
Current	7.260	0	0	0	0	7.260
Optimum	7.260	3.036	-2.529	-2.380	2.437	9.230
Unexpected	7.260	-2.724	2.757	2.006	-2.200	5.472

IV. CONCLUSION

Based on the results of research that has been done, it is concluded that the performance of the mitigation of climate change issues socialization carried out by utilizing the knowledge management system can still be increased until it reaches a value of 9.230 from a maximum scale of 0.000 – 10.000. However, if no efforts or innovations are made, the value will be reduced and decreased to reach the value of 5.472,

which means that the performance of the socialization has declined, because the current performance is worth 7.260. the thing that needs to be improved is to evaluate the processes that are not or less appropriate in the socialization activities of climate change issues carried out, then maximize the use of existing information systems and technology and build a mindset that in the current era of the industrial revolution 4.0, all activities can be carried out by utilizing the system and information technology and is no exception including its contribution in the success of the socialization activities of climate change issues. Because climate change will affect all aspects of sustainable development and because vulnerability is very dependent on development, policy makers must strive to prioritize adaptation to climate change into national and sectoral development while continuing to strive to improve performance in mitigating and promoting socialization on climate change based on local wisdom of the local community.

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