WORKER COMPETENCIES IN OPEN INNOVATION IMPLEMENTATION IN AUTOMOTIVE COMPONENT COMPANIES DURING THE ELECTRIC VEHICLE TRANSITION

Fara Rahmania Izzaty, Rahmat Nurcahyo, Novandra Rhezza Pratama, Sik Sumaedi

ABSTRACT

Background: One primary cause of air pollution is the internal combustion engine (ICE), causing a structural change in society from conventional cars to Electric Vehicles (EVs). This transition period demands that automotive component companies be innovative according to the changing dynamics of EV technology. Open Innovation (OI) develops as an approach to fastening the trajectory by involving various stakeholders in this process. The successful adoption of OI requires a deep understanding of the employee’s competencies in these companies to be effective. As a result, empirical studies have been performed to determine employee proficiency levels in various company scales.

Methods: The study was conducted by comparing four automotive component companies with different scales. Data was obtained from the questionnaires that were distributed to employees at each company and collected from December 2023 to January 2024. The study assessed three open innovation competencies, entrepreneurial, cooperation, and creativity competency. Then hypothesis testing was carried out using the Kruskal Wallis H-test method.

Results: The findings indicate that the company scale of the automotive component companies does not affect the proficiency levels of employee competencies in implementing open innovation.

Conclusions: The OI implementation process can be carried out in micro, small, medium, and large companies with employees who have competencies that support the implementation of OI.

Keywords: open innovation, competency, electric vehicle, transition.
COMPETÊNCIAS DOS TRABALHADORES NA IMPLEMENTAÇÃO DA
INOVAÇÃO ABERTA EM EMPRESAS DE COMPONENTES
AUTOMOTIVOS DURANTE A TRANSIÇÃO PARA VEÍCULOS
ELÉTRICOS

RESUMO

Histórico: Uma das principais causas da poluição do ar é o motor de combustão interna (ICE), o que está causando uma mudança estrutural na sociedade, que está trocando os carros convencionais pelos veículos elétricos (EVs). Esse período de transição exige que as empresas de componentes automotivos sejam inovadoras de acordo com as mudanças na dinâmica da tecnologia dos VE. A inovação aberta (IO) se desenvolve como uma abordagem para acelerar a trajetória, envolvendo várias partes interessadas nesse processo. A adoção bem-sucedida da IO requer uma compreensão profunda das competências dos funcionários dessas empresas para ser eficaz. Como resultado, foram realizados estudos empíricos para determinar os níveis de proficiência dos funcionários em várias escalas de empresas.

Métodos: O estudo foi realizado comparando quatro empresas de componentes automotivos com escalas diferentes. Os dados foram obtidos por meio de questionários distribuídos aos funcionários de cada empresa e coletados de dezembro de 2023 a janeiro de 2024. O estudo avaliou três competências de inovação aberta: competência empreendedora, de cooperação e de criatividade. Em seguida, o teste de hipótese foi realizado usando o método do teste H de Kruskal Wallis.

Resultados: Os resultados indicam que a escala da empresa de componentes automotivos não afeta os níveis de proficiência das competências dos funcionários na implementação da inovação aberta.

Conclusões: O processo de implementação da inovação aberta pode ser realizado em micro, pequenas, médias e grandes empresas com funcionários que tenham competências que apoiem a implementação da inovação aberta.

Palavras-chave: inovação aberta, competência, veículo elétrico, transição.

COMPETENCIAS DE LOS TRABAJADORES EN LA APLICACIÓN DE LA
INNOVACIÓN ABIERTA EN LAS EMPRESAS DE COMPONENTES DE
AUTOMOCIÓN DURANTE LA TRANSICIÓN DEL VEHÍCULO
ELÉCTRICO

RESUMEN

Antecedentes: Una de las principales causas de la contaminación atmosférica es el motor de combustión interna (MCI), lo que está provocando un cambio estructural en la sociedad, que está pasando de los coches convencionales a los vehículos eléctricos (VE). Este período de transición exige que las empresas de componentes de automoción sean innovadoras en función de la dinámica cambiante de la tecnología de los VE. La innovación abierta (IO) se desarrolla como un enfoque para acelerar la trayectoria mediante la participación de diversas partes interesadas en este proceso. Para que la adopción de la IO tenga éxito, es necesario conocer en profundidad las competencias de los empleados de estas empresas para que resulte eficaz. Como resultado, se han realizado estudios empíricos para determinar los niveles de competencia de los empleados en varias escalas de empresas.
Métodos: El estudio se realizó comparando cuatro empresas de componentes de automoción con diferentes escalas. Los datos se obtuvieron a partir de los cuestionarios que se distribuyeron a los empleados de cada empresa y se recopilaron entre diciembre de 2023 y enero de 2024. El estudio evaluó tres competencias de innovación abierta, la competencia emprendedora, la de cooperación y la de creatividad. A continuación, se realizaron pruebas de hipótesis mediante el método de la prueba H de Kruskal Wallis.

Resultados: Los resultados indican que la escala empresarial de las empresas de componentes de automoción no afecta a los niveles de competencia de los empleados en la implementación de la innovación abierta.

Conclusiones: El proceso de implantación de la IO puede llevarse a cabo en microempresas, pequeñas, medianas y grandes empresas con empleados que tengan competencias que apoyen la implantación de la IO.

Palabras clave: innovación abierta, competencia, vehículo eléctrico, transición.

1 INTRODUCTION

Air pollution is the biggest threat to public health throughout the world (United Nations Environment Programme, 2023). Epidemiological research has confirmed that the increase in respiratory diseases is closely related to levels of air pollution (Tao et al., 2016). Apart from causing respiratory problems, air pollution also has a certain impact on the cardiovascular and nervous systems, even at higher levels of pollution it can potentially cause cell mutations and increase the risk of cancer (De Kok et al., 1999).

As one step to mitigate the impact of more severe air pollution, it is important to know the sources of air pollution. Polluted air is caused by pollutants originating from several sectors, such as residential, transportation, industrial, commercial, and others. (United Nations Environment Programme, 2023). Based on research conducted by Huang, and Go (2014), air pollutants originating from the transportation sector including carbon monoxide (CO2), sulfur dioxide (SO2), nitrogen oxides (NOX), and particulate matter (PM10 and PM2.5) have a crucial role in worsening air quality. This statement is also supported by research conducted by Giannakis et al. (2020) that the transportation sector contributes 22% of total carbon dioxide (CO2) emissions.

According to Wang et al., (2023), energy-based vehicle production is the key for all countries to massively reduce carbon emissions which supports environmental preservation. This opinion is supported by research conducted by Borgstedt et al., (2017) which states that the shift in technology towards electric vehicles is an effort to overcome problems related to low mobility, such as carbon dioxide emissions. Apart from that, Nurdini et al.(2023) also stated that introducing electric vehicles is a good opportunity to
reduce the amount of air pollution in cities, especially CO2 from the transportation sector. Therefore, many countries in the world are now aggressively encouraging their people to switch to using electric vehicles (EVs) (Nurhadi et al., 2021).

The manufacturing industry always faces market uncertainty, dynamic technological innovation trends, changing environmental conditions, market globalization, intense competition, and changes in customer needs, including the emergence of EVs (Saptioratri Budiono et al., 2021). According to Christensen (2011), if viewed from a technological perspective, the shift towards EVs will revolutionize the automotive industry. It is estimated that 30% of automotive component suppliers in Indonesia will disappear because EVs require fewer components than conventional vehicles (Nurhadi et al., 2021). With these conditions, the component manufacturing industry must be able to develop alternatives to face the transition from vehicles with Internal Combustion Engine (ICE) engines to EVs which are highly dependent on innovation (Borgstedt et al., 2017). According to Al-Mamary et al., (2022), developing countries are struggling to compete in a tight global market, thus technological innovation capabilities are the key to maintaining and improving local capabilities to achieve economic strength and stability. In carrying out innovation, companies require cooperation from many parties, both internal and external. Based on the results of interviews with resource persons, innovation requires large resources, and this requires collaboration with external parties so that it can be realized more quickly. This is by the Open Innovation (OI) concept that the use of knowledge flows is used to accelerate internal innovation and expand the market for external use of innovation (Chesbrough, 2020).

To adopt the open innovation concept, companies need to know the competencies of their employees. This research aims to determine employee competency in implementing open innovation. There are three general competencies used to determine employee competency in implementing open innovation, namely entrepreneurship, cooperation, and creativity (McPhillips & Licznerska, 2021). Every innovation actor must have entrepreneurial competence because this helps productivity and collaboration in the Open Innovation paradigm (Podmetina, D.et al, 2018). Innovative work competencies are essential for implementing innovative ideas, and cooperation competencies are necessary to acquire a set of capabilities necessary for providing and receiving knowledge, the
capacity to operate in a variety of situations, and the administration of multifunctional projects (Chatenier et al., 2010).

2 LITERATURE REVIEW

This section will discuss Open Innovation and the competencies that support the implementation of Open Innovation in companies based on previous research.

2.1 OPEN INNOVATION

Technological developments and various kinds of ongoing disruptions have changed the image of the manufacturing industry, which was previously considered a mature industry, into an industry that continues to broaden its horizons and adapt to current conditions, one of which is by adopting the concept of Open Innovation (Obradović et al., 2021). Research conducted by Chesbrough, (2020) argued that Open Innovation is a distributed innovation process based on the flow of knowledge that is deliberately managed across organizational boundaries, using pecuniary and non-pecuniary mechanisms that are by the organization's business model. According to Ili et al. (2010, p.27) Open Innovation is defined as the deliberate entry and exit of knowledge, to expand the range of benefits to meet challenges to maintain competitiveness in a rapidly changing environment. There are two main reasons why companies need to take steps to open up their product development process, namely because not all competent employees work in one company, and general companies have technology that is not yet in line with current market needs (Parida et al., 2014). This research also reveals that three important aspects need to be considered in realizing Open Innovation, namely people, process, and technology. In the people aspect, OI principles suggest that a new set of skills and competencies must be applied to identify and utilize external knowledge effectively.

2.2 COMPETENCY

Competency is expertise, knowledge, and special skills possessed by employees, which enable them to overcome challenges and fulfill job responsibilities well (Lahti, 1999). Employee involvement in the Open Innovation implementation process requires three important dimensions, namely management of cooperation between innovation organizations based on the competence to carry out cooperation, management of the entire
innovation process based on entrepreneurial competence, and collaborative knowledge formation through creativity (Chatenier et al., 2010). Table 1 presents several previous studies that discuss entrepreneurial, cooperation and creativity competencies in OI implementation,

<table>
<thead>
<tr>
<th>Previous Studies</th>
<th>Competencies</th>
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<tbody>
<tr>
<td></td>
<td>Entrepreneurship</td>
</tr>
<tr>
<td>(Chatenier et al., 2010)</td>
<td>✓</td>
</tr>
<tr>
<td>(Jeraj, M et al., 2015)</td>
<td>✓</td>
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<td>(Mazur, J &amp; Zaborek, P, 2016)</td>
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<td>(J. Kratzer et al., 2017)</td>
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<td>(Podmetina et al., 2018)</td>
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<tr>
<td>(McPhillips &amp; Licznerska., 2021)</td>
<td>✓</td>
</tr>
</tbody>
</table>

Source: Results of Literature Study (2023)

3 METHODS

This research is a comparative study between four different company sizes. Micro category companies with less than 100 employees, small categories with 101-500 employees, medium 501-1000 employees, and large category companies with more than 1001 employees. Data was obtained using a questionnaire distributed to each employee in the mentioned automotive component company categories. The independent variable in this research is the company, and the dependent variable is the open innovation competencies of employees. The participants were 10 male employees (80%) and 2 were female employees (20%). This condition is suitable for automotive component companies that are dominated by male employees. The survey was conducted during regular work hours in the period of December 2023 to January 2024. All participants received an online questionnaire, so it is more convenient and easy to access.

Based on research conducted by McPhillips & Licznerska (2021), The Open Innovation Competence Profile score was measured using nine elements in three categories of factors: entrepreneurship, cooperation, and creativity. This research was carried out by adding one element related to creative competence so that a total of 10
elements were used in the questionnaire. Participants were asked to indicate their agreement with each statement in the questionnaire using a five-point Likert scale.

The validity and reliability test of the questionnaire was carried out to determine whether the data obtained was truly valid and consistent as a source of research data. The test results showed that of the 10 questionnaire items, all questions asked were valid (p <0.05) and reliable (Cronbach's Alpha = 0.781).

To answer the research question of whether there are differences in employee competency profiles in implementing OI in automotive component companies of different sizes, a comparative study was carried out using the Kruskal Wallis H-Test method. Based on the book written by Corder, Gregory W. (1972), The Kruskal–Wallis H-test is used to compare more than two independent samples. The research was carried out by classifying 12 participants into three groups, according to the size of each company. Because the data obtained has an ordinal scale and a small sample size (n<20), the data will be processed using non-parametric tests, so the Kruskal-Wallis H-test is a suitable method to use in analyzing data and testing research hypotheses. The hypotheses in this research are as follows:

**Hypothesis 1 (H1)**. The entrepreneurship factor differs between Micro, Small, Medium, and Big automotive component manufacturer companies.

**Hypothesis 2 (H2)**. The cooperation factor differs between Micro, Small, Medium, and Big automotive component manufacturer companies.

**Hypothesis 3 (H3)**. The creativity factor differs between micro, Small, Medium, and Big automotive component manufacturer companies.

**4 RESULTS AND DISCUSSION**

**4.1 RESULTS**

The analysis in this research uses the Kruskal-Wallis H-Test to test the hypothesis that was previously formulated. The Kruskal-Wallis H-Test is a ranking-based non-parametric approach used to determine whether there are statistically significant differences between four groups of independent variables (company size) regarding the dependent variable (OI competency perception ratings). As a non-parametric method, the
Kruskal-Wallis test does not assume normality but assumes that the observations in each group come from a population with the same distribution shape and the samples are random and independent (Ostertagová et al., 2014).

Table 2 shows the test result of The Kruskal-Wallis H-Test was significant \( H(1) = 4.521, p<0.05 \), so hypothesis 1 is rejected and there is no difference in entrepreneurial competency between Micro, Small, Medium, and Big automotive component manufacturer companies.

### Table 2 Entrepreneurship Factor

<table>
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<tr>
<th>Group</th>
<th>N</th>
<th>Mean Rank</th>
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<tbody>
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<td>Score</td>
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<tr>
<td>MICRO</td>
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<td>Small</td>
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<tr>
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### Test Statistics

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<th>Asymp. Sig.</th>
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<tbody>
<tr>
<td>Chi-Square</td>
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<td>210</td>
</tr>
</tbody>
</table>

\( a. \) Kruskal-Wallis Test  
\( b. \) Grouping Variable: Group

Source: Results of Data Processing (2023)

In Table 3, the chi-square shows 4,990 so H2 is rejected and there is no difference in cooperation competence between Micro, Small, Medium, and Big automotive component manufacturer companies.

### Table 3 Cooperation Factor

<table>
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<tr>
<th>Group</th>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>3</td>
<td>173</td>
</tr>
</tbody>
</table>

\( a. \) Kruskal-Wallis Test  
\( b. \) Grouping Variable: Group

Source: Results of Data Processing (2023)
Table 4 shows the test result of The Kruskal-Wallis H-Test was significant (H(3) =6.227, p<0.05), so hypothesis 3 is rejected and there is no difference in creativity competency between Micro, Small, Medium, and Big automotive component manufacturer companies.

Based on data processing that has been carried out previously, research results were obtained which show that the large number of employees in a company does not affect the competence they have. Therefore, the capacity of the companies for open innovation does not depend on its workforce size.

4.2 DISCUSSION

Since the OI implementation involves all stakeholders, there are several factors that influence the success of the process. While the findings of this study indicate that the size of the company does not affect, the success of OI is not solely reliant on this one factor.

Based on the interviews with managers, the company ownership status indirectly influences the OI implementation. Large and medium-sized companies, which are companies with a majority ownership system by foreign corporations and joint ventures, have easier access to implementing open innovation because the flow of knowledge and technological developments is easier to obtain, making it easier to implement OI. Meanwhile, in micro and small component manufacturing companies, access to
knowledge and technological developments is more limited because it is difficult for them to establish substantial collaboration, so the risk of failure in innovation is higher.

An alternative managerial perspective suggests that the adoption of OI is affected by constraints in time and financial resources. When integrating new knowledge and technology, an initial training period is essential. Companies might encounter challenges in sustaining their revenue during this training phase, as regular production cannot proceed as usual.

Apart from that, the level of dynamic capabilities possessed by the company is also considered to be influential. This managerial opinion is supported by research conducted by Rotjanakorn et al., (2020) that strong dynamic capabilities can build the capacity necessary to deal with the growing uncertainty of innovation and competition in the current market. Then, external factors, customer preferences, competitive pressure and incentives from the government also need to be considered in implementing OI.

Further research is necessary to explore the influence of all the mentioned factors on the implementation of OI. Delving into each factor individually and comprehensively examining its role in the context of OI will contribute to a more thorough understanding of the dynamics involved in successful OI implementation. This in-depth analysis will provide valuable insights that can guide organizations in effectively navigating and optimizing their OI strategies. As the field evolves, continuous investigation into these factors will enhance our knowledge and contribute to the refinement of OI practices in various organizational settings.

5 CONCLUSION

Air pollution which affects people's health levels is one of the triggers for switching to using electric vehicles. This happens because electric vehicles do not emit smoke from engine combustion like motorized vehicles with ICE engines. So, the use of EVs is being intensively promoted for the better health and environment.

With the rapid growth of EVs, the automotive components industry is experiencing disruption because fewer components are used in EVs than in vehicles using ICE engines. So, to compete and maintain its position, automotive component companies must innovate.

The company has embraced the Open Innovation concept as part of its endeavors to facilitate the seamless exchange of knowledge, insights, and technology during the
transition period to electric vehicles (EVs). This strategic adoption is aimed at actively engaging and involving all stakeholders, recognizing their significant roles in navigating the challenges and opportunities presented by the EV transition. By fostering an open approach to innovation, the company seeks to tap into a broader spectrum of expertise and resources, ultimately enhancing its ability to navigate and succeed in this transformative period.

In implementing Open Innovation, employees are the important aspect that deserves more attention. Because, they play a direct role in implementing OI. Thus, this research was conducted to determine three employee competencies, namely Entrepreneurial, Cooperation, and Creativity in implementing OI in automotive component companies with different numbers of employees.

The research results show that company size does not affect the level of employee competence, whether in entrepreneurial competence, cooperation, or creativity in the company. These results indicate that employees in micro companies are likely to have the same competencies as employees in large companies. So that the implementation process can be carried out in micro, small, medium, and large companies with employees who have competencies that support the OI.

The success of OI implementation is multifaceted, and it is not solely determined by a single factor. Consequently, a more concerted effort is required to discern the impact of various factors on the successful implementation of OI in component manufacturing companies. By thoroughly investigating the interplay of these factors, a comprehensive understanding can be developed, leading to more effective strategies for implementing OI in the specific context of component manufacturing. This ongoing exploration will contribute to the development of nuanced and tailored approaches to enhance the overall success of OI initiatives in this industry.

There are certain constraints associated with this study. Firstly, the sample size is limited; future investigations could benefit from a larger and more diverse sample to yield more representative findings. Secondly, the research is confined to automotive component companies in Indonesia, and outcomes may vary in other industries. Lastly, to comprehensively understand the impact of Open Innovation (OI) in the transition to Electric Vehicles (EVs), further research is essential. By expanding and refining this study, the automotive industry can potentially contribute more significantly to Indonesia's sustainability objectives and the promotion of green transportation.
ACKNOWLEDGEMENTS

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