# The Impact of Green Supply Chain Management on Firm Competitiveness

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**Abstract- This study was conducted to investigate the effect of green supply chain management on green performance and firm competitiveness in Shiraz Industrial Estate. Data were collected from 110 executives and managers in companies on the Estate using a pre-designed questionnaire. A descriptive, correlational methodology was adopted Data were analysed using structural equation modeling and partial least squares (PLS) path analysis. The results showed that: the internal green practices of a company have a positive and significant impact on external green collaboration; internal green practices and external green collaboration have a positive and significant impact on the company's green performance; and internal green practices, external green collaboration and the company's green performance have a positive and significant effect on firm competitiveness. Overall, the results suggest that strengthening green supply chain management improves green performance, which in turn increases firm competitiveness. Most prior researches have either concentrated on particular issues related to internal green practices or external green cooperation. This study brought into account papers both from internal and external green supply chain practices in order to elucidate the impact of green performance and practices on firm competitiveness.**

***Keywords*****:** *green supply chain management, internal green practices, external green collaboration, company's green performance, competitive advantage.*

## 1. Introduction

International organizations are always seeking to gain competitive advantage through innovation. In some cases, this takes the form of improving green performance by observing environmental laws and standards, increasing customer knowledge in this area, and reducing the negative environmental effects of their products and services [13]. Green performance involves assessing the relationship between trade and the environment [17]. Sustainable development is key to ensuring a company's survival and requires the commitment and participation of all employees and managers. Companies are faced with competitive pressure to coordinate and cooperate through the supply chain and to improve agility, flexibility and proper functioning. At the same time, increased concern about environmental issues is driving companies to adopt green supply chain management strategies that maintain competitiveness [22].

A green supply chain is an opportunity for sustainable consumption and environmentally friendly business operations. From a macro perspective, attention to green issues is important in relation to both the design of new green products and the creation of markets for products that are compatible with the environment. The creation of a green supply chain requires the development of opportunities for companies to invest in the design and manufacture of greener products and to meet the requirements of sustainability. It involves not only the production of green consumer goods, but also the involvement of suppliers in the creation of green markets [21].

This study sought to investigate the role of internal green practices and external green collaboration on green performance and firm competitiveness. Internal green practice recognizes that different administrative areas within the company need to be integrated for optimum performance [6]. External green collaboration involves mutual understanding of environmental responsibilities and risks and shared decision-making to solve

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environmental problems and allocate resources, skills and knowledge between suppliers, partners and customers in the supply chain to achieve common environmental goals [29].

To date, research in the field of green supply chain management has failed to investigate the effect of green supply chain management on green performance and firm competitiveness. The present study addresses this gap. It had two main aims: (1) To make more explicit the impact of green practices on organizational performance; and (2) To analyze the effect of internal green practices and external green collaboration on firm competitiveness.

## 2. Hypotheses

The study adopted the conceptual model developed by Yang et al. [30], shown in Figure 1, in which green supply chain management is understood as comprising internal green practices and external green collaboration. In the present study, internal green practices were identified as green policy, green shipping practices and green marketing, and external green collaboration comprised green collaboration with suppliers, green collaboration with partners and green collaboration with customers. The green performance of a company was assessed in two ways (reduction in pollutants and reduction in green costs) and firm competitiveness was evaluated in relation to service quality improvements, productivity increases and increased profits.

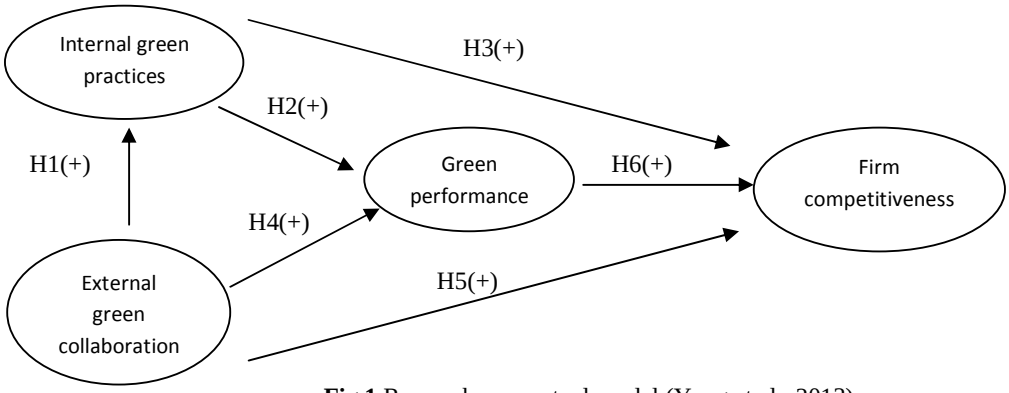


**Fig 1** Research conceptual model (Yang et al., 2013)

As shown in Figure 1, six testable hypotheses were identified. All of the direct associations indicated are hypothesised as positive. The theorised structural model incorporates green performance as the focal construct with internal green practices and external green collaboration as antecedents and firm competitiveness as a consequence. The model illustrates both direct and indirect associations among the study constructs. The model is designed to assess the impact of green supply chain indicators on firm competitiveness. We theorise that the combination of internal green practices and external green collaboration will enhance green performance, ultimately improving firm competitiveness.

Most previous studies had suggested that companies should achieve cooperation between internal processes to a relatively high degree before initiating external integration[24]. Internal integration removes key barriers and creates cooperation to meet customer needs rather than reflecting traditional administrative divisions and specializations [6]. When a company has a high level of internal communication and coordination, it can accelerate its external integration by utlising new knowledge obtained from external suppliers, partners and customers and acknowledging their business interests [2]-[10]-[14]-[27]. From the perspective of strategic partnership, if people in various operating units in the company do not interact with each other to integrate their objectives and activities [25]-[26], the company is unlikely to achieve a high degree of integration with its external customers and suppliers [12]. Hypothesis one follows from this theoretical justification:

*H1: Internal green practice has a significant impact on external green collaboration.*

Many previous studies have illustrated the impact of cross-functional and cross-organisational performance on firm performance Ref. [4]-[16]-[20]-[25]-[31] and derived that there is a positive relationship between internal performance and operational performance. Stank, Keller, & Daugherty [23] and Ellinger et al. [5] found that collaboration between marketing and logistics had a positive effect on distribution services performance. Zhu and Sarkis [32] proposed that companies with high levels of adaptation of green activity achieve improved environmental performance. Hence there is considerable

evidence to support the hypothesis that the implementation of internal green practices will lead to improved green performance. Based on this evidence we hypothesise that:

*H2: Internal green practice has a significant impact on the company's green performance.*

Green activities and integration have potential strategic value because they affect the value chain in multiple areas, producing unique benefits at each level of the supply chain [19]. Similarly, there should be a variety of measures of competitive performance which, as much as possible, provide a holistic approach to the environmental infiltrations on the firm's economic performance. Hypothesis three is, therefore, that:

*H3: Internal green performance has a significant impact on firm competitiveness.*

External cooperation enables companies to form relationships based on cooperation with their trading partners and reduces transaction costs while acknowledging their core competencies [33]. According to Vachon and Klassen [29], green cooperation involves the interactions between the organisation and the members of its green supply chain. It includes aspects such as setting common environmental goals, common environmental planning, and working together to reduce pollution or other environmental effects. Green cooperative activities are profitable for supply chain members in both economic and environmental terms Ref.[3] and can boost the development of environmental activities and the reduction of pollution [28]. Green supply chain management leads to effective collaboration among trading partners and helps them to reinforce green performance [19]. Based on this theoretical justification, hypothesis four is as follows:

*H4: External green collaboration has a significant impact on a company's green performance.*

Wider collaboration between members of the chain may enhance the development of improved environmental activities and reduce pollution [28]. In order to increase competitiveness in global markets, companies work together and with supply chain partners to act in accordance with environmental regulations, reduce environmental impacts and achieve environmental goals [18]. According to Vachon and Klassen [28], the benefits of external green collaboration for firm performance include not only reduced environmental impacts, but also the development of new sources of competitive advantage [19]. Hypothesis five is therefore:

*H5: External green collaboration has a significant impact on firm competitiveness.*

Recently, environmental or green considerations have appeared as sources of competition [11]-[19]. Successful environmental management can improve corporate structure Ref.[9] and provide new opportunities for companies to strengthen their capabilities and facilities [8]. Bacallan [1] showed that organisations can strengthen their position in a competitive environment by improving their green performance to be consistent with environmental regulations. Integration of environmental concerns into management activities can greatly assist companies to achieve competitive advantages [15]. Based on this theoretical justification, hypothesis six is as follows:

*H6: A company's green performance has a significant impact on its competitiveness.*

## 3. Methodology

Our aim was to investigate the impact of green supply chain indicators on firm competitiveness. A structural model with green performance embedded as the focal construct was described and supported in the previous section. Data were collected from a sample of experts (executives and operation managers) using a questionnaire designed and developed by Yang et al. [30]. The data were analysed to assess the structural model using the methods of structural equation modeling and partial least squares (PLS) path modeling.

### 3.1. Data Collection

The target population was executives and operation managers in companies in the Shiraz Industrial Estate since they were expected to have specialist knowledge of manufacturing, purchasing, selling, and information-related processes within their organisations. Sampling was not considered necessary since the population was limited in size (N=110). The questionnaires were distributed among all members of the target population requesting their participation and assuring them that all responses would be anonymous. In an effort to improve the participation rate, an offer was made to supply an executive summary to each of the respondents.

### 3.2. Measurement of Construct

The internal green practices variable included indicators related to green policy, green shipping practices and green marketing. These three indexes are patterned after those used by Yang et al. [30]. A 3- indicator developed by Yang et al. [30] was used to measure external green collaboration. Respondents were asked to indicate the importance of green collaboration with suppliers, green collaboration with partners and green collaboration with customers. A 2- indicator expanded by Yang et al. [30] was adopted to assess companies' green performance.

Respondents were asked to indicate the importance of reduction of pollutants and decline in green costs. Firm competitiveness was measured using three indicators fostered by Yang et al. [30] quality of service, productivity and corporate profits. Respondents were asked to rate their firm's competitiveness in these areas compared to that of their competitors in metrics. All measurement indicators had an organisation-level focus.

### 3.3. Statistical Analysis

This research was applied in type and descriptive-correlational in method. All measurement indicators were assessed for validity and reliability within a measurement model context and common model bias was assessed to ensure that the indicators consistently measured what they were supposed to measure. Descriptive statistics were computed to ensure that the study variables were sufficiently normally distributed. Correlations were computed to establish bivariate relationships among the study variables. The theorised model was then calculated following a structural equation modeling methodology using smart PLS software. This software creates goodness of fit indexes that were used to define how well the theorised model fits the data. The software also generates standardised coefficients that were used to assess support for the study hypotheses.

## 4. Results

### 4.1. Indicators Assessment Process

The research questionnaire was assessed for content validity by several experts and professors of business management working in universities. Following some modifications, which were approved by the expert panel, 30 questionnaires were distributed in the population to assess face validity. A number of questions were not clear. Several were deleted and others were rephrased. The final questionnaire was assessed as having sufficient face validity. PLS software has the capability to investigate internal consistency reliability, composite reliability, reagents' reliability, convergent validity and divergent validity.

Table 1 shows the values of Cronbach's alpha and composite reliability. As can be seen, the values of Cronbach's alpha coefficients for all components are greater than 0.7, indicating that the model has good internal consistency reliability. All values of composite reliability coefficients (CR) for all first and second order variables were larger than 0.7, indicating good model fit. Factor loadings for all indices were higher than 0.7, so there was no need to remove any questionnaire item from the model.

Table 1
*Cronbach's Alpha Coefficients and Composite Reliability, Average Variance and Factor Loading*

| Factor Loading | Indicators | Variable | Factor Loading | Indicators | Variable |
|---|---|---|---|---|---|
| 0.99 | Green Collaboration With Suppliers | External Green Collaboration | 0.92 | Green Policy | Internal Green Practices |
| 0.92 | Green Collaboration With Partners | Alpha Coefficient: 0.91 | 0.91 | Green Shipping Practices | Alpha Coefficient: 0.94 |
| 0.92 | Green Collaboration With Customers | Composite Reliability: 0.92 | 0.92 | Green Marketing | Composite Reliability: 0.94 |
| | | Average Variance: 0.90 | | | Average Variance: 0.84 |
| 0.88 | Quality Of Service | Firm Competitiveness | 0.93 | Reduction Of Pollutants | Green Performance |
| 0.91 | Productivity | Alpha Coefficient: 0.90 | 0.94 | Decrease In Green Costs | Alpha Coefficient: 0.86 |
| 0.94 | Corporate Profits | Composite Reliability: 0.93 | | | Composite Reliability: 0.93 |
| | | Average Variance: 0.83 | | | Average Variance: 0.88 |

In relation to convergent validity, the extracted average variance was examined with respect to the amount of the extracted average variance for all variables. This was larger than 0.5 so convergent validity of the model was confirmed.

Divergent validity was examined using the method of Fornell and Larcker [7]. As shown in Table 2, this involves first calculating the square root of amounts of AVE (average variance) and then replacing the obtained values on the diagonal matrix (latent variable correlation).

The square root of average variance for the main variables of the study in the main diagonal matrix was larger than the correlation between variables in the boxes of the lower-left diagonal. Thus it can be stated that the study variables in the model had more interaction with their indices than with indices of other variables; hence the divergent validity of the model was confirmed.

Table 2

*Matrix Assessing Divergent Validity Following Fornell & Larcker [7] (Latent Variable Correlations)*

| | External green collaboration | Firm competitiveness | Company's green performance | Internal green practices |
|---|---|---|---|---|
| **External green collaboration** | 0.92 | 0.00 | 0.00 | 0.00 |
| **Firm competitiveness** | 0.88 | 0.95 | 0.00 | 0.00 |
| **Company's green performance** | 0.73 | 0.82 | 0.93 | 0.00 |
| **Internal green practices** | 0.77 | 0.73 | 0.75 | 0.91 |

### 4.2. Structural Equation Modeling Results

Figure 2 shows the path coefficients of the impact of internal green practices and external green collaboration on green performance and firm competitiveness. The coefficient of determination ($R^2$) for the dependent variable firm competitiveness is almost equal to 0.969, indicating that all aspects together could explain 0.969 of variance of the variable firm competitiveness. Three values (0.19, 0.33 and 0.67) are considered as the standard values for weak, medium and strong values of $R^2$. Given that 0.97 was obtained as the coefficient of determination, and comparing the three boundary values for $R^2$, we can conclude that the model is of high predictability.

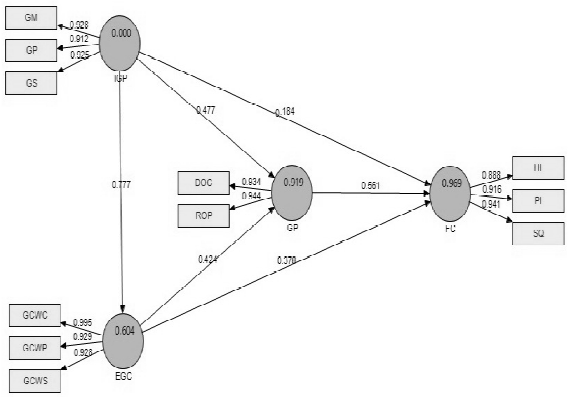


**Fig 2** The research model in estimating the standard coefficients

Figure 3 shows the research model in relation to significance of coefficients (t-value). This model virtually tests all measurement equations (factor loading) and structural equations (path coefficients) using the t-statistic. According to this model, path coefficient and factor loading are significant at 95% confidence level if the t-value is outside the range (-1.96 to +1.96); if the t-value is within this interval, the factor loading and path coefficient are not significant. Path coefficient and factor loading are significant at the 99% confidence level if the t-value is

outside the range (-2.58 to +2.58). The results of the t test showed that all factor loadings were significant at the 99% confidence level and played a significant role in measuring their structures.

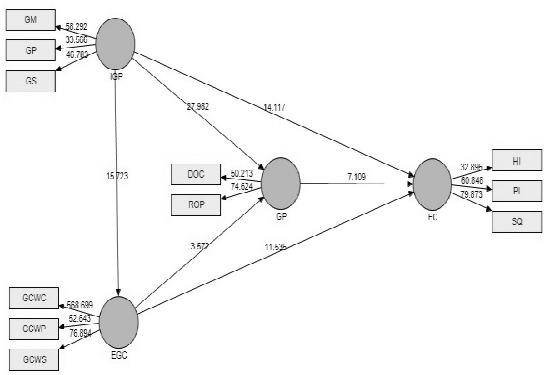


**Fig 3** Model of significant coefficients of assumptions in the research model

It is observed that overall, the theorised model fits the data well. The standardised estimates and associated *t*-values support all six hypothesised relationships, each of which is discussed below.

*Hypothesis 1: Internal green practice has a significant impact on external green collaboration.*

The results of path coefficient and t-statistics (Table 3 and Figures 3) show that internal green practice has a significant impact on external green collaboration (t-statistic is outside the range of -2.58 to +2.58). The impact of internal green practice on external green collaboration is positive and significant because the obtained path coefficient is positive. Therefore, improving internal green practice will increase external green collaboration and reducing it in the organisation will reduce external green collaboration.

*Hypothesis 2: Internal green practice has a significant impact on a company's green performance.*

The results of path coefficient and t-statistics (Table 3 and Figures 2 and 3) show that internal green practice has a significant impact on a company's green performance (t-statistic is outside the range -2.58 to +2.58). The impact of internal green practice on the company's green performance is positive and significant because the obtained path coefficient is positive. Therefore, improving internal green practice will increase the company's green performance and reducing it in the organization will reduce the company's green performance.

*Hypothesis 3: Internal green performance has a positive and significant impact on firm competitiveness.*

According to the results of path coefficient and t-statistics (Table 3 and Figures 2 and 3), internal green practice has a significant impact on firm competitiveness (t-statistic is outside the range -2.58 to +2.58). The impact of internal green practice on firm competitiveness is positive and significant because the obtained path coefficient is positive. Therefore, improving internal green practice increases firm competitiveness and reducing it reduces firm competitiveness.

*Hypothesis 4: External green collaboration has a positive and significant impact on a company's green performance.*

According to the results of path coefficient and t-statistics (Table 3 and Figures 2 and 3), external green collaboration has a significant impact on a company's green performance (t-statistic is outside the range -2.58 to +2.58). The impact of external green collaboration on a company's green performance is positive and significant because the obtained path coefficient is positive. Therefore, improving external green collaboration increases the company's green performance and reducing it in the organisation reduces the company's green performance.

*Hypothesis 5: External green collaboration has a positive and significant impact on firm competitiveness.*

According to the results of path coefficient and t-statistics (Table 3 and Figures 2 and 3), external green collaboration has a significant impact on firm competitiveness (t-statistic is outside the range -2.58 to +2.58). The impact of external green collaboration on firm competitiveness is positive and significant because the obtained path coefficient is positive. Therefore, improving external green collaboration increases firm competitiveness and reducing it in the organisation reduces firm competitiveness.

*Hypothesis 6: Green performance has a positive and significant impact on firm competitiveness.*

According to the results of path coefficient and t-statistics (Table 3 and Figures 2 and 3), a company's green performance has a significant impact on firm competitiveness (t-statistic is outside the range -2.58 to +2.58). The impact of a company's green performance on firm competitiveness is positive and significant because the obtained path coefficient is positive. Therefore, improving the company's green performance increases firm competitiveness and reducing it in the organization reduces firm competitiveness.

Table 3:

*Direct Effects, t-Statistics and Research Hypotheses Results*

| Hypothesis | Standardized Path Coefficient (B) | T-Statistics | Significance | Accept or Reject the Hypothesis |
|---|---|---|---|---|
| **Internal Green Practices → External Green Collaboration** | 0.77 | 15.72 | Sig<0.05 | Not rejected |
| **Internal Green Practices → Green Performance** | 0.47 | 27.98 | Sig<0.05 | Not rejected |
| **Internal Green Practices → Firm Competitiveness** | 0.18 | 14.17 | Sig<0.05 | Not rejected |
| **External Green Collaboration → Green Performance** | 0.42 | 3.57 | Sig<0.05 | Not rejected |
| **External Green Collaboration → Firm Competitiveness** | 0.37 | 11.53 | Sig<0.05 | Not rejected |
| **Company's Green Performance → Firm Competitiveness** | 0.56 | 7.11 | Sig<0.05 | Not rejected |

## 5. Discussion

In summary, a relatively broad sample of Shiraz Industrial Estate executives and operation managers provided data that were used to assess the GSCM model. All study indicators were determined to be reliable and valid and the measurement model fit the data well. Results of the structural equation modeling analysis supported all hypotheses. Internal green practice was positively associated with external green collaboration and green performance. Internal green practice was positively associated with firm competitiveness. External green collaboration was positively associated with green performance and firm competitiveness. Green performance was positively associated with firm competitiveness. The green supply chain strategy, which includes internal green practices and external green collaboration, is a viable, effective strategy for directly improving firm performance which, in turn, improves firm competitiveness. Green supply chain philosophy and associated practices have been successfully integrated at the supply chain level as well as the organizational level.

Our main objective was twofold: (1) to make more explicit the impact of green practices on organizational performance; and (2) to analyze the effect of internal green practices and external green collaboration on firm competitiveness. We found that success at organizational performance level and firm competitiveness requires internal green practices as well as external green collaboration. Our results demonstrated that internal green practices and external green collaboration diminish the firm's green costs (such as those associated with materials purchase, energy consumption, disposal of hazardous materials, operational wastage and fines for environmental accidents). They also decrease the amount of greenhouse gases (carbon dioxide, sulfur oxides, nitrogen oxides, etc.), sewage, noise pollution, wastes (e.g. oil, sludge and garbage) and hazardous materials. We can say firms can increase their competitiveness by a clear green policy, using green shipping practices and implementing green marketing, and paying attention to their respective indicators.

## 6. Conclusion

The study however is limited by its small sample size and the fact that we cannot guarantee that the information provided by the participants was completely accurate. Future research should include the additional measure of performance, such as the operational performance of the firm and the overall performance of the green supply chain. Further work is also needed to investigate the individual impact of each component on measures of performance and to assess the GSCM practices model in the service and governmental sectors.

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