

The Impact of Knowledge Sharing on Green Innovation in Jordanian Industrial Firms

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This study primarily aimed to investigate green innovation in the context of industrial firms in Jordan, and to empirically examine the effects of knowledge sharing dimensions of knowledge donating, and knowledge collecting on green innovation. Accordingly, the data was collected through the use of a questionnaire survey distributed to 357 managers of industrial firms in Jordan, particularly those located in Zarqa City. From the 357 questionnaire surveys distributed, 190 were retrieved and deemed usable for analysis. The data analysis was conducted using IBM SPSS Statistics 20 and was based on the obtained findings; knowledge sharing has a positive and significant relationship with green innovation. However, the knowledge donating dimension of knowledge sharing was found to have an insignificant effect on green innovation. Based on these results, the researcher recommends that industrial firms in Jordan concentrate on the dimensions examined in this study, so that their green innovation culture is promoted, and green innovation practice is enhanced.

Keywords: *Green innovation, Innovation, Knowledge sharing, Jordan.*

Introduction

In recent times, global and local concerns of the environment have experienced an upward trend, and in a way that companies have gone out of their way to meet their social responsibilities in terms of environmental conservation. Aligned with the global call for the realisation of a green economy, and the increasing environmental challenges ever present, companies have no recourse but to meet such responsibilities (Hou, Chen & Xu, 2017). Many firms inclined towards innovation were also barred from certain business operations because of environmental protection issues (Chen, Lai & Wen, 2006). In other words, green

innovation has become one of the top factors affecting environmental sustainability, and life welfare enhancements (Aguilera-Caracuel & Ortiz-de-Mandojana, 2013). Added to this, the countries' policies relating to manufacturing industries are geared towards the adoption of green innovation through the creation of products and processes that are environmentally friend, energy saving, pollution resistant, energy consumption mitigating, and largely dependent on renewable energy sources (Aguilera-Caracuel et al., 2013; Hou et al., 2017).

In the above background, knowledge holds the key to the performance of ongoing innovation as the two (knowledge and innovation) are interconnected (Liao, Fei & Chen, 2007). Hence, companies green innovation should employ knowledge sharing, particularly because ineffective research and development, the weak adoption of new knowledge and technology among managers and employees, and the weak legal environment and government requirements must all be addressed to promote green innovation (Hou et al., 2017; Ritala, Olander, Michailova & Husted, 2015; Yesil, Koska & Buyukbese, 2013).

In this line of study, empirical works are still few and far between, particularly those concerning knowledge sharing and green innovation to bring about an accurate description of the effects. A majority of prior studies in literature have reported a positive and significant relationship between knowledge and innovation (e.g., Al-Husseini & Elbeltagi, 2018; Hou et al., 2017; Liao et al., 2007; Lin, 2007; Omoush, 2018; Ritala et al., 2015; Siregar, Suryana, Ahman & Senen, 2019; Yesil et al., 2013). It is notable that knowledge sharing in the context of green innovation is unique from other types of innovation, as manufacturers satisfaction of the environmental regulations, as well as green expectations in their business production and final markets, is called for (Wong, 2013). A review of literature indicates that empirical works are still limited when it comes to tackling the knowledge sharing, and green innovation relationship (Abbas & Sagsan, 2019; Ryszko, 2016; Wang & Wang, 2012; Wong, 2013). Thus, the present study attempts to fill in the gap in literature, and provide significant contributions.

Similar to other developing countries, Jordan is still riddled by several environmental issues, with recent events indicating that the Jordanian Government passed the National Green Growth Plan for Jordan (NGGP) (Ministry of Environment, 2017), evidencing the commitment of the country to transform into a green economy, building on the Jordan National Vision 2025, and its sustainable achievement. The NGGP illustrated that the major keys to achieving the green growth initiative involve the use of local knowledge of the natural resources, and ecosystem services in an efficient way; the motivation of private and public investment in low-flexible infrastructure in a carbon climate; the adoption of mixed policies and incentives to change the patterns of production and consumption; and the promotion of investment in innovation technologies and business models by the private sector (Ministry of Environment, 2017).

In cognisance of its invaluable resources, Jordan proceeded to delve into clean energy and green investments, as new methods to promote the development of the economy, provide green job positions, and maintain natural resources availability. In fact, Jordan is the first MENA country to carry out a national green economy, highlighting opportunities to initiate green initiatives, such as renewable energy and energy efficiency, management of water and water-waste, solid waste, green buildings, and transportation and eco-tourism, among others. Nevertheless, the possibility of mainstreaming the potential of the green economy is still curtailed in the abovementioned sectors. Although, Jordanian firms have begun focussing on green innovation in earnest, reflected through their practices and top management strategies (Alhadid & As'ad, 2014). In this regard, it is pertinent for Jordanian firms to commit to international standards, and environmental agreements that are centred on providing green products, and although the country lacks energy sources, and is facing high pollution, there is a need for companies to adopt new innovative policies.

A review of literature shows the lack of empirical works dedicated to examining the knowledge sharing, and green innovation relationship. Thus, the present study contributes to literature by explaining the green innovation ways that can be adopted in Jordan. The study has implications to both scholar, and practitioner circles, concerning the ways to heighten the green innovation level in the country, particularly in manufacturing firms.

Literature Review

Green Innovation

Generally speaking, companies have been driven by environmental challenges to adopt dire changes to their products and processes via green innovation. In Kucukoglu and Pinar's (2015) study, the authors defined green innovation as innovation that mitigates environmental effects of the company, in terms of re-use and recycle, solving environmental issues in terms of the mitigation of hazardous components use, and developing environmental friendly and/or effective products and processes through less resources and use of energy.

On a similar note, Abbas and Sagsan (2019) referred to green innovation as the firms' way to eliminate or mitigate the negative impact of their operations on the environment. Meanwhile, Hou et al. (2017) described the concept as the innovation that paves the way to pollution minimisation, resource saving, and environmental enhancement with ecological, as well as economic advantages, promoting sustainable development and enhancing the enterprises' competitiveness level. On the other hand, Wong (2013) focussed on explaining the adverse effect on the environment or human hazard stemming from product raw material extraction, and the use of energy, and pollution in the life cycle of the product (usable life and final

disposal). Also, green innovation was likened to green patents that can be registered according to Caracuel et al. (2013).

A green innovation measurement within firms was the objective behind Chen et al.'s (2006) study, and they mentioned green product innovation and green process innovation, consisting of hardware or software innovation that is employed in green products or processes, with the inclusion of technological innovation that brings about saving energy, preventing pollution, recycling wastage, green product design or the management of corporate environmental units. Prior studies also provided ample discussions on the green innovation concept, which can be classified into product green innovation, and process green innovation (see Abbas & Sagsan, 2019; Alhadid & As'ad, 2014; Bernauer, Kammerer & Seijas, 2006; Chen et al., 2006; Ibrahim & Talibe, 2018; Khazaaal & Dheaab, 2019; Kucukoglu & Pinar, 2015; Seng, Wang, Chiu, Geng & Lin, 2013; Tang, Walsh, Lerner, Fitza & Li, 2018; Wong, 2013).

Furthermore, green product innovation is useful in promoting environmental management performance to achieve environmental protection needs (Chen et al., 2006), and to mitigate environmental impacts during the life cycle of the product (Bernauer et al., 2006). Other studies like Seng et al. (2013) focussed on the customers' needs through a new green product competitiveness level. In other words, firms attempt at creating new products that employ lower energy levels, less materials, and less resources in designing and developing them, as this is a feasible way to achieve green products (Tang et al., 2006). This could involve product recycling at the end of the product life, using non-toxic materials and environmentally friendly packaging.

In other related studies, green process innovations were described as those bringing enhancements to production processes, whereby raw material is transformed into a useable product (Abbas & Sagsan, 2019), and as the use of environmentally friendly technologies and manufacturing processes for the generation of goods, and provision of services imposing no/less adverse effects on the environment, and the people living within it (Wong, 2013).

There are three conditions established by Alhadid and As'Ad (2014) for green process innovation and they are: 1) the effective reduction of hazardous substances or waste in the manufacturing process; 2) the reduction of the water, electricity, coal, and oil consumption in the manufacturing process; and 3) the reduction of raw materials use in the manufacturing process.

The present study adopts a unidimensional concept of green innovation, which is based on the prior literature combination of the overall outcome of green product or process innovation, as this is more appropriate to the study context and setting.

Knowledge Sharing

According to the resource-based view of the firm, knowledge is the top strategic resource (Van den Hooff & Leeuw van Weenen, 2004). Therefore, knowledge sharing among employees is quite crucial. In the same line of study, Al-Husseini and Elbeltagi (2018) related that daily interaction among employees develops new knowledge via the exchange of knowledge, donation of knowledge, and collection of knowledge. Omoush (2018) and Wong (2013) explained that social interaction culture reflects people's knowledge, experience, and skills being exchanged throughout the whole organisation.

Suffice it to say, it is a must for firms to share their knowledge to be able to access external knowledge that could help in developing or enhancing their innovation activities (Hou et al., 2017). Firms disinclined to share knowledge externally may fall short of reaching the potential of their strategy (Ritala et al., 2015). Knowledge sharing was similarly referred to as the process through which explicit or tacit knowledge is relayed to an individual or group of individuals (Abbas & Sagsan, 2019). Moreover, prior studies' definition and exploration of the knowledge sharing concept can be categorised into two dimensions: knowledge donating, and knowledge collecting (see Liao et al., 2007; Lin, 2007; Van den Hooff & de Leeuw van Weenen, 2004; Al-Husseini & Elbeltagi, 2018; Ryszko, 2016; Yesil et al., 2013).

To begin with, knowledge donating involves encouraging employees to relay their knowledge, also known as intellectual capital, to their colleagues (Liao et al., 2007). It is the inclination of the employee to actively relay knowledge to others in the workplace (Lin, 2007). Al-Hussein and Elbeltagi (2018) supported this definition by stating that it is the inclination of organisational members to share, and relay knowledge to others.

Comparatively, knowledge collecting involves the asking and consulting of questions and advice by employees from each other for the purpose of sharing, and obtaining knowledge or intellectual capital (Liao et al., 2007). Lin (2007), and Yesil et al. (2013) described knowledge collecting as entailing consultation with colleagues for active learning, whereas Wong (2013) related that it is initiated by the active search for market gaps by the employees, which leads to requirements. Finally, Hussein and Elbeltagi (2018) searched for novel ways of consulting with colleagues via observation, listening, and practising to boost intellectual capital sharing.

Knowledge Sharing and Green Innovation

According to the reviewed literature, employees often take enjoyment from assisting others through knowledge sharing, and others facilitate suitable environment and culture to bring about innovation activities (Wong, 2013). In fact, in firms that are innovation adopters, the

employees' skills, knowledge, and experience are significantly related to the firms' creation, and sharing of knowledge (Siregar et al., 2019). Overall, knowledge sharing has a significant role in improving employee knowledge, reducing errors and mistakes, and enhancing sustainable operations and economies. In turn, these allow firms to obtain economic advantages, and establish green innovation, while mitigating the hazardous activities to the environment (Abbas & Sagsan, 2019).

Recent studies dedicated to explaining the relationship between knowledge sharing, and innovation or green innovation have been extensive, although the findings reported are inconsistent, based on different contexts. Studies including Al-Husseini and Elbeltagi (2018), Hou et al. (2017), Liao et al. (2007), Lin (2007), Omoush (2018), Ritala et al. (2015), Siregar et al. (2019), Wang and Wang (2012), and Yesil et al. (2013), revealed a positive and significant knowledge sharing-innovation relationship, whereas others like Abbas and Sagsan (2019), Hou et al. (2017), and Ryszko (2016) and Wong (2013) revealed general significant relationships.

To begin with, in Abbas and Sagsan's (2019) study, the authors revealed a positive knowledge sharing-green innovation relationship based on a test involving 302 Pakistani managers in small and medium-sized enterprises, and large-sized manufacturing and service firms. The same finding was revealed by Wong (2013), in the context of 203 green innovation project leaders working in electronic manufacturer firms in China. The author reported a direct positive effect of knowledge sharing on green process innovation. In Poland, Ryszko (2016) revealed a significant direct impact of knowledge sharing on eco-innovation, which was based on data obtained from 292 firm managers.

On the other hand, Hou et al. (2017) indicated that external knowledge sourcing, with the inclusion of knowledge sharing, negatively affected green innovation growth with various limitations on research and development levels among different industries.

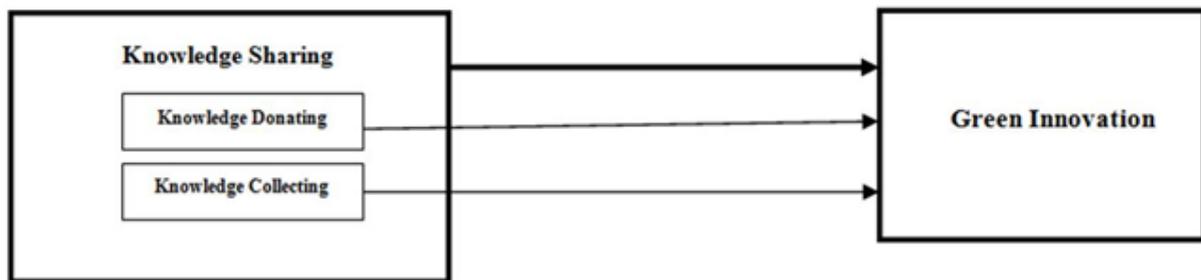
On the basis of the above discussion, this study proposes the following hypotheses for testing:

- H1:** There is positive relationship between knowledge sharing, and green innovation.
- H1a:** There is positive relationship between knowledge donating, and green innovation.
- H1b:** There is positive relationship between knowledge collecting, and green innovation.

Research Mode

Knowledge sharing is a major interest in developing green innovation capacity among organisations, and consequently, the above explanation leads to the proposed research model (refer to Figure 1).

Figure 1. The research model and the hypotheses development



Research Methodology

Population and Sampling of the Study

In the present study, the total population of the industrial firms in Jordan was obtained from the Social Security Corporation (2018), numbering 14,020 firms. Nevertheless, for the sake of practicality, 5,244 firms were selected in Zarqa City as the study population (Ministry of Planning & International Cooperation, 2016). The reason behind the selection of Zarqa City was because the City is one of the top cities in which the majority of industrial firms in Jordan are located, totalling 52 percent (Ministry of Environment, 2017), which explains the intense pollution in the area, and the presence of environmental issues, including overpopulation, heavy traffic, inefficient liquid or solid waste management, and a high level of gas emission (e.g., sulphur dioxide, hydrogen sulphide, and carbon dioxide) (Ministry of Environment, 2016).

The study followed Krejcie and Morgan's (1970) measurement of sample size, and the suitable size is 357. The study employed a systematic random sampling method, after which 357 questionnaire surveys were administered. From the administered questionnaires, 190 questionnaires were retrieved and deemed useful for analysis, indicating a rate of response of 53.2 per cent. The study respondents were comprised of the managers of industrial firms located in Zarqa City, with a majority of the age of firms being under ten years (66.8 per cent). Based on the analysis, 32 per cent of firms were categorised under the food and agriculture sector, while 18 per cent were categorised under the engineering and electrical sector. As for their total number of employees, a majority of the firms employed 20–99 employees (43.7 per cent).

Measurements

This study adopted a five-point Likert scale to measure the items, ranging from one or ‘strongly disagree’ to five or ‘strongly agree’. Specifically, eight items, which were adopted from Chen et al. (2006), were used to measure green innovation, six and eight items were respectively adopted from Van den Hooff and de Leeuw van Weenen (2004), which were used to measure the knowledge donating dimension, and knowledge collecting dimension of knowledge sharing, respectively.

Data Analysis and Results

As mentioned, the study used IBM SPSS 20 for the descriptive analysis of data, and regression analysis was used to test the formulated hypotheses.

Reliability Test

The variables reliability was established following the minimum Cronbach’s alpha threshold provided by Nunnally (1978), which is 0.86. The Cronbach’s alpha coefficient values of each variable (two independent, and one dependent factor) are listed in Table 1, where they indicate high reliability levels.

Table 1: Reliability Test

Variable	Number of Items	Cronbach’s Alpha
Knowledge Donating	6	0.80
Knowledge Collecting	8	0.91
Green Innovation	8	0.86
Total	22	0.88

Hypothesis Test

The obtained results are presented in Table 2, which support the first hypothesis (hypothesis H1), in that knowledge sharing has a significant and positive effect on green innovation (Beta=0.140, $t=2.543$, Sig=0.012). More specifically, with regards to hypothesis H1a, knowledge donating was found to have an insignificant effect on green innovation, on the total sample (Beta=0.074, $t=1.341$, Sig=0.181), whereas with hypothesis H1b, knowledge collecting was found to have a significant and positive effect on green innovation, on the total sample (Beta=0.657, $t=13.504$, Sig=0.000). Overall, the hypothesis is supported, indicating that knowledge sharing has a positive and significant relationship to green innovation.

Table 2: Hypothesis Results

Hypothesis	B	Beta	T	Sig	Result
H1	0.113	0.140	2.543	0.012	Yes
H1a	0.070	0.074	1.341	0.181	No
H1b	0.512	0.657	13.504	0.000	Yes

Discussion

This study's main objective is to investigate the effect of knowledge sharing dimensions, namely knowledge donating, and knowledge collecting on green innovation among Jordanian industrial firms. Based on the results, knowledge sharing does have a positive and significant effect on green innovation — a result that is aligned with and supports prior studies results reported by Abbas and Sagsan (2019), Hou et al. (2017), Ryszko (2016), and Wong (2013). Meanwhile, knowledge donating in this study is a dimension that does have not an effect on green innovation.

The positive and significant relationship of knowledge sharing on green innovation may be attributed to the fact that firms are largely dependent on the knowledge, skills, and experience of their employees, and in turn, with the creation and sharing of knowledge (Siregar et al., 2019). Moreover, knowledge sharing has been evidenced to improve employees' knowledge, which leads to mitigated errors and mistakes, and operational or economic sustainability enhancements. Such enhancements allow firms to reap economic advantages, and establish green innovation, while mitigating the carrying out of hazardous activities within the environment (Abbas & Sagsan, 2019).

However, the study result also showed that knowledge donating had no significant relationship to green innovation, and this may be related to the willingness of the employees to relay and share their knowledge to others, which a majority of the employees lack the skills, and capabilities to do so. Industrial firms have a role to play in encouraging and boosting their employees' interaction and engagement in the innovation environment to increase and enhance their green innovation levels.

Based on the study's statistical results, the mean value obtained for green innovation was 2.9, which falls in the moderate category. Such a result may be explained by the lack of green innovation culture among the examined Jordanian industrial firms, which is necessary for the exploration of their learning opportunities. Although the percentage of respondent firms are located in Zarqa (an industrial area), green innovation practices are quite weak, and green innovation culture is indicative of the present practices and true commitment to the new products improvements, in terms of their environmental friendly aspects.



Regardless of its contributions to both theory and practice, the present empirical study has several limitations which need to be addressed to pave the way for future avenues of research. The study model may be extended by future studies to include some control variables (e.g., the size, and age of the firm), and the study mode may be focussed on a larger scale involving significant number of respondents, number of firms, and number of industries, in order to provide an in-depth insight of the effects of knowledge sharing on green innovation.

The study contributes by highlighting and explaining how Jordanian industrial firms can enhance their success. The results of the study are expected to have implications to both scholar, and practitioner circles, concerning how to enhance the green innovation level among firms. Empirical studies of the like, which focus on the knowledge sharing dimensions — namely knowledge donating, and knowledge collecting — on green innovation in industrial firms in Jordan, are still lacking.

The researcher recommends that industrial firms in Jordan concentrate on the dimensions examined in this study, so that their green innovation culture is promoted, and green innovation practice is enhanced.

Conclusions

This study primarily studied the dimensions of knowledge sharing, namely knowledge donating, and knowledge collecting, and their effects on green innovation from the point of view of managers in the Zarqa industrial firms in Jordan. The data was collected through a survey questionnaire, and the data gathered was analysed using SPSS regression analysis. The results showed that the dimensions do have a significant effect on green innovation, supporting prior studies that reported knowledge sharing to have the highest effect on green innovation.

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