

Green Manufacturing's Adoption Framework for Small and Medium Enterprises in Indonesia

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Abstract

The objective of the research is to develop a conceptual framework for the adoption of Green Manufacturing (GM) by Small and Medium Enterprises (SMEs) in Indonesia. This study used the extended Technology, Organizational and Environmental framework (TOE) and institutional theory to analyze the factors that influence GM's adoption by SMEs and the effect this has on their financial and environmental performance. This paper examines four variables, three factors (TOE) plus the characteristics of managers. In a SME, the manager/owner is the key person, as the actor who makes various decisions. In previous studies, the construct of the characteristics of managers tended to focus on cognitive and contextual problems. This paper observes that emotional problems, which are related to the spiritual aspects of managers, are important things that are widely investigated in individual ecological behavior. Spiritual aspects have not been widely studied in the construct of a manager's characteristics, whereas in the realm of psychology, this aspect influences their behavior related to the environment. This paper contributes by considering the spiritual factors in the characteristics of managers. A quantitative research technique using the survey method will be applied for the research.

Keywords

Green manufacturing, spiritual, TOE, institutional theory, SME

I. Introduction

Garbage and pollution are one of the environmental problems that threaten human life (Leonidou and Leonidou 2011). Public awareness of environmental problems is increasing, making companies adopt ecological issues in their activities (Anderberg et al. 2010). One of the innovations taken by companies to respond to environmental problems is Green Manufacturing (GM). GM differs from traditional manufacturing, as it includes a variety of things during the production process that are concerned with the companies' environmental impacts (Rehman et al. 2014). GM is a manufacturing method that minimizes pollution and waste (Chuang and Yang 2014). The approach of GM includes the design of the product and engineering activities to minimize the environmental impact (Deif 2011).

Literature studies on GM's bibliometrics indicate that this topic showed significant developments in 2010 (Setyaningsih et al. 2018). Research into GM's adoption has been focused on large companies (Aykol and Leonidou 2015), with only a limited focus on small businesses (Setyaningsih et al. 2018). Small companies are considered to have a lower environmental impact, so that their activities in relation to the environment receive less attention from stakeholders (Tilley 1999). SMEs also have less financial, labor, and technical facilities to start and implement environmental management activities (Tilley 1999). These constraints are considered to be a barrier to SMEs adopting GM (Revell et al. 2010).

In Indonesia, there are 19.2 million SME that contribute 60% of the country's GDP, account for 14.17% of its total exports, and employ 116 million people (UKM 2018). In Indonesia, most SMEs operate along traditional lines in production and marketing (Indarti and Langenberg 2004). The purpose of this paper is to develop the conceptual framework for GM's adoption by Small and Medium Enterprises (SMEs) in Indonesia.

2. Literature Review

Researchers have proposed various factors that influence GM's adoption. A literature search conducted by researchers into the adoption of innovation (Gangwar et al. 2014; Oliveira and Martins 2011; Hameed et al. 2012) identified that TOE was the most widely used framework for the adoption of innovation at the organizational level. TOE is a framework proposed by Tornatzky and Fleischer (1990) which identifies that three aspects, namely technology, organization and environment influence the adoption of innovation, influence the process of further assimilation and affect organizational performance (Wen and Chen 2010). Specific factors identified in the three contexts can vary in different studies, and do not provide the theoretical reasons needed to establish causal relationships (Mishra et al. 2007). In TOE's view, companies can effectively implement innovative practices when the right balance of internal and external drivers can be established (Aboelmaged 2018). Tornatzky and Fleischer (1990) developed TOE for organizational adoption, based on the organizational contingency theory (Arpaci et al. 2012).

TOE is useful for examining the factors that influence technology's adoption by an organization (Hameed et al. 2012). It has consistent empirical support in the adoption studies of various technologies (Zhu and Kraemer 2005). TOE has been applied in the study of various innovation's adoptions, such as Electronic Data Interchange (EDI) (Al-Qirim 2007), Enterprise Resource Planning (ERP) (Awa and Ojiabo 2016), GM (Piaralal et al. 2015; Lin and Ho 2011), and the internet (Oliveira and Martins 2010). TOE has consistent empirical support, even though specific factors identified in its three aspects vary in different studies (Oliveira and Martins 2011). These three aspects of technology, organization and environment have proven to influence companies to adopt new innovations, and also affect organizational performance (Wen and Chen 2010).

However, the researchers state that because of different technological characteristics, specific measurements determined in the three factors vary, depending on the type of technology studied (Wang et al. 2010). The different characteristics of the technology adopted cause TOE to be expanded to include different variables outside the TOE's framework (see Table 1) (Chong and Olesen 2017). This study uses TOE as a basis for research concepts that look at external and internal factors of the company, as driving factors for GM's adoption (Tornatzky and Fleischer 1990).

3. Green Manufacturing's Adoption by SMEs

In general, in adopting GM, SMEs tend to be passive and at the operational level (Xie et al. 2016). Most companies approach GM with an "end-of-pipe" approach, in which a company tries to reduce the adverse environmental impacts that exist, rather than adopt a proactive approach to reduce waste or pollution sources (Hsu et al. 2013). In fact, introducing GM at the beginning of the production process is able to improve a company's performance (Weng et al. 2015).

This paper examines the influence of technological, organizational and environmental factors on the adoption of GM at various levels (strategic, tactical and operational) using the TOE framework and institutional theory. Although proven to be strong in analyzing organizational adoption in three aspects (Hameed and Counsell 2012), TOE is considered to be less concerned with the individual aspects of an organization (Ghobakhloo et al. 2011). In the context of SMEs, the manager/owner factor is a crucial factor, as the actor who makes various decisions (Thong and Yap 1995). In the context of Indonesian SMEs, the research conducted by Indarti and Langenberg (2004) showed that the characteristics of the owner/entrepreneur determined the SME's success. Organizational decisions to adopt or reject innovation often reflect the personal characteristics of top managers (Hameed and Counsell 2012).

Table 1. Previous research of adoption

No.	Author/s	Adoption	Theory/ Model	Technology	Organization	Environment	Other Variable
1.	(Yahya et al. 2014)	Green practices	TOE, DoI, Thong's Model	- Relative advantage - Complexity - Compatibility - Cost - Company image	- Quality of Human Resources - Management support - Size	- Competitive pressure - Buyers pressure - Regulatory pressure - Government's support	Individual context: - CEO's innovativeness - CEO's green knowledge
2.	(Aboelma ged, 2018)	Sustainable manufacturing practices	N-RBV, TOE	- Technology Infrastructure (-) - Technology Competence (-)	- Management support (+) - Employee's engagement (+)	- Competitive capabilities (+) - Environmental regulations (-) - Environmental pressures (+)	-
3.	(Maduku et al. 2016)	Mobile marketing	TOE	- Relative advantage (+) - Complexity (-) - Cost (+/-)	- Top management (+) - Financial resource (-) - Employee capability (+)	- Vendor support (-) - Competitive pressure (-) - Customer pressure (+)	-
4.	(Thong and Yap, 1995)	Information Technology	Thong's Model		- Competitiveness of environment (-) - Information intensity (-) - Business size (+)		Individual characteristics - CEO's innovativeness (+) - CEO's IT knowledge (+) - CEO's attitude towards adoption of IT (+)
5.	(Al-Qirim 2007)	eCommerce communications and application technology	TOE extended	- Relative advantage (+) - Cost (+) - Compatibility (+)	- Size (-) - Information intensity of product (+)	- Competition (+) - Buyer/supplier pressure (-) - Support from technology vendor (+/-)	The Entrepreneurial: - CEO's innovativeness (+) - CEO's involvement (+)
6.	(Ramayah et al. 2016)	Website continuance	TOE extended	- Relative advantage (+) - Cost (+) - Compatibility (-) - Security (-)	- Size (-) - Employee IS knowledge (-)	- External pressure (-) - External support (-)	CEO characteristics - Innovativeness (+) - IT knowledge (-) - IT adoption attitude (-)
7.	(Gholami et al. 2013)	Green Information System	Institutional Theory, Belief-Action-Outcome framework	-	-	- Coercive pressure (+) - Mimetic pressure (-)	- Manager's attitude (+) - Manager's consideration of future consequence (+)
8.	(Awa et al. 2017)	Technology	TOE, task-technology-fit (TTF) and unified theory of acceptance and use of technology (UTAUT)	- Perceived simplicity (+) - Compatibility (+/-) - Perceived values (+)	- Management support (+) - Size of the enterprise (+) - Scope of business (+)	- Normative pressure (+) - Mimetic pressure (+)	1. Individual a. Social influence (+/-) b. Hedonistic drives (-) 2. Task a. Task complexity (+) b. Task interdependence(+)

(+) positive significant; (-) not significant; (+/-) negative significant.

The success of technology's adoption needs to overcome cognitive, emotional, and contextual factors (Straub 2009). In previous studies, the construct of the characteristics of managers has tended to focus on their cognitive and contextual problems (see Table 2). Thong and Yap (1995) examined if the CEO's innovation, the CEO's knowledge about IT, and the CEO's attitude toward IT's adoption have an influence on innovation's adoption. Damanpour and Schneider (2006) examined the influence of the manager's demographic aspects, namely age, gender, and level of education, as the characteristics of managers in innovation's adoption. Larsen (1993) studied the influence of differences in managerial tenure, education and the knowledge of managers. This paper observes that emotional problems, which are related to the spiritual aspects of managers, are important things that are widely investigated in individual ecological behavior. Spiritual aspects have not been widely studied in the constructs of a manager's characteristics, whereas in the realm of psychology, this aspect influences the behavior related to the environment (Kaiser et al. 1999). This paper contributes by reporting the spiritual factors in the characteristics of managers.

Table 2. CEO characteristics

No.	CEO factors	Significant	Insignificant
1.	CEO's innovativeness	11	6
2.	CEO's attitude	10	1
3.	CEO's IT knowledge	10	6
4.	Manager's tenure	5	5
5.	Manager's age	1	5
6.	Manager's gender	1	4
7.	Manager's educational level	2	2
8.	CEO's involvement	2	5
9.	Social Influence *)	1	0
10	Hedonistic Drives*)	0	1

Source: (Hameed et al. 2012; *) Awa et al. 2017)

Empirically, the study of the relationship between GM's adoption and performance has been the object of much debate and discussion in the literature, because the results are heterogeneous (Miras-Rodriguez et al. 2015). Some research considers that the adoption of GM will have a positive impact on company performance (Rehman et al. 2016; Rusinko 2010; Zhang and Yang 2016), while other research says it will not (Walley and Whitehead 1994). The existence of this contradiction shows that the influence of the adoption of green manufacturing on company performance has not been conclusive, so it creates an opportunity for further study.

In addition, research on the adoption of GM by SMEs is widely studied in developed countries, such as America (Cordano et al. 2010), China (Lau and Wang 2015), India (Mittal et al. 2016) and Europe (Rahbauer et al. 2016), but rarely done in developing countries, especially Indonesia; despite the fact that the activities of SMEs in Indonesia contribute noticeably to environmental pollution. In terms of water pollution alone, the contribution from the waste of SMEs producing such items as tofu, batik, tapioca and livestock amounted to 2.3 million tons and 0.96 million tons of methane, equivalent to 24 million tons of CO₂ (Purnamawati 2014). This reality is linear with the findings of research by Parker et al. (2009) which states that SMEs are estimated to contribute as much as 60% of carbon dioxide and 70% of all industrial pollution, globally.

Initially, the technological aspects offered by TOE refer to internal and external technologies used or available within the company (Wen and Chen 2010), and technological attributes that are relevant to the innovation under study (Hwang et al. 2016). In the adoption of GM, this technological factor is hardly analyzed (Lin and Ho 2010). In its development, this aspect is adjusted to the characteristics of the innovation adopted (Wang et al. 2010). The technology attributes used in this article are based on three technological attributes.

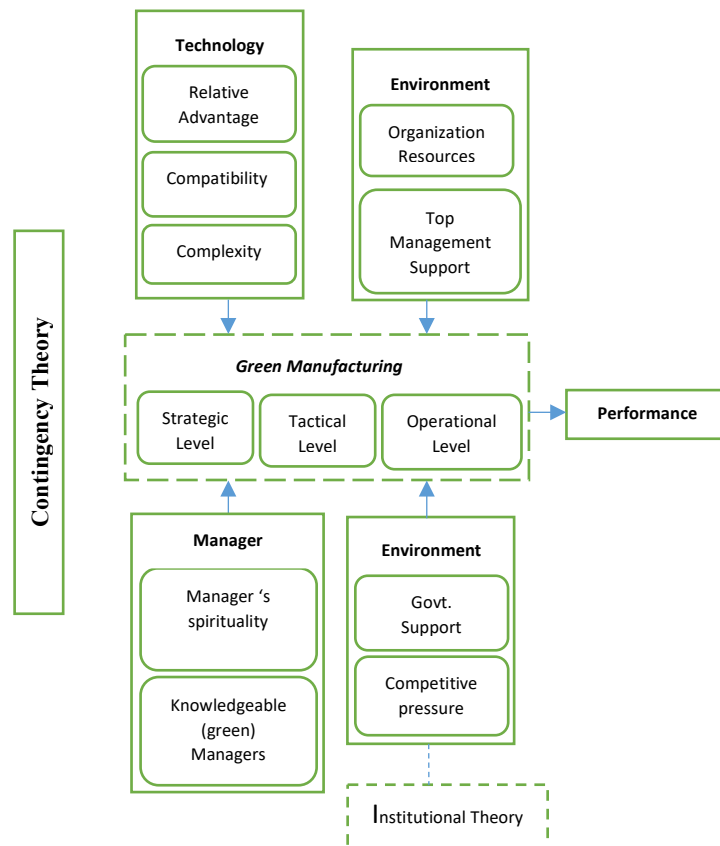


Figure 1. Research Model

4. Development of Hypotheses

The objective of this study is to find the likelihood of GM's adoption by small and medium sized enterprises in Indonesia. Figure 1, using a combination of the contingency theory, TOE framework, and institutional theory, proposes that there are significant relationships between organizational, environmental, technological and manager aspects in GM's adoption by SMEs.

4.1 Technology

The technology attributes used in this paper are based on three technological attributes proposed by Rogers (1995), namely relative advantage, compatibility, and complexity, which have been proven to be consistently related to adoption decisions in various studies (Hwang et al. 2016). These attributes are able to improve the technological aspects of the TOE framework because they have a significant influence on technology's adoption by an organization. These attributes have been used in studies of the adoption of various forms of technological innovation to determine the characteristics of technology (Hwang et al. 2016).

The characteristics of innovation are identified as the aspects of technology. Three attributes, relative advantage, compatibility, and complexity (Hwang et al. 2016), have consistently impacted the adoption decisions in many fields of study (Xie et al. 2016). The most significant variables in the adoption process are compatibility, based on Zhu et al. (2006) and relative advantage (Rogers 1995). This research uses three characteristics of innovation as technology

characteristics.

H1: Relative advantage has a positive effect on the adoption of green manufacturing.

H2: Compatibility positively affects the adoption of green manufacturing.

H3: Complexity has a negative impact on green manufacturing's adoption.

4.2 Organization

The organizational aspect discusses the characteristics of the company, including the size and scope of the organization, its managerial structure (centralization, formalization and complexity of managerial structures), and internal resources in the form of the quality of the human resources (Ghobakhloo and Tang 2013; Hwang et al. 2016). Molla and Licker (2005) found that the decision to adopt technology occurs when organizational resources are positively supported. This means that the dimensions of human, business, and technological resources for organizational readiness have a major influence on adoption.

SMEs have limited resources (Thong et al. 1996); this does restrict their competence to innovate (Huang 2012). Financial resources have a significant impact on innovation's adoption (Damanpour 1991). In SMEs, the owner/manager is the decision maker (Oliveira and Martins 2011). Managers influence the adoption of innovations by formulating policies to respond to environmental changes, controlling resources and altering key decisions (Damanpour and Schneider 2009). Chiu et al. (2017) found that top managements' support provides significant factors in the adoption process. An organization's constructs, in this research, are the readiness of its organizational resources and its top managements' support.

H4: Organizational resources have a positive effect on green manufacturing's adoption.

H5: Top managements' support influences green manufacturing's adoption.

4.3 Environment

The adoption of innovation can be influenced by the institutional environment in which the company is located, which is linear with the institutional theory. This environment consists of suppliers and other trading partners, competitors, customers, and regulatory bodies such as the government, which can create incentives and obstacles in the adoption of innovation (Gibbs and Kraemer 2004). The institutional theory emphasizes the importance of the institutional environment in shaping organizational structures and actions (Scott (2001) in Gibbs and Kraemer 2004). According to the institutional theory, organizational decisions are not driven purely by the rational goals of efficiency, but also by social, cultural and legitimate concerns (DiMaggio and Powell 1983). Applying the institutional theory, in conjunction with TOE, is very helpful in identifying and explaining the important determinants of adoption (Gibbs and Kraemer 2004). External pressure factors tested in the TOE's study include institutional variables such as the level of adoption due to pressure from competitors, suppliers and customers, and the government (Gibbs and Kraemer 2004).

H6: Government support positively influences the adoption of green manufacturing

H7: Competitive pressures positively affect green manufacturing's adoption

4.4 Owner/Manager Characteristics

In addition to the three aspects of technology, organization and environment, in the context of SMEs the manager/owner factor is a crucial factor, as the actor making various decisions (Thong 1999; Thong and Yap 1995). Managers are involved in all the strategic decision-making (Shuman et al. 1985). This evidence is supported by the research of Premkumar (2003) which states that not only the three aspects of technology, organization and environment, but also the characteristics and factors of individuals, must be included in the adoption's study. This opinion is supported by Thong (1999), that TOE needs to be expanded with the characteristics of decision makers in the research into SMEs' adoptions. Technology's adoption needs to overcome cognitive, emotional, and contextual factors. Premkumar and Roberts (1999) stated that owner/managers with more knowledge will be more aggressive in their adoption of innovation.

In SMEs, the motivation for environmental initiatives is triggered by the values of the owners/managers (Baden et al. 2009). One of the values is the spiritual factor. This spiritual factor has not been studied in the constructs of a manager's characteristics, but in the environmental psychology stream, since this factor influences behavior related to the environment (Kaiser et al. 1999).

H8: A manager's spirituality positively affects green manufacturing's adoption

H9: Knowledgeable (green) managers positively influence green manufacturing's adoption

4.5 Financial and Environment Performance

Besides involving the individual characteristics of decision makers, the adoption of GM by SMEs is still assumed to be at the operational level, as most SMEs are, in general (Xie et al. 2016). Even so, it does not rule out the possibility that there are SMEs that have been at the tactical or even strategic level. Research on the adoption of GM at a strategic, operational and tactical level, in relation to limited organizational performance (Ashton et al. 2017), is scarce, so this paper will examine the effect of GM's adoption at various levels (operational, strategic and tactical) on SMEs' performance.

H10: Adopting green manufacturing will have a positive influence on the financial and environmental performance

This research suggests that GM's adoption has only been done by a small number of SMEs in Indonesia. Thus, this research will further examine differences in the performance of the adopter and non-adopter SMEs. Also, in the adoption of information technology, there is no significant difference in the tactical and operational levels with the performance of SMEs (Hung et al. 2014). Then, this research would further examine the different performance of SMEs at different GM levels (operational, tactical and strategic).

4. Conclusion

The model in this research is at an early stage of research into GM's adoption by SMEs. The respondent will be the SMEs existing in Indonesia. In the next phase, a study of the process of GM's adoption and its impact on financial and environmental performance will be carried out. It is expected that this proposed framework will fill the gap for a comprehensive model of GM's adoption by SMEs at the operational, tactical and strategic levels. Besides, the basics of the extended TOE framework, and the institutional theory, are framing the model that we offer. In addition, contributions are also made in the characteristics of the manager. The spirituality of the manager is one variable that is less noticeable in the extended TOE framework from previous studies.

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