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COVER LETTER

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Dear,
We wish to submit an original research article entitled “BAYESIAN NETWORKS APPROACH ON INTELLIGENT SYSTEM DESIGN FOR DIAGNOSIS OF HEAT EXCHANGER” for consideration by SINERGI.

We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

In this paper, we report on / show that:

Topic	:	Bayesian Networks Implementation in Heat Exchanger
Brief Background	:	In the steel plate-making manufacturing industry, several types of machines are used to convert semi-finished steel into plates. Each machine has a hydraulic oil and lubrication system with several components, namely a tank, pump, filter, accumulator, water circulation, and heat exchanger. One of the extremely critical or important components is the Heat Exchanger (HE). This device is used to exchange heat from a fluid to another using temperature difference. Furthermore, this heat exchange occurs through direct or indirect contact. The fluid exchanged are either in the same phase, for instance, liquid to liquid or gas to gas, or in two different phases. This tool is widely used in the industrial world due to its important function. There are many kinds of HEs based on their shape, including the Plate Heat Exchanger (PHE), which consists of a plate and frame, where the heat transfer process occurs between the two fluids on the side of the heat exchanger plate. A HE is highly influential in the success of the whole series of processes because an operational failure has the ability to stop the system from operating. Therefore, a HE needs to have good performance to obtain maximum results and be able to fully support an

operating unit. Similar to other components or machines that generally have a service life applicable to HEs, problems are often encountered in operating conditions, such as decreased performance, and operational failure at PHE. These are influenced by several factors such as increased pressure drop in PHE, decreased output flow, leakage, and inconsistency in fluid mixing. Therefore, any form of a decrease in PHE performance needs to be immediately taken care of to avoid production losses.

The problems that exist in the HE are due to some factors that impact performance degradation and operational failure. Therefore, maintenance and maintenance are needed in order to maximize performance. Maintenance activities often carried out based on the history of inspection and maintenance need accurate data and take a long time to conclude the problem factors that arise in the HE, thereby making it less efficient. Therefore, a system that functions to diagnose the performance of the HE thereby making it easier to conclude the problem factors is needed. One of the usable algorithms in Bayesian Networks (BNs).

The BNs itself is an uncertified method that presents a causality relationship and exploits conditional free relationships in building network structures. Therefore, it builds a more structured model and reduces the complexity of calculations in making inferences. Generally, the structure and parameters of the BNs are learned from the data. In certain cases, its structures also rely on prior knowledge to realize non-data-type information fusion. In addition, parallel computing frameworks have been introduced to accelerate the learning rate of the BNs model in cases related to big data environments. BNs provide a complex description of interrelated risk and model uncertainty. In addition, even with limited data, conclusions still generate information using a Bayesian approach, because it helps identify sensitive variables.

Therefore, using this BNs system, makes it easier to diagnose the performance abnormality of the HE caused by its operational failure parameters, hence a preventative solution is determined. In the absence of

		this system, it takes a prolonged period to determine the problem of operational failure on the HE, thereby making it less efficient. Therefore, this led to the research on the BNs approach for designing intelligent system performance diagnosis for PHE SH041H-1P-55.
Research Problem	:	There are several signs that can cause a decrease in the performance of the plate type heat exchanger. Maintenance activities based on the manual history inspection and maintenance system are less efficient in concluding the problems that arise with the heat exchanger. A sophisticated system is needed that functions to facilitate maintenance activities for all employees. It is not yet known the success of the application of Bayesian Networks in the design of a heat exchanger diagnostic system.
Overview of Method	:	The system was designed using MSBNX and MATLAB software comprising of several implementation stages. It starts by determining the related variables and categories in the network, making a causality diagram, determining the prior probability of the variable, filling in the conditional probability of each variable, and entering evidence to analyze the prediction results. This is followed by carrying out a case test on the maintenance history to display the probability inference that occurs during pressure drop on the PHE.
Significant finding	:	• The Bayesian Networks Model • The implementation method of diagnosis heat exchanger system and Bayesian Networks • Creating software and design interface

We have no conflicts of interest to disclose.

Thank you for your consideration of this manuscript.

Sincerely,
Dedik Romahadi

AUTHORSHIP STATEMENT

We wish to submit an original research article entitled "[***title of article***]" for consideration by SINERGI.

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript.

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Please submit 3 (three) potential reviewers (*that have not listed in SINERGI*) to speed up the review process that competent for the topic and has a good reputation in that area.

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