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THE EFFECTS OF GREEN PRODUCT INNOVATION AND GREEN PROCESS INNOVATION ON COMPANY PERFORMANCE

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Abstract

This paper aims to investigate effects of green product innovation and green process innovation on the performances of companies. It presents in-depth interviews with Alarko Carrier A.Ş. and Cenal Elektrik Üretim A.Ş. which are companies of Alarko Holding in Turkey. Alarko Carrier A.Ş. produces, sells, exports, imports, makes marketing activities and after sales services of cooling, heating and water pressurization systems. Cenal Elektrik Üretim A.Ş. is an electric plant which produces electricity from coal by conducting environmentally friendly innovation activities in their business processes. The in-depth interviews were conducted with middle level managers from these companies to find out their green product innovation and green process innovation practices and their effects on their company performances. It is found out that these companies have corporate cultures supporting their green product innovation and green process innovation practices which affect their financial performance and stakeholder performance. Additional in-depth interviews can be conducted with companies from other sectors for further studies.

Keywords: *Green Product Innovation; Green Process Innovation; Company Performance*

1. Introduction

Green product innovation and green process innovation are becoming more important for company performance. Although numerous studies have focused on this issue in the World, there are limited number of studies in Turkey. This paper aims to investigate effects of green product innovation and green process innovation on the performances of companies. In-depth interviews were conducted to measure the effects of green product innovation and green process innovation practices on the company performances of Alarko Carrier A.Ş. and Cenal Elektrik Üretim A.Ş in Turkey.

The sections of this paper are as follows: (1) the concept of green product innovation; (2) the concept of green process innovation; (3) company performance; (4) the effects of green product innovation and green process innovation on company performance; (5) in-dept interviews with Alarko Carrier A.Ş. and Cenal Elektrik Üretim A.Ş.

Environmental legitimacy pressure leads companies use all of their resources, enhance production processes, recycle wastes, and minimize energy usage (Li et al., 2018, p. 1092).

Green product innovation is essential for sustainability of a company (Song et al., 2020, p. 224).

2. The Concept of Green Product Innovation

Conducting green product innovation practices is a relatively new approach for companies. Improvement of environmental awarenesses among stakeholders lead companies to conduct greem product innovation to have competitive advantages and reach high performances by gaining the support of their stakeholders.

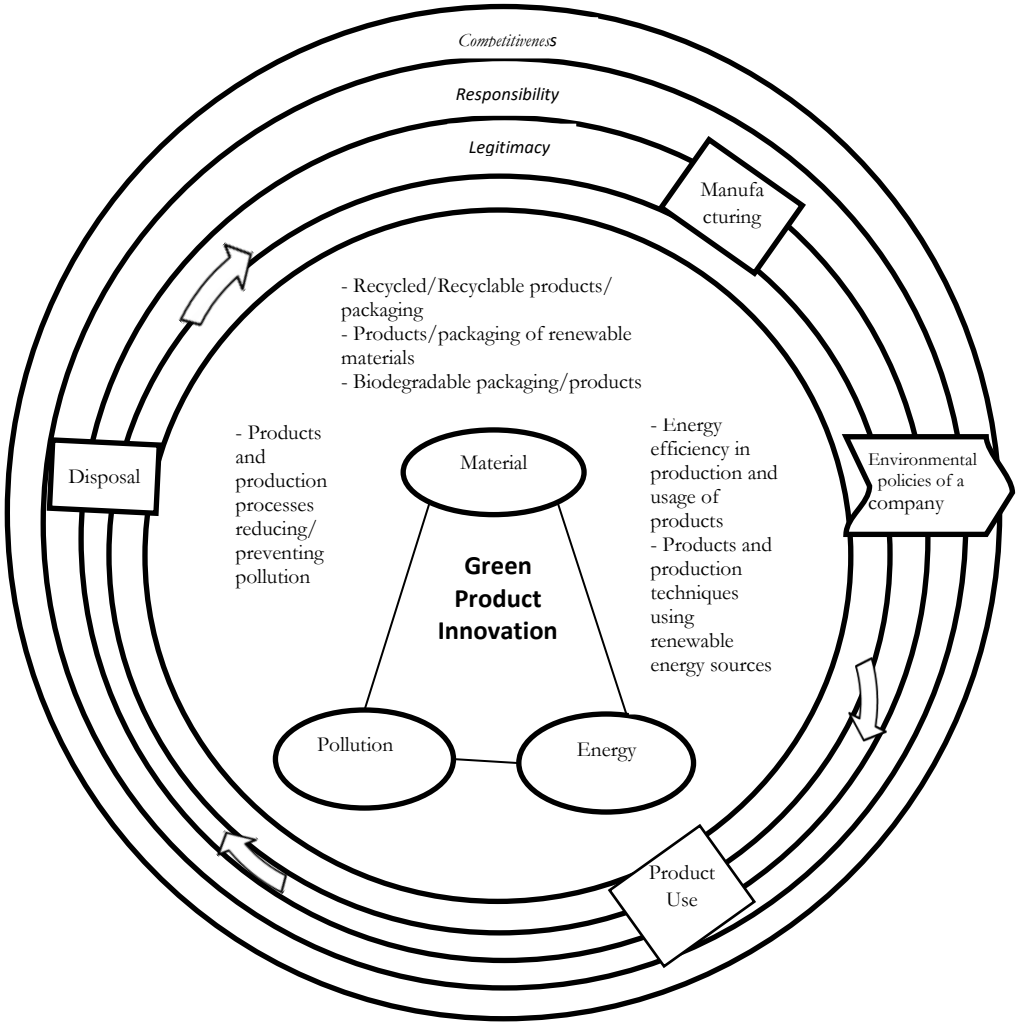

Figure 1. A Conceptual Framework for Green Product Innovation

Reference: The figure was adapted from R. M. Dangelico and D. Pujari (2010). Mainstreaming green product innovation: Why and how companies integrate environmental sustainability. *Journal of Business Ethics, 95*, p. 472. doi:10.1007/s10551-010-0434-0

As observed in Figure 1, green product innovation has multiple processes where energy, material, and pollution-are highlighted based on the effect of the environment at different product life cycle stages-manufacturing process, product use, and disposal. Radical green innovation introduction in the stages of product's life cycle addresses dimensions such as pollution prevention, energy use, and material selection which may create product competitiveness and differentiation for products. Introducing innovation will need an improved level of corporate environmental responsibility and sustained level of the organizational environmental policy implementation to convert green product ideas into practices and get rid of risks and challenges (Dangelico and Pujari, 2010, p. 472).

Green product innovation is the application of innovative ideas which lead to the design, production and marketing of new products whose greenness and newness outperform competitive products (Baumann, Boons and Bragd, 2002; Soylu and Dumville, 2011; Wagner, 2009) (Wong, 2012, p. 471).

Green product innovation protects the natural environment and makes contributions to environmental benefits more than competitive products (Reinhardt, 1998) (Lin, 2013, pp. 101-103). Since, environmental concerns has become more important in the business world, green product innovation has been crucial among manufacturing companies. Many companies make investments in sustainability initiatives for risk mitigation, cost savings, and revenue generation (http://fortune.com/2015/08/27/green-giants-freya-williams/) (Dangelico et al., 2017, p. 491).

3. The Concept of Green Process Innovation

An essential mission of green process innovation is performing organizational processes in a environmentally friendly manner not to harm the nature. If a company aims to apply green process innovation, it has to redesign its production infrastructure compatible to conduct green innovation practices. Its machineries, materials, supply chain choices, waste disposal systems and other infrastructure systems should facilitate its green process innovation practices.

Companies conduct green process innovation in their production processes to decrease production time and costs (Lambertini and Mantovani, 2009) (Calza et al., 2017, p. 1303).

Green process innovation requires reorganizing manufacturing processes of companies to develop new products or improve the current ones. The management approach of the company and its manufacturing facilities should be updated to implement green process innovation effectively. Green process innovation is the enhancement of current manufacturing processes and use of environmentally friendly technologies to manufacture products and provide services which have reduced or no negative effects on the environment (Wong et al., 2012) (Tang et al, 2018, pp. 40-41).

Green process innovation focuses on implemention of new and innovative processes to reach goals. The green process innovation focuses on processes for saving energy during manufacturing and other processes (Dai and Zhang, 2017). Green process innovation leads companies to recycle their wastes to protect the environment. Implementing green process innovation decreases waste and toxic materials (Geffen and Rothenberg, 2000). It affects economic and environmental performances because less waste decreases production costs (Jakobsen and Clausen, 2016). Green process innovation affects organizational performance through these aspects: (1) Companies should adopt green process during production. Companies should reduce toxic material emmission during production (Lee and Min, 2015); (2) Companies should reuse and recycle their products to decrease waste and emmission of hazard (Chen et al., 2006); (3) Companies should consume less water, electricity, and oil and coal resources (Jakobsen and Clausen, 2016); (4) Companies should develop policies to decrease raw materials during production. Companies can adopt green process innovation to improve their organizational performances by implementing these four factors (Zailani et al., 2015) (Shafique et al., 2017, p. 98).

Green process innovation highlights ability of companies to enhance current processes and develop new processes for saving energy, preventing pollution, leaving less toxicity and recycling waste in innovation processes (Chen et al., 2006; Chen, 2008; Huang and Li, 2017, pp. 311-316) (Karabulut, 2019, p. 187).

4. Company Performance

Green product innovation and green process innovation practices have effects on company performance especially on financial performance and stakeholder performance. If a company conducts green innovation practices, its financial performance and stakeholder performance increase.

Performance is a flexible and continuous process which involves managers and managing partners within a framework which shows how they should work together to achieve the expected results (Armstrong, 2006). Performance is an activity endresult which includes outcomes of the strategic management process. The strategic management practices are adjusted in terms of their ability to enhance performance of the company (Wheelen and Hunger, 2010) (Agha et al., 2012, p. 195).

Company performance is determined by how efficiently and effectively the business strategy of the company is implemented (Galbraith and Kazanjian, 1986; Walker and Ruekert, 1987) (Olson et al., 2005, p. 49).

There are several critrias of enterprise performance measurement namely financial performance, non-financial performance, quantitative performance, qualitative performance (Bemowski and Stratton, 1995; Coulambidou and Dale, 1995; Conti, 1997; Lascelles and Peacock, 1996; Hakes, 1998) (Chin et al., 2003, p. 443).
IAI (2007) claims that financial performance is the organizational ability to manage and control its resources. Financial statement analysis using financial ratios measure financial performance. Harahap (2008, p. 303) states that performance achievement measurement results are the basis for improving performance in the following period and be used for punishment and reward (Mahrani and Soewarno, 2018, p. 43).
Stakeholders are instruments affecting corporate ecological responsiveness (Bansal and Roth, 2000, 717-736) and environmental strategies (Neu, Warsame, and Pedwell, 1998, pp. 265-282; Buysse and Verbeke, 2003, pp. 453-470). The government, pressures of competitors and employee affect green innovation practices positively and significantly if government, employees, suppliers competitors, and customers are considered as stakeholders. Companies should adopt environmental management issues while they are formulating company strategies, setting company structures and rules, offering training courses, etc. It is essential for companies to provide clear guidelines and appropriate monitoring mechanisms for their employees (Weng et. al., 2015, pp. 4999-5019).
Employee performance is what an employee does and what he doesn't do. Employee performance reflects presence at work, quantity and quality of output, accommodative and helpful nature, and timeliness of output. Yang (2008) presented that on individual performance highlighted that employee performance cannot be verified. Altough companies try to satisfy their customers a lot, they don't pay attention to satisfy their employees. However, customers will not be satisfied if employees are satisfied. If employees are satisfied, they will work harders so customers will be satisfied (Ahmad, 2012). Motivation affects employee performance. If employees are motivated, they will work harder and their performances will improve (Azar and Shafighi, 2013) (Shahzadi et. al., 2014, p. 161).

5. The Effects of Green Product Innovation and Green Process Innovation on Company Performance

Green product innovation is product oriented whereas green process innovation is process-oriented, so implementing these innovations will lead a greater organizational competitive advantage to companies which apply both innovation types (Xie et al., 2019, p. 704).
The measurement of green product innovation performance is composed of the following items: (1) the company chooses materials which produce the least amount of pollution for the product design and development; (2) the company chooses materials which consume the least amount of resources and energy for the product design and development; (3) the company uses the smallest amount of materials for the product design and development; (4) the company plans whether its products are easy to reuse, decompose, and recycle for the product design and development (Chen et al., 2006; Chang, 2011) (Chang, 2016, p. 71).
If a company uses environmental technologies, green product innovation performance will be excellent. Companies should focus on environmental management due to environmental pressures (Chen et al., 2006). Companies should focus on effects of stakeholders on their activities to conduct environmental management (Hoffman, 2001; Qi et al., 2013). Green product innovation leads companies to provide awesome green products and reduce environmental effects. Green product innovation can facilitate companies to search green opportunities and to enter into the green emerging market. Green product innovation succeses can create sustainable organizational competitive advantage (Chang, 2016, pp. 68-75).
According to a study conducted on 2181 firms and nine green process innovation types found that two of nine positively affect company performance (Doran and Ryan, 2016). Charlo et al. (2015) reveal that socially responsible companies in Spain have higher profits for the same level of risk. Porter and Van Der Linde's hypothesis points out environmental regulation effects on economic performance and innovation. It highlights that innovation offsets can happen with technological change "partially or more than fully offseting the costs of complying with environmental regulation" (Porter and Van Der Linde, 1995, p. 98) (Tang et al., 2018, p. 41).
Green product innovation leads companies improve their economic performances by finding new markets, conducting product differentiations, increasing sales and improving their competitive advantages and corporate images (Dangelico, 2016; Noci and Verganti, 1999) (Melander, 2017, p. 1096).
From financial performance perspective, when companies increase their resource productivity by doing green innovation, they can have earnings as much as their environmental costs (Porter and Van Der Linde, 1995, pp. 120-

134; De Burgos-Jiménez et all., 2013, pp. 981-1018). On the other hand, when they initiate environmental practices, they can develop new markets and increase their market shares (Chen, Lai, and Wen, 2006, pp. 331-339; Berry and Rondinelli, 1998, pp. 38-50). From non-financial performance perspective, companies can increase the number of new customers, customer loyalty and enhance their reputations and images by doing green innovation practices (Chen, Tsou, and Huang, 2009, pp. 36-55; De Burgos-Jiménez et al., 2013, pp. 981-1018; Blazevic and Lievens, 2004, pp. 374-391). Chen (2008, pp. 531-543; 2008, pp. 271-286) highlighted that companies which play pioneer roles in green innovation will have first-mover advantages in terms of new market opportunities, higher product prices, more competitive advantages and improved corporate images. Reducing environmentally hazardous substances, pollution emissions and waste at the source, including recyclable materials in products and improving energy efficiency reflect environmental performance (Lindell and Karagozoglu, 2001, pp. 38-52; Zhu, 2010, pp. 380-392). According to previous studies, manufacturing process and productivity improvements will enhance environmental performance (Montabon, Sroufe, Narasimhan, 2007, pp. 998-1014). Stakeholders affect choices of German manufacturing companies for environmental response patterns (Murillo-Luna, Garcés-Ayerbe, and Rivera-Torres, 2008, pp. 1225-1240). They are positively related to patented environmental innovations (Wagner, 2007, pp. 1587-1602) (Weng et. al., 2015, pp. 4999-5003).

Table 1. The Effects of Green Product Innovation and Green Process Innovation on Company Performance

Author/ Year	Purpose	Sample	Conclusion
Chen et. al. (2006)	The purpose of this study is to examine the effect of the performance of the green innovation on competitive advantage.	Manufacturing, marketing, R&D, environmental protection department managers of companies in "2003 Business Directory of Taiwan" of Business Express Co., Ltd.	It is found out that the performances of the green product innovation and green process innovation are positively correlated to the competitive advantage.
Lin et al. (2013)	The purpose of this study is to examine market demand effects on green product innovation and company performance in the motorcycle industry. It tries to answer two questions: (a) how does market demand affect a company's green product innovation? and (b) how can green product innovation affect company performance?	208 responses from four leading foreign motorcycle firms in Vietnam.	It is found out that market demand is correlated to green product innovation and company performance; and green product innovation performance is correlated to company performance. It categorizes three types of green product innovation and reveals their effects on market demand and company performance.
Weng at al. (2015)	The main purpose of this study is to examine the moderating effect of green produt innovation and green process innovation on the relationship between stakeholders and environmental performance and company performance. It also tries to discover the moderating effect of innovation orientation in	202 responses from Taiwanese manufacturing and service companies.	It is found out that employee conduct, government and competitor pressures affect green innovation practices. Also, there is a moderating effect of innovation orientation in the relationship between employee conduct and green product innovation practices.

	the relationship between stakeholders and green product innovation and green process innovation.		
Chen et. al. (2016)	This study points out the relationships between proactive and reactive green innovations and green product development performance, and the mediating effect of green creativity.	Members and leaders of green product development projects, managers of manufacturing, R&D, marketing, environmental protection departments of companies in "2003 Business Directory of Taiwan" of Business Express Co., Ltd.	It is found out that proactive green innovation has positive effects on green creativity and green product development performance, and green creativitiy has positive effects on green product development performance. It is also found that green creativity partially mediates the relationship between proactive green innovation and green product development performance.
Chang (2016)	The purposes of this study are to examine the effects of corporate environmental commitment and green human capital on green product innovation performance and to discuss the mediation effect of green adaptive ability.	This study was conducted on 136 of manufacturing companies in Taiwan	It is found out that corporate environmental commitment has positive direct effects on green product innovation performance and positive indirect effects on green adaptive ability.
Xie et. al. (2016)	The purpose of this study is to highlight the effects of green process innovation on the financial performance of manufacturing companies by focusing on the moderating effects of government subsidies versus absorptive capability of industries.	A panel sample of 28 manufacturing industries from 2001 to 2010, and the dynamic panel model based on the literature.	The results reveal that end-of pipe technologies and clean technologies are positively related to financial performance. Strong absorptive capacity enhances this relationship, but green subsidies decrease this relationship.
Chang (2018)	The purposes of this study are to verify the framework to examine the effects of inward and outward capabilities on competitive advantage with green service innovation or green product innovation performance as the mediator and to compare the antecedents of green service innovation or green product innovation performance in service and manufacturing companies.	161 and 202 valid questionnaires were returned from manufacturing and service companies respectively. The sample of manufacturing and service industries in Taiwan from the 2014 Factory Operation Census of Ministry of Economic Affairs.	It is found out that when a company wants to improve its green product innovation performance, it should increase locus of planning and environmental scanning capability in a service industry. On the other hand, when a company wants to improve its green product innovation performance, it should only enhance environmental scanning capability in a manufacturing industry.
Xie et al. (2019)	The purposes of this study are to examine the relationships between green process innovation, green product innovation, and	209 listed companies in heavily polluting manufacturing industries.	It is found out that green process innovation has a positive effect on green product innovation, and green process

	company's financial performance and contingent factors which affect the relationship between green product innovation and company's financial performance.		innovation and green product innovation can increase a company's financial performance. It is also found out that the relationship between green process innovation and financial performance of a company is mediated by green product innovation, and the relationship between green product innovation and financial performance is moderated by green image.

Resource: This table was prepared by authors.

6. In-depth Interviews

Alarko Sanayi ve Ticaret A.Ş. has operations in the fields of cooling, heating, water pressurization, and air conditioning since 1954. It established an equal partnership with Carrier in 1988. This new company is called as Alarko Carrier Sanayi ve Ticaret A.Ş. and improved its technology, increased its foreign market expansion opportunities and competitive advantages (https://www.alarko-carrier.com.tr/tr/kurumsal/genel-bakis/tarihce, 3.8.2020).

Alarko Carrier Sanayi ve Ticaret A.Ş. has 10.800.000 TL registered capital and 16.394.930 TL net profit in 2019. It has 366 white-collar and 240 blue-collar employees (Alarko Carrier Sanayi ve Ticaret A. Ş. Faaliyet Raporu, 2019, p.10, 17 and 27, http://www.intranet.alarko.com.tr/Dosya/yatirimci_iliskileri_pdf/acst_pdf/faaliyet/2019/Alarko%20Carrier%20TR.pdf, 3.6.2020).

Alarko Carrier Sanayi ve Ticaret A.Ş. has the following certificates: ISO 9001 TSE Quality Management System Certificate, ISO 14001 Environmental Management System Certificate, ISO 27001 Information Security Management System Certificate, ISO 50001 Energy Management System Certificate, ISO 45001 Occupational Health and Safety Management System Certificate, SA 8000 Social Responsibility Management System Certificate (https://www.alarko-carrier.com.tr/en/corporate/ company-overview/quality-certificates, 3.7.2020).

Cenal Elektrik Üretim A.Ş. is a jont venture company established by Alarko Holding A.Ş. and Cengiz Holding A.Ş. with equal partnerships in Biga, Çanakkale in 2011. It has 454.518m² facility for a power plant which produces electricity by using imported coal, a pier, an ash storage area and a deep sea discharge project. It has 1320 MW (2X660 MW)/1380 MWm/2926 MWt installed daily electricity production capacity, 7500 hours annual planned operation time and 9.900.000 MWh annual planned electricity production. It plays an important role in meeting Turkey's growing electricity needs. It produces reliable and high quality electricity for an economic growth of the country, creating new business opportunities and increasing GDP per capita (http://www.cenal.com.tr/about.html, 3.4.2020).

Quality, Environment, Energy Efficiency and Occupational Health and Safety (OHS) policy of Cenal Elektrik Üretim A.Ş. within the framework of legal and other requirements is as follows to serve its country and sector and improve its success (http://www.cenal.com.tr/uploads/kcei.pdf, 3.5.2020):

1. To have environmental and occupational safety awareness to prevent pollution at its source in our production and post-production services.
2. Performing high quality, environmentally friendly, standard and timely productions in compliance with the requirements of Quality, Environment, Energy Efficiency and OHS Management System by closely following technological developments and legislations.
3. To eliminate process hazards and determine the quality, environment, energy efficiency and OHS risks to conduct necessary studies to reduce high risks.
4. To consider the energy performance in the design and modification of our production and processes.

5. We are committed to increase awareness of employees and the society in the efficient use of energy and natural resources in our products and processes.

6.1. In-depth Interview with Alarko Carrier Sanayi ve Ticaret A.□.

1. Do you have a green innovation strategy? If you do, is your green innovation strategy consistent to other company strategies?

Although the green innovation strategy is not included in our strategic plan, the principle of green innovation is adopted by our founders and included in our holding philosophy. These principles are included in our company's Ethical Rules and Social Responsibility Guidelines and we work by following them: "To take care of protecting nature in all our activities", "To ensure the prevention of pollution by protecting the natural environment in all our activities, to increase the efficiency by reducing natural waste by controlling the use of natural resources", "Ensuring the use of energy" by monitoring every situation and process, developing projects which reduce its use, increasing productivity by researching alternative sources ".

2. Would you like to talk about green innovation practices of your company?

Our company emphasizes environmental awareness in its activities. Even if green innovation practices increase its costs, it does not compromise from them. It is the member of sectoral associations such as DOSİDER and İSKİD. However, our company does not compromise on environmentally friendly innovation practices even if it increases its costs. Some companies continue to use old technologies for a long time to decrease their costs and increase their sales. However, our company switches to technological improvements earlier because it wants to decrease its energy usage and energy costs, use less energy for our country and reduce environmental harms. When we move to more expensive, more technological and more efficient devices which pollute the environment less, we support the transition to new technology but the market becomes 10-20% smaller. Alarko Carrier Sanayi ve Ticaret A.Ş. is a more environmently conscious company than its competitors. It makes investments in its factory to increase its productivity, energy efficiency and recycled wastes. There is a unit called the Facilities Management which works on cooling and heating of the building, producing water, solid, liquid chemical wastes which comply with environmental regulations. The audit of the activities carried out in Turkey is delayed. Some competitors which do not comply with the environmental regulations in the sector reach unfair high profits, but our company does not compromise on doing activities which comply with the environmental regulations. When the materials used for production exceed their expiry dates, it does not keep them in the stock. If there is a warning that any product will not be produced after a certain date, it will definitely not be produced after that date. As a philosophy, our company does not compromise on complying with environmental regulations. We use materials that do not harm health at all (e.g. machine oil, paint, thinner, etc.). We organized a painting contest across Turkey to increase the environmental awareness about the harms of global climate change. A table calendar was prepared consisting of 13 awarded pictures at the end of the contest. We created a forest themed trade show stand to increase an awareness to climate change. However, we cannot allocate additional marketing budget for our environmental awareness activities. Organizational activities are carried out to use energy efficiently in order to reduce the damage to the environment. The automation systems in our company are designed to be environmentally friendly even the lights are set automatically based on sunlight. In addition, thanks to the sensors, the heating system is adjusted automatically in our factory based on the outside temperatures. Thus, excess energy consumption is prevented. As a company, we have an environmental awareness, but we are modest in this matter and do not present it as a public relations activity.

3. What are the factors which lead your company to green innovation practices?

Our goals are to reduce our energy costs, consume energy of our country consciously, contribute to energy saving and leave a more livable environment to future generations.

4. When and how did you start green innovation practices?

Alarko Carrier Sanayi ve Ticaret A.Ş. has already been doing green innovation practices. We do these practices with the aim of increasing productivity and giving less harm to the environment. However, we did not label and present this under the name of green innovation. Because we perceive an innovation as making something from scratch, but we , but we generally import components from Europe and produce adopted European products for Turkey and export market. However, we are pioneer to produce these products in Turkey.

5. What are the effects of green innovation practices on your company performance?

There are applications in our facility which provide more efficient and faster production and shipment, especially in manufacturing. These applications which are called "5S" are similar to Japanese Kanban. Reporting scores are

checked at meetings held in certain periods. Important issues are paid attention such as waste reduction. Carrier has studies which are based on two pillars about them. One of the pillar is products. Studies in the field of energy efficiency are carried out due to regulations in product pressures for water pressurization products. Circulation pumps have started to be produced with high energy class. A huge investment which was millions dollars was made for water pressurization product category. Our company is the only producer for high energy class pumps in Turkey. We are working very hard with our dealers to convert current pumps into high efficiency pumps. We give training to our dealers about energy saving. We are the leader in energy-saving products in the water pressurization sector in Turkey. Alarko Carrier has a brand awareness in the boiler sector, but we are not a market leader because cheaper products are generally sold more than our high quality and specification products and cheaper product manufacturers unfortunately have higher market shares. However, our company never ceases to add the most efficient and environmentally friendly products to its product range and pioneer in this. Even if we can not reach a higher market share. Nevertheless, our company launched a high condensing combi boiler which was a very risky project and required a large amount of investment. Its sales expectations were not estimated but our company took a risk to make this investment. Although, some European manufacturers produce higher quality and more expensive products in their countries, they don't always launch them in Turkish market. First, they launch medium quality products in Turkish market and want to launch higher quality products gradually. But Alarko Carrier always launches higher quality products to Turkish market although we are not the market leader. These products have not reached higher sales figures yet. For example, our company achieved to produce double condensing boiler which requires innovation and has the best hot water efficiency in a boiler system. We demonstrated this achievement in advertising campaigns and magazine articles. Some important European manufacturers have launched the same products to Turkish market after we launched. We were making an advertising as "we have the first and the only double condensing combination boiler in Turkey". This example shows us although we are not the leader of sales in the market, we are the leader of innovation and environmentalism.

6. Which products do you manufacture? Which products do you import?

Alarko Carrier A.Ş. produces and outsources its products. If we are looking at the partnership's structure, Alarko Holding A.Ş has 42%, Carrier HVACR Investments B.V. has 42% share and 16% of the share is publicly traded in the stock exchange. Alarko Holding A.Ş. has a heating and water group, and Carrier HVACR Investments B.V. has individual and central air conditioning products. Additionally, Toshiba is a Carrier HVACR Investments B.V. brand. If a product is innovative, requires advanced technology and is not suitable for manufacturing in the factories of Alarko Holding A.Ş and Carrier HVACR Investments B.V., we buy it from Turkey or abroad. If Turkey has these products, we provide it from our country. Shortly, we are outsourcing production from both Turkey and abroad but our priority is outsourcing production from Turkey. Our outsourced products mostly include the side equipment of the heating devices, expansion tank, domestic hot water tank, and radiator valve. For example, our company produces panel radiator but it outsources the radiator valve. Likewise, we produce condensing boiler, but outsource hydraulic header, domestic hot water tank and expansion vessel which are used in condensing boiler systems and boiler rooms. We generally prefer outsourcing hauxiliarry heating equipments from Turkey because there are many important Turkish high quality heating equipment manufacturers in Turkey. However, we prefer China for outsourcing the water group support products.

6.2. In-depth Interview with Cenal Elektrik Üretim A.□.

1. Do you have a green innovation strategy? If you do, is your green innovation strategy consistent to other company strategies?

Our company does not have a green innovation strategy but there are green innovation practices in the company processes. The main goal of our company is to use the most efficient and the best techniques in the world and to search the better alternatives. We have a responsibility to be an example for our industry. However, we are conscious to prioritize human health and environmental protection. Thus, we do high cost innovations even if it contradicts with our economic survival expectations.

2. Would you like to talk about green innovation practices of your company?

Cenal Elektrik Üretim A.Ş. generates electricity as its main product due its organizational structure. The main input of our production is coal. From this point of view, our company has environmental awareness to carry out the production stages to convert coal to the electricity without harming the environment. Coal-fired power plant management has several globally standardized practices. It is not easy not to apply these standards for economic reasons and competitiveness. However, when it comes to environmental sensitivity, Cenal Elektrik Üretim A.Ş. can apply these standards to have innovative and feasible systems. It has reflected this approach in the design phase of its new facility. Our company has made environmental investments and created series of precautions starting from the design stage to make contributions for a livable world for tomorrow. The Cenal Elektrik Üretim A.Ş. is the first and only ultra-supercritical coal-fired power plant of Turkey. Shortly, Cenal Elektrik Üretim A.Ş. has the most efficient power plant model which can convert coal sources into energy. This results less fuel consumption and waste creation in equivalent energy production compared to other power plants. The chosen boiler type provides high-efficiency combustion and minimizes the waste gases with its infrastructure. The company can use its resources most efficiently at the maximum level by designing generator systems which can produce electricity from cooled steam. It can utilize the used steam for a longer time by recycling and reheating in the system. All of the coal lines in the power plant are designed closed to the atmosphere. Thus, resource loss and environmental impacts are reduced. Apart from this, the coal dust generated by dust collectors located at 54 different points along all production lines is collected and re-included in the system. This practice is important in terms of reducing the environmental impact of resources and using resources efficiently. Our company has Sea Water Sulfur Removal System (Seawater Flue Gas Desulfurization). This system exists in one more company in Turkey and few companies in the world. Although the investment cost is higher; flue gas treatment applications are preferred by our company because of their high SO2 retention efficiency, lower waste generation (almost zero waste) and sustainable environmental effects. Electrostatic filters with the capacity to hold the ash in the flue gas 99.9% are planned and put into practice in the plant design. All ash transfer lines are pneumatic and closed to the atmosphere. Thus, almost all of the ash in the flue gas is kept in the system and its effects in the atmosphere are prevented. Ash is not a waste, it is a byproduct in our power plant. We have not sent ash waste to ash storage areas for 1.5 years. The entire ash released as a result of the activities at the power plant is sold to domestic and international markets as a byproduct. Additionally, the efficiency of all these systems is monitored and controlled continuously (7/24).

3. What are the factors which lead your company to green innovation practices?

Cenal Elektrik Üretim A.Ş. believes in the importance of being in a better tomorrow fiction and taking the right steps for tomorrow. It tries to be a positive example in its sector by trying to use the technological infrastructure at the highest level while doing this. Energy is an essential need for the modern and livable world in the future. Main motivations of our company are to produce an energy which is the raw material of the future and establish the optimum balance in reducing environmental impacts for a sustainable and livable world. Our company works with the desire to stay one step ahead of other sectoral stakeholders in terms of environmental sensitivities.

4. When and how did you start green innovation practices?

Cenal Elektrik Üretim A.Ş. tries to be the cleanest and the most efficient power plant especially in the project design and production processes for motivating group companies to prefer the most technological value added products and reflect their environmental sensitivity and deep-rooted history to the future. This process starts from the plant design stage. Being one of the newest plant affects this as well. It will not be economically sustainable to keep the entire system up-to-date, most efficient and environmentally friendly all the time in the power plants which have been operating for many years.

5. What were your expectations from green innovation practices? What kind of results did you get?

The basis for taking environmentally friendly approaches is to reduce the total amount of waste as much as possible in our company. Not generating waste is naturally possible by using the resources efficiently. Main goal of our company is owning the high efficieny and low waste generating power plant. We progress as we planned so far. We would like to be in the right position in terms of environmental responsibilities to the national legal authorities. There are debates in our sector that many power plants don't have flue gas emission systems or don't operate them properly. Our company operates in 1/5th of 1/10th of the legal limits in national flue gas emission parameters permitted by national legislations. The reasons for this are our ability to work at such a low level of the atmosphere emission values for our sector and our efficient and environmentalist ideas which we never compromised starting from the design stage. Cenal Elektrik Üretim A.Ş. is happy with the results received from its practices in order to

become a sustainable business. However, it will not hesitate to take steps when opportunities exist to improve its performance in the future.

6. What are the effects of green innovation practices on your company performance?

Green innovation practices positively affected Cenal Elektrik Üretim A.Ş. When it is aimed to use the limited world resources, every step is planned accordingly. Environmentalist approaches are realized spontaneously when operations are achieved successfully. The most accurate operations can be achieved with the most effective management of resources. The highest profitability is obtained when resources are used efficiently with the least loss and waste level. As a result of our operations, ash is released. Most of our competitors stock this ash as waste in huge dam structures. We made it a byproduct to sell to the world. But of course this did not happen in one day. In order to achieve this, many issues are effectively designed, from choosing the right boiler in the operations to using the flue gas treatment systems efficiently. R&D and investment costs for each innovation decreases profits. However, being a pioneer, producing high quality products, creating a positive corporate image in our environment increases motivations of our employees and stakeholders. When we evaluate our total earnings, innovation creates value-added and profits to our company. Most of our employees are residents of this region. Residents of this region had negative ideas about our company at the beginning due to the media and their previous power plant experiences. However, employees experiencing our environmental sensitivity and residents in this region have better impressions about company now. There is also a positive trend towards NGOs' reactions. We owe these to our production models which respect the nature. Our practices contribute to have a positive impression on legal authorities as well. We can comply legislations for permissions and licencing processes earlier than permitted periods. Positive and encouraging feedbacks from legal authorities about our practices after they get briefs during company visits and when they conduct company controls become sources of our motivation. Cenal Elektrik Üretim A.Ş. aims to set an example of a good environmental practice in a heavy industry sector. We are pleased to create a conviction in the minds of our social, official and individual visitors that "This work could be done so clean and environmentally friendly". We think that our stakeholders are also satisfied with the positive feedback they receive about us.

7. Would you like the conduct other green innovation practices in the future?

We are satisfied with Cenal Elektrik Üretim A.Ş.'s image, performance and sustainable resource management. We will not hesitate to follow the new world in which technologies and innovative approaches will evolve in the future. As we mentioned at the beginning, coal-fired power plant management includes globally standardized practices. We will continue to push the limits of these standards just we do today.

7. Conclusion

As it is learned from indepth interviews of Alarko Carrier Sanayi ve Ticaret A.Ş., although it does not have a green innovation strategy, it conducts both green product innovation and green process innovation activies. The company has an environmental awareness. Thus, it complies to environmental regulations, reduces its energy costs, consumes energy of our country consciously and contributes to energy savings. It uses environmentally friendly raw materials, applies environmentally friendly processes and manufactures environmentally friendly products to satisfy its stakeholders. On the other hand, although Cenal Elektrik Üretim A.Ş. does not have a green innovation strategy, it conducts green process innovation activies. It uses the highest technologies to comply with environmental regulations, inceases efficiency and productivity and decreases energy usage, costs and wastes. Employees and other stakeholders of this company are satisfied with its environmental sensitivity. As a result of both in-depth interviews, it is found out that these companies have corporate cultures supporting their green product innovation and green process innovation practices which affect their financial performance and stakeholder performance. Additional in-depth interviews can be conducted with companies from the same sectors and other sectors for further studies.

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