

ANTECEDENTS AND CONSEQUENCES OF GREEN INNOVATION

Prof. Dr. Ahu Tuğba KARABULUT

Istanbul Commerce University, Turkey

Abstract

The purpose of this study is to shed light to antecedents and consequences of green innovation. Antecedents and consequences are important to understand why companies decide to proceed green innovation and what are their benefits to the companies and their stakeholders. Antecedents are motivations of companies to conduct green innovation whereas consequences are contributions of them to the World.

Keywords: Green Innovation, Antecedent, Consequence

1. Introduction

Green innovation has been a popular concept in the management literature which reflects sensitivity of companies to environmental management for sustainability. Antecedents and consequences need to be reviewed to understand the importance and feasibility of the concept.

Green innovation is the development of software and hardware solutions related to green products and processes. It involves problem-solving related to pollution-prevention, energy-saving, green product design, waste recycling, and corporate environmental management (Chen et al., 2006) (Song and Yu, 2018, p. 139).

Green innovation is concerned with the environmental issues such as eco-design, energy saving, waste recycling, and pollution prevention (Chang, 2011; Chiou et al., 2011; Bocken et al., 2014; Cai and Zhou, 2014) (Huang and Li, 2017, p. 309).

Green innovation is the enhancement of products and processes to reach targets of sustainability and reduce environmental burden (Rennings, 2000). Green product and process innovation are the most widely accepted green innovation types (Chen et al., 2006; Chang, 2011; AmoresSalvado´ et al., 2014; Lin et al., 2014). Green product innovation is efforts to enhance product quality and safety for product differentiation and environmental issues by promoting sustainability, which in turn it increases profits and competitive advantages (Chen, 2008). Testa et al. (2011) reveal that companies want to increase their investments in green innovation to enhance energy efficiency and decrease environmental impact due to regulatory pressure. Yalabik and Fairchild (2011) show that companies make more green product investments to have competitive advantages. Companies will be forced to make more green product innovation investment and develop more green products to meet regulatory requirements and have competitive advantages due to social expectations for environmental legitimacy for climate change and environmental regulatory pressures. Green process innovation is modifications for manufacturing processes and systems to save energy, prevent pollution, and recycle waste (Kammerer, 2009). The implementation of green process innovation lets companies recycle wastes, reduce usage of resources, raw materials and costs, and increase resource productivity (Porter and van der Linde, 1995; Chen, 2008). Environmental legitimacy pressure encourages companies use their resources completely, minimize usage of energy, recycle wastes, and improve production processes continuously (Li et al., 2018, p. 1092).

Green process innovation is related to saving energy, preventing pollution, recycling waste, and reducing manufacturing toxicity (Zhu and Sarkis, 2004; Chiou et al., 2011). Green process innovation shows organizational ability to improve current processes and develop new ones to prevent pollution, recycle waste, save energy, and leave less toxicity in innovation processes (Chen et al., 2006; Chen, 2008) (Huang and Li, 2017, pp. 311-316).

Companies practice green innovation to satisfy goals related to environmental protection (Chen et al., 2006). Green organizational identity helps this process by combining different skills and expertise for facilitating innovation (Benet-Martínez et al., 2002; Chang and Chen, 2013). Companies can stimulate innovation by using their knowledge

to generate ideas appealing and useful to their stakeholders (Ancona and Caldwell, 1987; Chang and Chen, 2013). Green organizational identity can motivate employees for discovering new customer needs and technologies. This effort leads companies to use of their resources to improve green innovation (Dougherty, 1990; Chang and Chen, 2013) (Song and Yu, 2018, p. 139).

Trend toward environmentalism leads companies face customer consciousness for environmental issues, regulatory pressures and practice environmental management (Huang and Wu, 2010; Cai and Zhou, 2014). Green innovation describes organizational contributions to sustainable development to enhance competitiveness (OECD 2010; Zhu et al. 2012; Bocken et al. 2014). Green innovation is an innovation which decreases environmental impact (OECD, 2010; Cai and Zhou, 2014). Green innovation leads industries conduct sustainable production and facilitates evolution of sustainable production initiatives. Companies can control their environmental impacts if they comply with international environmental conventions and apply technological breakthroughs which strengthen green innovation (Chen, 2008; Chiou et al., 2011). Many green innovation researches focus on incremental innovations such as products, processes, organizations, institutions, and marketing methods (OECD, 2010; OECD, 2012). Products' energy consumption and production processes' redesign lead industry efforts to enhance recycling possibilities. The main concern of green innovation efforts is technological advances of products and processes (Chen et al., 2006; Chen, 2008; Chiou et al., 2011). Green innovation is development of green products and processes to modify a current product design to decrease negative effect on the environment during a product life cycle (Chen et al., 2006; Chen, 2008; Chiou et al., 2011). Green product innovation focuses on innovation of products for recovery and recycling, environmentally friendly material and packaging, and eco-labeling (Chen et al., 2006; Chen, 2008) (Huang and Li, 2017, p. 311).

2. Antecedents of Green Innovation

Antecedents of green innovation lead companies feel more responsible and make efforts for green practices. Also, they reflect expectations of their stakeholders. When companies want to survive longer, they have to adopt themselves for requirements of their stakeholders and perform green innovation practices.

Adopting green practices is a major concern for companies nowadays (Shu et al., 2016). Societal pressures, resource limitations, regulatory policies, and customer preferences lead countries to a more balanced approach to environmental sustainability and economic growth (López et al., 2008; Dhakal, 2009) (Tang et al, 2018, p. 39).

Environmental management requires adoption of green products, processes and practices which are less detrimental to the environment than previous ones (Zhu and Sarkis, 2004; Zhu et al., 2012) (Huang and Li, 2017, p. 309).

Managers are concerned about environmental performance because of several reasons such as public perception, competitive advantages, and regulatory and contractual compliance (Zhu and Sarkis, 2004; Chiou et al., 2011) (Huang and Li, 2017, p. 316).

Companies can invest more in green innovation to gain and maintain environmental legitimacy (Rennings, 2000) (Li et al., 2018, p. 1090).

Innovation is an essential mechanism to improve organizational ability to maintain competitive advantages (Eisenhardt and Martin, 2000). Green innovation has an essential role to create competitive advantages in environmentalism era (OECD, 2010; Bocken et al., 2014; Przychodzen and Przychodzen, 2015). Green innovation can offer business and customer values which contribute to sustainable development and reduce environmental effects and costs (Hillestad et al., 2010; Zhu et al., 2012; Bocken et al., 2014; Cai and Zhou, 2014). Companies can demonstrate green concepts in designing and packaging to enhance advantages of product differentiation (Chen et al., 2006; Chen, 2008). Managers can be concerned about environmental performance due to several reasons such as competitive advantage, regulatory and contractual compliance and public perception (Zhu and Sarkis, 2004). Green product and process innovation increase competitive advantage and decrease the negative effect on the environment (Chen et al., 2006; Chiou et al., 2011) (Huang and Li, 2017, p. 314).

Companies try to protect the environment by decreasing their wastage for their corporate social responsibility. Thus, they face a lot of pressure to protect the environment (Delmas and Toffel, 2003) (Shafique, Asghar and Rahman, 2017, p. 94).

Companies trying to cope with environmental regulations are should consider the green innovation strategy which require to initiate creative thinking, accept new ideas, and use resources efficiently to enhance green creativity. Tough

competition and environmental concerns can push companies to develop flexible product and process strategies (Chang and Chen, 2013). Companies should focus on green products to meet customer demands for environmental responsibility (Lin et al., 2013). Green innovation strategy is critical for companies to survive and achieve competitive advantages. Green innovation strategy can improve green awareness level of a company and stimulate its ability to create beneficial ideas for green product and processes (Song and Yu, 2018, p. 137).

Companies have developed environmentally friendly programs such as green technologies and products to enhance their capacities for green innovation (Zhu et al., 2008; Chiou et al., 2011; Yung et al., 2011). Several studies have examined factors which affect green innovation (Friedman and Miles, 2002; Chang, 2011; Lin et al., 2013; Tseng et al., 2013). Many studies have examined external contextual factors affecting green innovation capabilities of companies (Chiou et al., 2011; Lin et al., 2013; Ford et al., 2014). Chiou et al. (2011) showed that greening of suppliers could enhance green innovation. Lin et al. (2013) revealed that demand affected green product innovation in the motorcycle sector. Ford et al. (2014) pointed out that environmental regulations could affect green innovation level positively. Some researchers have examined internal factors expanding organizational capability for green innovation. Chang (2011) searched the relationship between corporate environmental ethics and competitive advantages. They (2011) showed that corporate environmental ethics positively motivated green product and processes innovation to enhance competitive advantages (Chang, 2011; Marin et al., 2017). External pressures to be more environmentally responsible and green product demand motivate companies to strive for green innovation (Chang, 2011; Lin et al., 2013). There are few researches which revealed internal organizational factors affecting green innovation, and identified green innovation strategy as a substantial factor to enable green product and process innovation (Eiadat et al., 2008). Green innovation strategy can enhance business models and change management attitudes to create a green organizational identity for triggering green innovation (Chen, 2011). Green creativity can be defined as 'the development of new ideas about green products, green services, green processes, or green practices that are judged to be original, novel and useful' (Chen, 2011). When a company with a strong sense of green organizational identity faces with external pressures to address environmental issues, creative responses to this pressure can result useful and novel ideas to trigger organizational capability for green creativity (Chen, 2011; Chen and Chang, 2013). Then, these useful and novel green ideas can support green innovation (Song and Yu, 2018, p. 136).

According to Hart and Sharma (2004), social collaboration between the company and its stakeholders can lead innovative ideas which cause organizational difference. Chang and Lin (2014) believe that social collaboration is a main driver of green innovation by creating environmentally friendly products. Lee and Kim (2012) highlight that the success of green innovation depends on collaboration between the company and its suppliers (Handayani, Wahyudi, and Suharnomo, 2017, p. 153).

Globalization created awareness among NGO's, customers, and government organizations to protect the environment. Thus, they make pressure on companies to reduce their wastages and protect the society. Also, International Standard Organization set standards for companies to protect the environment (Shafique, Asghar and Rahman, 2017, p. 93).

Paraschiv et al. (2012) mention that companies can innovate sustainable products and update their product range continuously to develop strong relationships with their stakeholders (Handayani, Wahyudi, and Suharnomo, 2017, p. 154).

According to de Medeiros, Vidor and Riberio (2018, p. 334), critical factors of green innovation is as follows: Investing in basic R&D infrastructure, cleaner technology research and qualified employees, creativity, fulfilling customer expectations, gathering knowledge about factors which lead sustainable purchase, integrating R&D, production and marketing, integrating with stakeholders, eliminating cultural barriers, complying with regulations and laws, gathering knowledge of competing products, predispositioning culturally towards collaboration, experimentation, proactivity of leader, and developing critical reflective analysis capability.

Green innovation practices are affected from corporate social responsibility, business ethics, environmental participation, public care, social collaboration, integration of resource capabilities, social interaction, minimizing hazardous emission, efficiency of natural resource utilization, production by environmental standard and product recycle (Handayani, Wahyudi, and Suharnomo, 2017, p. 156).

Researches related to critical success factors of green innovation are highlighted in Table 1:

Table 1. Critical Success Factors of Green Innovation

Factor	Variables	Authors
Legislation and market knowledge	Fulfilling customer expectations	Iyer (1999), Rennings (2000), Chen (2001), Pujari et al. (2003), Beise and Rennings (2005), Zhu et al. (2005), Mickwitz et al. (2008), Visser et al. (2008), Kammerer (2009), Carrillo-Hermosilla et al. (2010), Doran and Ryan (2012), Horbach et al. (2012)
	Complying with regulations and laws	Rennings (2000), Chen (2001), Beise and Rennings (2005), Zhu et al. (2005), Mickwitz et al. (2008), Kammerer (2009), Horbach et al. (2012)
	Information or financial support from government	Köhler et al. (2013), Kiss et al. (2013)
	Gathering knowledge about cultural variables affecting buyer behavior	Hanssen (1999), Baker and Sinkula (2005), Beise and Rennings (2005), Lee et al. (2006), Peng and Lin (2008), Gonza'lez-Benito and Gonza'lez-Benito (2008), Brito et al. (2008), Naranjo-Gil (2009)
	Gathering knowledge about factors which drive sustainable purchase	Foster Jr et al. (2000), Bre'card et al. (2009), Brouhle and Khanna (2012), Lin et al. (2013)
	Gathering knowledge about consumption patterns of reference persons	Bhate and Lawer (1997), Halme et al. (2006), Houe and Grabot (2009), Welsch and Kühling (2009)
	Gathering knowledge of competing products	Cetindamar (2007), Triebswetter and Wackerbauer (2008), Yalabik and Fairchild (2011)

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Collaborating cross-functionally	Predisposition culturally towards collaboration	Gonzalez-Benito (2008), Hallstedt et al. (2010), Albino et al. (2012)
	Integrating R&D, production and marketing	Pujari et al. (2003), Pujari et al. (2004), Pujari (2006)
	Integrating with stakeholders (suppliers, environment specialists, universities etc.)	Byrne and Polonsky (2001), Jos and Jabbour (2008), CarrilloHermosilla et al. (2010), Aschehoug et al. (2012), De Marchi (2012), Jabbour et al. (2012)
Innovation oriented learning	Eliminating cultural barriers	Eder (2003), Jamali (2006), Battisti (2008)
	Developing a set of green competences (creativity, leader proactivity, and experimentation)	Chen (2007, 2008), Arago'n-Correa et al. (2008), Hallstedt et al. (2010), Chen and Chang (2012)
	Developing critical reflective analysis capability	Jos and Jabbour (2008), Arevalo (2010)
Investing in R&D	Investing in cleaner technology research	Porter and Linder (1995), Hemel and Cramer (2002), Horbach (2008)
	Investing in methods for sustainable product development	Hemel and Cramer (2002), Montalvo (2003, 2008), Horbach (2008), Boons and Wagner (2009)
	Investing in basic R&D infrastructure	Montalvo (2003, 2008), Testa et al. (2011), Horbach et al. (2012)
	Investing in qualified employees	Montalvo (2003, 2008), Zailani et al. (2012)

Resource: Janine Fleith de Medeiros, Gabriel Vidor, & Jose' Lu's Duarte Ribeiro (2018), "Driving factors for the success of the green innovation market: A relationship system proposal", *Journal of Business Ethics*, 147, p. 329.

Design, materials, recyclability, reusability, packaging and labeling of current and new products, products using less energy, materials and resources in the development and design stages are some important issues (Chen et al., 2006; Chen, 2008) whereas the ease of recycling products at the end of their lives, the use of non-toxic materials (Chiou et

al., 2011) and environmentally friendly packaging (Wong et al., 2012) are other important issues (Tang et al, 2018, p. 43) for green innovation.

3. Consequences of Green Innovation

Companies want to achieve green innovation for its consequences, mainly benefits for themselves and their stakeholders. If companies achieve successful green innovation practices, they can improve their business practices, processes and performances. They can also make contributions to their stakeholders and the World. Natural resources are diminishing in the World and companies can decelerate this process by conducting green innovation practices. Also, they can decrease their costs and increase their efficiencies as well.

Green management focuses on how green practices influence organizational profitability and competitiveness (Banerjee, 2002; Pane Haden et al., 2009). Companies can initiate green innovation based on green product and process innovation. Companies which have environmental concerns can consider green innovation as a business opportunity (Zhu et al., 2012; Bocken et al., 2014) (Huang and Li, 2017, p. 310).

Scholars started to discuss green innovation in the late 1990s. It presents a shift from current production technologies to innovate products and processes to line up with environmental regulations and environmental, economic, and social considerations to improve long-term production and reach sustainable industrial development (Cleff and Rennings, 1999; OECD, 2009). Many studies explored development and performance of green innovation management (Chiou et al., 2011). Green innovation leads companies to gain incentives from using natural resources and assets, increasing productivity, reducing pollution, energy consumption and waste (Cheng et al., 2014), and improving corporate image, competitive advantages and long-term profitability (Porter and Van der Linde, 1995; OECD, 2009) (Tantayanubutr and Panjakajornsak, 2017, p. 195).

There are three studies related to managerial environmental concern (Eiadat et al., 2008; Qi et al., 2010; Ar, 2012). They consider centrality of environmental innovation to a company strategy and perceive its importance and effectiveness to achieve strategic goals (Tang et al, 2018, p. 44).

Environmental performance can improve through implementing eco design during manufacturing (Diabat and Govindan, 2011). The main purpose of eco design is to recover investment by reusing products repeatedly. It will decrease remanufacturing costs and wastage. Thus, eco design affects environmental and economic performances. Customers prefer eco-friendly designs as well (Miroshnychenko et al., 2017) (Shafique, Asghar and Rahman, 2017, p. 96).

The integration of green concept into product design and packaging can enhance product quality and product differentiation advantages (Chen et al., 2006; Chen, 2008; Hillestad et al., 2010) (Huang and Li, 2017, p. 310).

Technological environmentally friendly innovation is socially acceptable interms of environmental sustainability and may enhance company performance. Green innovation may enhance product quality. Products become more efficient in the energy use and cost, need shorter time for product development (Boonkanit and Kengpol, 2010) (Handayani, Wahyudi, and Suharnomo, 2017, p. 154).

Chen (2008) highlights that if companies pioneer in green innovation, they can have first mover advantages and charge higher prices for their green products. Also, green innovation enhances corporate image (Huang and Li, 2017, p. 315).

Companies can increase economic efficiency and decrease production costs by applying environmental practices such as reusing materials, reducing energy consumption, and redefining production and operation processes (Zhu and Sarkis, 2004; Huang and Wu, 2010; Dong et al., 2014) (Huang and Li, 2017, p. 310).

Continuous and endless innovation is the sole option for companies to invent, adopt and implement new procedures. Innovation can reduce institutional pressure directed from competitors and customers to improve company performance (Porter van der Linde, 1995) (Shafique, Asghar and Rahman, 2017, pp. 92-93).

Managers should realize the importance of green innovation and engage in green innovation practices. Corporate commitment to environmental issues focuses on this and enhances environmental concern of management which has a positive impact on company performance (Pipatprapa et al., 2017). The relevance of environmental concern of management enhances positive impact of innovation on performance. By making the environment a relevant concern for management, companies can promote green innovation as a means to improve performance (Tang et al, 2018, p. 48).

Companies can adopt green innovation based on green product and process innovation to improve their performances (Chiou et al., 2011) (Shafique, Asghar and Rahman, 2017, p. 98).

Companies can adopt proactive green innovation strategies to merge ecological protection goals with economic performance (Chen et al., 2006; Janicke, 2008; Zhu et al., 2012) (Huang and Li, 2017, p. 315).

Cheng and Shiu (2012) pointed out that green product and process innovation improved corporate environmental performance. Green process innovation influences environmental performance more significantly by improving organizational confidence to disclose carbon information. Green product innovation creates more competitive advantages in the financial performance (Rennings, 1998) and enhances financial performance (González-Benito and González-Benito, 2005) (Li et al., 2018, p. 1101).

Green product innovation lets companies respond to environmental needs of governments and markets to enhance resource effectiveness to optimize environmental benefits in a product life cycle (Chiou et al., 2011; Dong et al., 2014). Green process innovation requires to decrease pollutant emissions and clean production costs to comply with environmental regulations (Chiou et al., 2011; Dong et al., 2014). Companies aiming to decrease environmental costs make efforts toward green innovation to increase productivity and minimize production waste (Huang and Wu, 2010; Chiou et al., 2011). Companies which practice green innovation can avoid punishments and protests from government regulators and satisfy environmental protection requirements (Chen, 2008; Zhu et al., 2008; Chang, 2011). Green product and process innovation are positively related to environmental performance because of that (Huang and Wu, 2010; Chiou et al., 2011; Dong et al., 2014) (Huang and Li, 2017, p. 315).

Green innovation decreases institutional pressure and improves environmental and economic performances (Lee Min, 2015). Product innovation, process innovation and managerial innovation are three types of green innovation which are interlinked and equally important in companies (Li et al., 2017). Companies face environmental pressure from competitors, suppliers, customers, and regulatory bodies (Fikru, 2016) to formulate strategies to apply higher standards to improve their performances and gain competitive advantages (Weerakkody et al., 2016) (Shafique, Asghar and Rahman, 2017, p. 93).

Chang (2011) shows that there is positive relationship between green innovation and competitive advantage. Chiou et al. (2011) add that green innovation can enhance competitive advantages and environmental performance. Huang and Wu (2010) find that high-tech companies can develop green product and process innovation to convert their products and operations more environmentally efficient. Green innovation has a positive effect on financial performance (Huang and Li, 2017, p. 315).

4. Conclusion

Antecedents and consequences of green innovation are main motivators and contributions of companies. As it is reviewed, green innovation practices should be enhanced for sustainability and profitability of companies and leave a more livable World to new generations. Although, it requires substantial investments and efforts, companies should conduct green innovation to satisfy their stakeholders, have more responsible presence and play leadership roles in their sectors. When the number of sensitive stakeholders increases, companies will feel more responsible to protect the World via green innovation practices. Green innovation efforts will yield to higher performance and chance for long term survival of companies as well.

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