Journal of Business Research 69 (2016) 4667–4674

Contents lists available at ScienceDirect

Journal of Business Research

# IT infrastructure and competitive aggressiveness in explaining and predicting performance

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ARTICLE INFO

*Article history:*
Received 1 February 2016
Received in revised form 1 March 2016
Accepted 1 March 2016
Available online 26 April 2016

*Keywords:*
IT infrastructure capability
Competitive aggressiveness
Green supply chain management
Environmental sustainability
Firm performance
Partial least squares

ABSTRACT

While prior Information Systems and Operations Management literature emphasizes the role of both the firm's IT infrastructure and the general degree of competition as antecedents of firm performance, the organizational capabilities that mediate these important relationships remain undetermined. Responding to the increasing importance of incorporating environmental sustainability practices across the internal and external supply chain, this study proposes green supply chain management as an important mediator of the IT infrastructure/competitive aggressiveness–firm performance relationship. Enabled by internal IT capabilities and external competitive pressure, green supply chain management capabilities support firms in achieving operational excellence, thereby contributing to the firm's overall performance. Using primary and secondary data on 203 large firms in Spain, this study applies the partial least squares approach to structural equation modeling. Its empirical analysis reveals that green supply chain management fully mediates the relationships between IT infrastructure capability and firm performance, and competitive aggressiveness and firm performance, respectively.



## 1. Introduction

Challenged by increasing demand for more sustainable solutions among stakeholders (e.g., Benitez & Walczuch, 2012), firms seek to exploit various environmental management opportunities that reduce their activities' impact on the natural environment, simultaneously saving costs and increasing revenues (Benitez, Llorens, & Fernandez, 2015; Saeidi, Sofian, Saeidi, Saeidi, & Saaeidi, 2015). Whereas sustainability-related activities typically refer to firm logistics, waste management, and purchasing activities (e.g. Green, Zelbst, Meacham, & Bhadauria, 2012; Zhu & Sarkis, 2004), recent research emphasizes the importance of information technology (IT)-related activities in contributing to a more sustainable future (Benitez & Walczuch, 2011; Dao, Langella, & Carbo, 2011). Although IT represents a potential source of environmental contamination during the processes of product manufacturing, usage, and disposal, advanced IT capabilities have the potential to improve resource efficiency at both firm and supply chain levels (Elliot, 2011; Wang, Chen, & Benitez, 2015).

Much prior Information Systems (IS) and Operations Management literature aims to understand how IT triggers the firm's supply chain management capabilities (e.g. Devaraj, Krajewski, & Wei, 2007; Setia & Patel, 2013), but research on the role of IT in enabling green supply chain management is very limited. To close this research gap, this study examines the extent to which internal IT capabilities strengthen pursuit of environmental management activities across the internal and external supply chain, which, in turn, might represent an important precursor of superior firm performance (Benitez, Llorens, & Fernandez, 2013; Wang et al., 2015).

Like the firm's internal IT capabilities, external factors may affect the extent to which firms exploit new opportunities to save costs and increase revenues by executing environmental management activities (Bose & Pal, 2012). One external driver of green supply chain management refers to the overall degree of competitive aggressiveness that a firm faces in a specific industry (Hofer, Cantor, & Dai, 2012). Firms operating in an industry with a high degree of competitive aggressiveness, for example, experience greater need to adapt their course of action by searching and exploiting new business opportunities. Implementing environmental management activities in the supply chain provides a way for firms to differentiate themselves from their competitors to benefit from superior firm performance (Benitez et al., 2015; Chen, Wang, Nevo, Benitez, & Kou, 2015a; Ferrier, 2001).

Using primary and secondary data on 203 large firms in Spain, structural equation modeling (SEM) with partial least squares (PLS) shows that both IT infrastructure capability and competitive aggressiveness impact firm performance through green supply chain management by means of a full mediation effect. The effect of an industry's competitive aggressiveness on development of green supply chain management capability exceeds the effect of IT infrastructure capability on green supply chain management. Based on these insights, this study contributes to the IS and Operations Management literature in at least three ways.

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http://dx.doi.org/10.1016/j.jbusres.2016.03.056
0148-2963/

First, it opens the black box between IT infrastructure, competitive aggressiveness, and firm performance. Second, it shifts the focus from a general perspective on supply chain management activities to a more contemporary view of supply chain management that incorporates a sustainability focus. Finally, this paper discloses both internal (i.e., IT infrastructure capability) and external (i.e., competitive aggressiveness) drivers of green supply chain management and, by this means, provides important guidance for managerial practice.

## 2. Hypotheses and proposed research model

### *2.1. IT infrastructure capability and green supply chain management*

IT infrastructure capability is the firm's ability to leverage its technological, managerial, and technical IT resources effectively to perform business activities (Benitez & Walczuch, 2012; Chen et al., 2014). Whereas technological IT resources include servers, computers, laptops, operating systems, software, electronic communication networks (email, Intranet, wireless devices), and shared customer databases, managerial IT resources refer to IT managers' business and technical skills (Benitez & Ray, 2012). Technical IT resources, in contrast, comprise IT employees' business and technical skills (Chen et al., 2015a; Wang et al., 2015). Firms that can leverage their IT resources effectively are in a better position to execute and coordinate various operational activities across their internal and external supply chain (Devaraj et al., 2007; Setia & Patel, 2013). These operational activities target the firm's processes of sourcing, developing, manufacturing, selling, and distributing products and services, the core processes of the firm's supply chain (Sousa, Amorin, & Rabinovich, 2015). While addressing the firm's information and material flow in general, these activities leverage its IT resources, contributing to pursuit of various environmental management activities (Bose & Pal, 2012). Exploitation of advanced technological IT resources, for instance, not only supports firms in effective communication and coordination with suppliers and customers to execute environmental management activities jointly (e.g., green purchasing practices, or reverse logistics), but also supports internal execution of environmental management practices in manufacturing and logistics operations (e.g., eco-design, green manufacturing practices, and investment recovery) (Benitez & Walczuch, 2012; Benitez et al., 2013; Green et al., 2012; Zhu & Sarkis, 2004). Similarly, leveraging IT managers' business and technical IT skills fosters good IT decisions (e.g., acquiring the appropriate enterprise resource planning solution), affecting execution of environmentally beneficial activities in the supply chain. IT employees' business and technical skills may support the supply chain to solve IT (e.g., data incompatibility) and business problems (e.g., supplier's environmental resistance) in implementing environmental management activities.

Based on this discussion, this study proposes IT infrastructure capability as an important driver of green supply chain management—the firm's ability to pursue managerial practices that adopt and integrate environmentally friendly activities into the supply chain (Green et al., 2012; Zhu & Sarkis, 2004). The study thus hypothesizes that:

**Hypothesis 1 (H1).** : IT infrastructure capability positively relates to green supply chain management.

### *2.2. Competitive aggressiveness and green supply chain management*

This study further examines the role of competitive aggressiveness in developing and implementing environmental management activities throughout the supply chain. Competitive aggressiveness indicates the extent to which firms experience competitive attacks with high volume, duration, complexity, and unpredictability from industry key competitors (Chen et al., 2015a; Ferrier, 2001). Firms operating in a highly competitive industry face continual and more serious pressure to adapt their course of action by exploiting new business opportunities than do firms that experience low competitive aggressiveness. Good responses to increasing competitive aggressiveness include not only cutting costs, expanding to markets abroad, or upgrading existing products with new functions or additional services, but also establishing product or process solutions that address ecological constraints (Bose & Pal, 2012; Zhu & Sarkis, 2004). Prior literature (Benitez et al., 2015; Green et al., 2012) suggests that differentiation based on contribution to a sustainable environment is increasingly important as a source of competitive advantage. To exploit this resource and respond adequately to high levels of competitive aggressiveness, firms must adapt their supply chain practices and ensure adoption and integration of environmental-friendly activities into their internal and external supply chain (Mignerat & Rivard, 2009; Zhu & Sarkis, 2004). Green supply chain management, for instance, supports firms in communicating and coordinating requests and requirements for more sustainable solutions (e.g., reduction of emissions and waste, improved material efficiency), from downstream to upstream supply chain partners. As these managerial practices enable firms to respond more holistically to customers' needs or to address new customers, they support firms in keeping and extending their customer base. Exploitation of sustainability-related business opportunities in the supply chain can constitute a good response to high levels of competitive pressure (Hofer et al., 2012). Based on this discussion, this study proposes competitive aggressiveness as an external driver of green supply chain management.

**Hypothesis 2 (H2).** : Competitive aggressiveness positively relates to green supply chain management.

### *2.3. Green supply chain management and firm performance*

While execution of green supply chain management practices may increase costs (e.g., changing supplier contracts, adapting manufacturing processes, implementing new incentive policies), such practices have the potential to reduce operational costs significantly and to increase the firm's revenue streams. For example, cross-functional cooperation for environmental improvements reduces consumption of raw materials to save costs (Benitez & Walczuch, 2011, 2012). Similarly, collaborative activities with suppliers (e.g., green purchasing) and customers (e.g., reverse logistics) improve customer satisfaction as well as firm reputation and brand value. Such measures grant firms increased revenues, resulting in higher firm performance. Apart from prior literature that similarly provides support for a positive relationship between green supply chain management and firm market performance (e.g. Bose & Pal, 2012; Green et al., 2012; Mitra & Datta, 2014), managerial practice suggests a positive relationship between green supply chain management and firm performance. For example, Mercadona (a leading Spanish retailer) works very closely with suppliers on a long-term basis, cooperating with its strategic suppliers to reduce packaging size of its home brand products (developed by a strategic supplier) to cut costs and increase firm performance, as well as to reduce the supply chain's impact on the natural environment (Benitez et al., 2015; Ton & Harrow, 2010). Similarly, Xerox Corporation and Siemens gain business benefits from take-back programs by refurbishing and remanufacturing pre-owned equipment (Xerox saves 200 million U.S. dollars annually by remanufacturing products). Based on this discussion, this study hypothesizes that:

**Hypothesis 3 (H3).** : Green supply chain management positively relates to firm performance.

## 3. Research methodology

### *3.1. Data and sample*

This study uses a combination of survey and secondary data on 203 large firms in Spain. The measures of IT infrastructure capability, competitive aggressiveness, green supply chain management, strategic flexibility (control variable), and quality management (control variable) make use of survey data. Firm performance and firm size (control variable) use information collected from the *Actualidad Economica* database (http://www.actualidadeconomica.com/) (Benitez & Ray, 2012; Benitez et al., 2015). Wherever possible, the final questionnaire adapts measurement items from existing scales. The authors use mail and email invitations to motivate senior IT and business executives of 1046 large firms (see 2007 edition of *Actualidad Economica*) to participate in the online survey. Data collection from December 2007 to April 2008 yields a total of 203 valid questionnaires, giving an effective response rate of 20.24%.

To rule out the possibility that non-response bias might threaten research quality, this study assesses non-response bias by verifying that the responses of early and late respondents do not differ. All possible t-test comparisons between means of the two groups of respondents show non-significant differences. The sample firms operate in 25 different industries: wholesale (39 firms, 19.21%), real estate and/or construction (35 firms, 17.24%), chemical (15 firms, 7.39%), communications and graphic design (15 firms, 7.39%), retail (12 firms, 5.91%), non-metal mining (10 firms, 4.93%), consulting (9 firms, 4.43%), food and beverage (8 firms, 3.94%), and other industries (60 firms, 29.56%).

### 3.2. Measures

This study measures IT infrastructure capability as a composite second-order construct composed of the following dimensions: technological IT infrastructure, managerial IT infrastructure, and technical IT infrastructure capabilities. The authors measure technological IT infrastructure capability by means of annual IT investment in technological IT infrastructure per employee (Ray, Muhanna, & Barney, 2005). The constructs managerial and technical IT infrastructure capabilities have four indicators each, adapted from Byrd and Davidson (2003) and Ray et al. (2005), respectively.

Competitive aggressiveness consists of four new indicators based on the conceptual underpinnings of Ferrier (2001) and focuses on the volume, duration, complexity, and unpredictability of competitive attacks from each of the firm's key competitors. Green supply chain management consists of seven indicators adapted from Zhu and Sarkis (2004). Firm performance refers to rate of sectoral excellence (RSE) for the years 2007–2011. The corresponding information derives from the *Actualidad Economica* database for the years 2007–2011. RSE is an objective measure of the firms' sectoral positioning (Benitez & Ray, 2012; Benitez & Walczuch, 2012). Its estimation derives from the firm's ranking position as follows: RSE = 1 − (ranking position of firm / total number of firms in the industry). The present study calculates the RSE based on the firm's sales ranking in its industry, and values range from 0 to 1. The closer the RSE is to the maximum value of 1 for the industry, the better the firm's performance (e.g., Benitez et al., 2015).

This study controls for firm size, strategic flexibility, and quality management in firm performance. Firm size is the natural logarithm of number of employees (Benitez & Ray, 2012). Strategic flexibility includes four indicators created from Volberda (1996). Quality management consists of two indicators adapted from Zhu and Sarkis (2004). All constructs are composites at both first- and second-order levels (Henseler, 2015).

## 4. Empirical analysis

The study employs the variance-based SEM technique and the PLS method of estimation to test the proposed research model, using the statistical software package Advanced Analysis for Composites (ADANCO) 1.1.1 Professional (http://www.composite-modeling.com/) (Henseler & Dijkstra, 2015). The PLS approach to SEM is preferable to the alternative covariance-based SEM for the following reasons. First, PLS is a full-fledged SEM approach that can test for exact model fit and works very well in explanatory and predictive research (Chin, 2010; Hair, Sarstedt, Ringle, & Mena, 2012; Henseler, Hubona, & Ray, 2016; Sarstedt, Ringle, & Hair, 2014; Shmueli & Koppius, 2011). Second, since all constructs specify as composites, PLS represents a suitable method that produces consistent estimations (Gefen, Straub, & Rigdon, 2011; Hair et al., 2012; Henseler et al., 2014; Rigdon et al., 2014). Third, using PLS-SEM is advisable when the underlying data refer to secondary data (Benitez & Walczuch, 2012; Gefen et al., 2011; Ringle, Sarstedt, & Straub, 2012). Fourth, compared with alternative covariance-based SEM techniques, PLS SEM achieves better results when estimating complex models (i.e., those with a large number of indicators or multidimensional constructs) (Hair et al., 2012; Roldan & Sanchez, 2012). Finally, PLS is a well-established variance-based SEM technique in the IS and Operations Management literature (Benitez et al., 2015; Braojos, Benitez, & Llorens, 2015a, 2015b; Chen, Wang, Nevo, Benitez, & Kou, 2015b; Chou, Wang, & Tang, 2015; Roldan & Sanchez, 2012). To estimate the significance levels of weights and path coefficients, this research runs the bootstrapping algorithm with 5000 resamples (Barroso, Cepeda, & Roldan, 2010; Hair, Ringle, & Sarstedt, 2011; Petter, Straub, & Rai, 2007).

### 4.1. Measurement model evaluation

To evaluate the measurement model, this research analyzes the content validity, multicollinearity, and weights of all composite constructs (Cenfetelli & Bassellier, 2009). First, the study assesses whether the indicators of all first-order constructs and the dimensions of second-order constructs capture the constructs' full domain. The study ensures that indicators and dimensions have content validity by using validated scales and pre-testing the questionnaire with 15 faculty members and eight IT/business executives.

After data collection, the authors examine multicollinearity by calculating variance inflation factors (VIFs) at first- and second-order level. All VIF values are below 3.3 and thus do not indicate serious multicollinearity problems (Petter et al., 2007; Roberts & Thatcher, 2009; Roldan & Sanchez, 2012).

This study also examines whether the weights of indicators and second-order dimensions are substantial and significant (Benitez & Ray, 2012). As shown in Table A1 (Appendix A), all weights are substantial and significant at the 0.001 level. The authors apply the two-step approach to calculate the second-order constructs (Chin, 2010). Table A1 (Appendix A) provides detailed information on the VIF values and weights of the indicators and dimensions. Table A2 presents the correlation matrix.

### 4.2. Test of hypotheses

This study examines the beta coefficients, significance level, $R^2$, and $f^2$ values of the proposed research model. Fig. 1 presents the results of the PLS estimation. Table 1 provides the analysis of the effect size for every relationship in the proposed model. $f^2$ values of 0.02, 0.15, and 0.35 indicate a weak, medium, or large effect size between an exogenous and endogenous variable (Henseler & Fassott, 2010). The empirical analysis generally supports H1, H2, and H3, as findings show that both IT infrastructure capability ($\beta = 0.26^{***}$) and competitive aggressiveness ($\beta = 0.40^{***}$) positively affect green supply chain management. Further, the study supports the positive relationship between green supply chain management and firm performance ($\beta = 0.21^{**}$).

The beta coefficients, their significance level, the $f^2$ values, and the $R^2$ values are individual measures of the explanatory power of the model (Shmueli & Koppius, 2011). Beta coefficients around 0.20 are economically significant, while $R^2$ values higher than 0.20 indicate good explanatory power of the endogenous variables (Benitez & Ray, 2012; Chin, 2010). The beta coefficients of the hypothesized relationships in the proposed research model range from $0.21^{**}$ to $0.40^{***}$. The effect size analysis suggests that industry competitive aggressiveness ($f^2 = 0.20$)

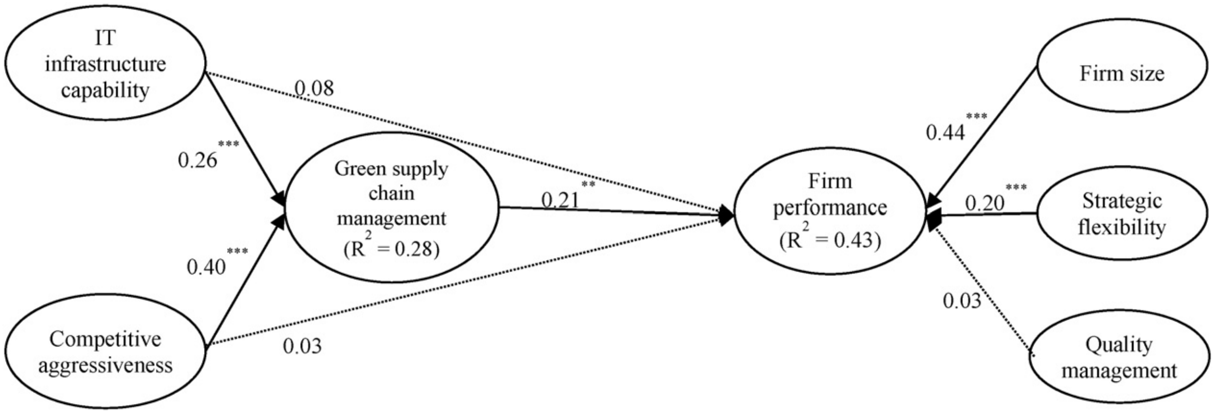


**Fig. 1.** Results of the PLS estimation (*p < 0.05, **p < 0.01, ***p < 0.001, one-tailed test).

has a greater influence than IT infrastructure capability ($f^2 = 0.08$) in explaining the development of green supply chain management. The $R^2$ values range from 0.28 to 0.43 and suggest good explanatory power for the proposed research model.

Finally, this study also evaluates goodness of model fit for the research model at first- and second-order levels by examining the SRMR, $d_{ULS}$, and $d_G$ values (Henseler et al., 2014). These values evaluate the discrepancy between the empirical correlation matrix and the model-implied correlation matrix (Henseler, 2015). The lower the SRMR, $d_{ULS}$, and $d_G$, the better the research model fit (Henseler & Dijkstra, 2015). Since the SRMR values of the first and second step are below the recommended threshold of 0.08, the proposed research model shows adequate overall model fit (Hu & Bentler, 1998). Further, all discrepancies are below the 95%-quantile of the bootstrap discrepancies (see Table 2), suggesting a good model fit for the proposed research model.

### 4.3. Mediation analysis

This study performs mediation analysis to examine the mediation effects of the proposed research model. To this end, the research model includes links between: (1) IT infrastructure capability and firm performance, and (2) competitive aggressiveness and firm performance. Since direct effects of these two links are not significant (0.08 and 0.03) although their indirect effects are (0.05* and 0.08**), green supply chain management fully mediates the relationships between: (1) IT infrastructure capability and firm performance, and (2) competitive aggressiveness and firm performance, respectively (Zhao, Lynch, & Chen, 2010).

**Table 1**
Effect size analysis.

| Relationship | $f^2$ value | Effect size |
|---|---|---|
| Hypothesized relationship | $f^2$ value | Effect size |
| IT infrastructure capability → green supply chain management (H1) | 0.08 | Weak-medium |
| Competitive aggressiveness → green supply chain management (H2) | 0.20 | Medium-large |
| Green supply chain management → firm performance (H3) | 0.05 | Weak-medium |
| Control variables | $f^2$ value | Effect size |
| Firm size → firm performance | 0.30 | Large |
| Strategic flexibility → firm performance | 0.06 | Weak-medium |
| Quality management → firm performance | 0.01 | Very weak |

### 4.4. Qualitative comparative analysis for the second-order construct

The construct IT infrastructure capability refers to a composite second-order construct composed of the following three dimensions: technological, managerial, and technical IT infrastructure capabilities. While the PLS estimation considers the net effect of the second-order construct on the endogenous variable, this study additionally examines whether different configurations of the first-order dimensions of IT infrastructure capability cause high levels of green supply chain management. To this end, the study applies configurational approach fuzzy set qualitative comparative analysis (fsQCA) to control for equifinality (Fiss, 2011; Woodside, 2013). Equifinality implies that several causal paths may exist per outcome (Fiss, 2011). fsQCA follows three steps: (1) transform measures into fuzzy set membership scores, (2) construct and refine the truth table, and (3) analyze sufficient conditions for the outcome of interest (Fiss, 2011). When transforming the measures into fuzzy set membership scores, this study uses the unstandardized latent variables scores for the multiple-item measurement constructs. The constructs managerial IT infrastructure, technical IT infrastructure, and green supply chain management use the anchor point 6 for full membership, 2 for full non-membership, and 4 for the crossover point (Ordanini, Parasuraman, & Rubera, 2014). The single-item construct technological IT infrastructure uses 21% as anchor point for full membership, 1% for full non-membership, and 11% as the crossover point. When redefining the truth table, this study sets 2 as cut-off value for the minimum number of cases per solution and 0.90 as cut-off value for the minimum consistency level of a solution. Analysis of the complex, parsimonious, and standard solution term produces the same configurations. Overall solution coverage is 0.43, and overall solution consistency 0.87. The fsQCA eventually reveals two distinct configurations that cause a high level of green supply chain management. These configurations are: (1) presence of technological and managerial IT infrastructure, and (2) presence of technological and technical IT infrastructure. The presence of technological IT infrastructure in both solutions indicates its prominent role as a critical dimension for evaluating and measuring IT infrastructure capability, a finding consistent with prior IS research (e.g., Melville, Kraemer, & Gurbaxani, 2004).

**Table 2**
Overall model fit evaluation.

| Discrepancy | First step | | | Second step | | |
|---|---|---|---|---|---|---|
| | Value | $HI_{95}$ | Conclusion | Value | $HI_{95}$ | Conclusion |
| SRMR | 0.05 | 0.10 | Supported | 0.07 | 0.11 | Supported |
| $d_{ULS}$ | 0.87 | 2.91 | Supported | 1.83 | 3.84 | Supported |
| $d_G$ | 0.45 | 1.40 | Supported | 0.51 | 1.16 | Supported |

### 4.5. Prediction analysis

While affirming that green supply chain management mediates the relationships between IT infrastructure and firm performance, and competitive aggressiveness and firm performance, this study also explores whether the proposed research model performs well with regard to prediction. Since a model with good overall fit and explanatory power (both evident from the previous sections) does not automatically produce good predictions, this study also assesses the proposed model's predictive ability by performing: (1) blindfolded cross-validation analysis, and (2) k-fold cross-validation analysis (Gigerenzer & Brighton, 2009; Shmueli & Koppius, 2011; Shmueli, Ray, Velasquez, & Chatla, 2016; Woodside, 2013). The blindfolded cross-validation analysis uses SmartPLS 2.0.M3 (Ringle, Wende, & Will, 2005). This study indicates 5 as omission distance and uses the cross-validated redundancy approach in SmartPLS (Hair et al., 2011). Table 3 presents the resulting Stone-Geisser $Q^2$ values for each endogenous variable as well as the relative prediction relevance ($q^2$) of each exogenous variable (Hair et al., 2012).

While the blindfolded cross-validation analysis indicates adequate predictive ability (all Stone-Geisser $Q^2$ values are greater than zero), this study also uses k-fold cross-validation analysis to describe predictive ability in greater detail. In contrast to the blindfolded cross-validation procedure, which represents an in-sample prediction method, the performed k-fold cross-validation analysis refers to an out-of-sample prediction evaluation method (Shmueli et al., 2016). To this end, this study randomly splits the original dataset into k equally sized subsamples ($k = 10$) (Hastie, Tibshirani, & Friedman, 2009). While the training sample consists of $k - 1$ subsamples, the remaining single subsample constitutes the validation (holdout) sample. The parameter estimates that emerge from the training sample build the basis for predicting the values of the validation (holdout) sample. Prediction analysis generally occurs at construct and item level, providing various types of prediction (Shmueli et al., 2016). The present study performs and reports the results of the following prediction procedures: latent and operative prediction (Shmueli et al., 2016). While the latent prediction analysis generates predictions of endogenous construct scores ($Y_i$) based on the manifest items of the exogenous constructs ($x_{ij}$), the operative prediction analysis generates predictions of the manifest items of the endogenous construct ($y_{ij}$) based on the manifest items of the exogenous constructs ($x_{ij}$) (Shmueli et al., 2016). Operative prediction analysis thus considers the full information in the proposed research model (i.e., estimations of both measurement and structural models). Following the procedure shown in Table A3 (Appendix A), this study calculates the resulting correlations and prediction errors manually. The study calculations use unstandardized data and apply the redundancy-based prediction approach, predicting the endogenous construct scores ($Y_i$) from the exogenous constructs ($X_i$) using the path coefficients ($\beta_i$), and then predicting the measurement items of the exogenous constructs ($y_{ij}$) from the exogenous construct ($Y_i$) via the loadings ($\lambda_{ij}$). To estimate the exogenous constructs ($X_i$), the calculation uses the manifest items of the exogenous constructs ($x_{ij}$), and their corresponding measurement weights ($w_{ij}$). To predict the construct firm performance, this study uses the predicted values of the construct green supply chain management that emerge from a prediction using the construct scores of both exogenous constructs (i.e., IT infrastructure capability and competitive aggressiveness) and their corresponding path coefficients, instead of predicting the construct scores of green supply chain management using its manifest items and the corresponding weights.

The resulting correlations (r) and prediction errors (residual = actual value − predicted value) form the basis for evaluating the overall prediction ability of the proposed research model. Table 4 presents the squared correlations ($r^2$) and root mean squared error (RMSE) values for each of the 10 folds as well as the corresponding averaged values for both prediction procedures (latent and operative prediction).

**Table 3**
Blindfolding analysis.

| | Green supply chain management ($Q^2 = 0.17$) | Firm performance ($Q^2 = 0.23$) |
|---|---|---|
| | $q^2$ | |
| IT infrastructure capability | 0.04 | 0.00 |
| Competitive aggressiveness | 0.11 | 0.00 |
| Green supply chain management | | 0.03 |

## 5. Discussion and conclusions

By testing the proposed research model through PLS estimation, this research finds that IT infrastructure capability and competitive aggressiveness impact firm performance through green supply chain management. In so doing, this research adds the following contributions to the fields of IS and Operations Management. First, the findings open the black box between IT infrastructure, competitive aggressiveness, and firm performance, and reveal green supply chain management as an important mediator. Second, while prior research primarily explores potential antecedents and the impact of a firm's supply chain management capabilities in general, this research shifts focus to a more contemporary view of supply chain management that incorporates a sustainability focus and enriches the literature on green supply chain management (e.g. Bose & Pal, 2012; Hofer et al., 2012; Zhu & Sarkis, 2004). In addition to affirming the positive impact of green supply chain management on firm performance, this study shows that the drivers promoting the firm's ability to pursue environmental management practices throughout the internal and external supply chain correspond to both a resource-based and a market-based view on capability formation. On the one hand, green supply chain management derives from leveraging the firm's internal resource base. Leveraging their technological, managerial, and technical IT base, firms run cutting-edge

**Table 4**
k-fold cross-validation analysis.

| $r^2$ | Latent | | Operative | | | | |
|---|---|---|---|---|---|---|---|
| k-fold | GSCM | RSE | RSE 2007 | RSE 2008 | RSE 2009 | RSE 2010 | RSE 2011 |
| 1 | 0.45 | 0.19 | 0.22 | 0.04 | 0.18 | 0.20 | 0.04 |
| 2 | 0.25 | 0.36 | 0.69 | 0.33 | 0.12 | 0.08 | 0.00 |
| 3 | 0.30 | 0.44 | 0.45 | 0.34 | 0.17 | 0.27 | 0.16 |
| 4 | 0.17 | 0.48 | 0.67 | 0.22 | 0.16 | 0.10 | 0.17 |
| 5 | 0.21 | 0.30 | 0.29 | 0.10 | 0.19 | 0.25 | 0.22 |
| 6 | 0.24 | 0.27 | 0.43 | 0.03 | 0.02 | 0.09 | 0.08 |
| 7 | 0.41 | 0.57 | 0.65 | 0.43 | 0.24 | 0.10 | 0.31 |
| 8 | 0.15 | 0.33 | 0.40 | 0.18 | 0.02 | 0.16 | 0.17 |
| 9 | 0.00 | 0.55 | 0.52 | 0.29 | 0.50 | 0.50 | 0.17 |
| 10 | 0.28 | 0.17 | 0.22 | 0.15 | 0.08 | 0.03 | 0.03 |
| Mean | 0.25 | 0.37 | 0.45 | 0.21 | 0.17 | 0.18 | 0.14 |
| SD | 0.13 | 0.14 | 0.18 | 0.13 | 0.14 | 0.14 | 0.10 |
| RMSE | Latent | | Operative | | | | |
| k-fold | GSCM | RSE | RSE 2007 | RSE 2008 | RSE 2009 | RSE 2010 | RSE 2011 |
| 1 | 1.15 | 0.27 | 0.37 | 0.22 | 0.23 | 0.25 | 0.26 |
| 2 | 1.46 | 0.20 | 0.29 | 0.23 | 0.30 | 0.24 | 0.25 |
| 3 | 1.50 | 0.22 | 0.30 | 0.20 | 0.24 | 0.22 | 0.21 |
| 4 | 1.48 | 0.21 | 0.36 | 0.21 | 0.20 | 0.17 | 0.20 |
| 5 | 1.55 | 0.27 | 0.43 | 0.23 | 0.22 | 0.22 | 0.23 |
| 6 | 1.39 | 0.19 | 0.37 | 0.21 | 0.21 | 0.16 | 0.19 |
| 7 | 1.60 | 0.17 | 0.65 | 0.43 | 0.24 | 0.10 | 0.31 |
| 8 | 1.55 | 0.20 | 0.34 | 0.16 | 0.19 | 0.19 | 0.22 |
| 9 | 1.43 | 0.21 | 0.34 | 0.19 | 0.22 | 0.16 | 0.31 |
| 10 | 1.34 | 0.24 | 0.40 | 0.23 | 0.22 | 0.26 | 0.21 |
| Mean | 1.45 | 0.22 | 0.39 | 0.23 | 0.23 | 0.20 | 0.24 |
| SD | 0.13 | 0.03 | 0.10 | 0.07 | 0.03 | 0.05 | 0.04 |

GSCM = green supply chain management.
SD = standard deviation, RMSE = root mean squared error.

business applications to coordinate with suppliers and customers in executing environmental management activities. Green supply chain management derives, however, from external market conditions (here in terms of degree of competitive aggressiveness) that force the firm to exploit new opportunities to save costs and increase revenues by executing environmental management activities. Firms that operate in an industry with a high degree of competitive aggressiveness may experience a greater trigger to integrate environmental management activities into their supply chain as a possible solution for long-term survival.

While generating these important theoretical contributions, the research also has practical relevance. Firstly, firms' investments in IT infrastructure provide the required IT platforms and IT knowledge to coordinate better with suppliers and customers in executing environmental management activities. Firms that pursue greener supply chain management should invest more in IT infrastructure and leverage their IT knowledge. Secondly, managing the supply chain in a more environmentally sustainable way enables firms to achieve superior performance. Practices such as recycling, remanufacturing, and energy efficiency enable cost saving. Further, collaborative green activities with customers (e.g., reverse logistics) improve customer satisfaction, firm reputation, and brand value, and may lead to increased sales and revenues. The case of PerkinElmer exemplifies the lesson learned in this study. PerkinElmer (a global technology firm that develops advanced precision instruments for health and environmental sciences) implements end-of-life management practices (i.e., reuse, remanufacturing, recycling, or disposal) to contribute to sustainable development along the supply chain. The firm motivates customers to return their equipment to the firm and receive a 10% discount on the next purchase. PerkinElmer in return helps to reduce the environmental impact of products and improves customer relations, inhibits competitors from refurbishing and reselling their equipment, and reduces processing costs (remanufacturing costs are lower than manufacturing new equipment) (Veleva, Montanari, Clabby, & Lese, 2013).

This research has some limitations. First, the study findings generalize only to large firms in Spain. Future research might explore whether this study's theory and prediction are valid in small and medium-sized firms from other national entrepreneurial contexts. Second, although this study measures firm performance with five-year panel data, the measures of IT infrastructure capability, competitive aggressiveness, and green supply chain management are cross-sectional. Future research might revisit the explanatory and predictive power of the proposed model by using panel data for all model variables.

## Acknowledgments

This manuscript benefits from the comments of Javier Llorens and Jörg Henseler. The European Regional Development Fund (European Union) and the Spanish Government (Research Projects ECO2010-15885 and ECO2013-47027-P), the Regional Government of Andalusia (Research Project P11-SEJ-7294), and the COVIRAN-Prodware Chair of Digital Human Resource Strategy at the School of Human Resource Management of the University of Granada sponsor this research.

## Appendix A

**Table A1**
Measurement model evaluation at first- and second-order level.

| Construct/indicator | VIF | Weight |
|---|---|---|
| *Technological IT infrastructure* | 1.44 | 0.31*** |
| Annual investment in technological IT infrastructure per employee | 1.00 | 1.00 |
| Managerial IT infrastructure: 1: Strongly disagree, 7: strongly agree | 1.93 | 0.53*** |
| IT managers identify and support IT-enabled business activities | 1.88 | 0.28*** |
| IT managers provide adequate funding to execute IT innovation projects | 1.88 | 0.27*** |
| IT managers redesign IT processes to sense and respond to business opportunities | 1.61 | 0.37*** |
| IT managers work closely with business managers to execute the firm's business strategies | 1.94 | 0.31*** |
| Technical IT infrastructure: 1: Strongly disagree, 7: strongly agree | 1.43 | 0.40*** |
| Skills of our IT personnel in designing databases are excellent | 2.05 | 0.31*** |
| Skills of our IT personnel in developing new IT applications are excellent | 2.46 | 0.28*** |
| Skills of our IT personnel in improving the efficiency of the IT services are excellent | 1.79 | 0.33*** |
| IT personnel know different programming languages | 1.54 | 0.31*** |
| Competitive aggressiveness: Please indicate, on a scale of 1 to 7, the degree to which you agree or disagree with the following statements as they apply to your industry in the last 5 years: 1: Strongly disagree, 7: strongly agree | | |
| Key competitors typically carried out competitive attacks with a high number of competitive action events (e.g., pricing, new product development, capacity, or service actions) | 2.45 | 0.30*** |
| Key competitors typically carried out competitive attacks of long duration | 2.03 | 0.30*** |
| Key competitors typically carried out competitive attacks with a broad range of types of competitive actions (complex repertoire of competitive actions) | 2.66 | 0.28*** |
| Key competitors typically carried out unpredictable sequences of competitive moves | 2.61 | 0.28*** |
| Green supply chain management: How would you evaluate your firm's ability to implement the following green supply chain management practices when they are perceived to be useful to create business and/or environmental value? 1: Poor, 4: good, 7: excellent | | |
| Commitment and support for green supply chain management from managers | 2.50 | 0.19*** |
| Cross-functional cooperation for environmental improvements | 2.57 | 0.18*** |
| Design of products (or services) for reduced consumption of material/energy | 2.11 | 0.17*** |
| Environmental management system exists | 2.50 | 0.19*** |
| Collaboration with suppliers on environmental issues | 2.33 | 0.21*** |
| Cooperation with customers on environmental issues | 2.02 | 0.14*** |
| Making decisions about ways to reduce overall environmental impact of our products | 2.06 | 0.15*** |
| *Firm performance* | | |
| RSE 2007 | 1.88 | 0.36*** |
| RSE 2008 | 2.01 | 0.23*** |
| RSE 2009 | 2.18 | 0.23*** |
| RSE 2010 | 2.13 | 0.23*** |
| RSE 2011 | 1.89 | 0.17*** |
| *Strategic flexibility* | | |
| Our firm changes current strategies quickly with low costs | 2.82 | 0.30*** |
| Our firm can easily increase the variety of products for delivery | 2.29 | 0.28*** |
| Our firm can enter in new markets for delivery | 1.62 | 0.31*** |

**Table A1** (*continued*)

| Construct/indicator | VIF | Weight |
|---|---|---|
| Our firm periodically adopts new technologies | 2.86 | 0.29$^{***}$ |
| Quality management: How would you evaluate your firm's (degree of) implementation of the following quality management practices? 1: Not considering it, 2: planning to consider it, 3: currently considering it, 4: implementation will begin in the short term, 5: currently initiating implementation, 6: intermediate implementation phase, 7: implementing successfully | | |
| ISO 9000 serial certification | 1.19 | 0.57$^{***}$ |
| Total Quality Management type programs | 1.19 | 0.62$^{***}$ |

**Table A2**
Correlation matrix.

| Construct | 1 | 1.1 | 1.2 | 1.3 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. IT infrastructure capability | 1.00 | | | | | | | | | |
| 1.1. Technological IT infrastructure | 0.69$^{***}$ | 1.00 | | | | | | | | |
| 1.2. Managerial IT infrastructure | 0.91$^{***}$ | 0.55$^{***}$ | 1.00 | | | | | | | |
| 1.3. Technical IT infrastructure | 0.76$^{***}$ | 0.23$^{***}$ | 0.54$^{***}$ | 1.00 | | | | | | |
| 2. Competitive aggressiveness | 0.27$^{***}$ | 0.21$^{***}$ | 0.16$^{**}$ | 0.26$^{***}$ | 1.00 | | | | | |
| 3. Green supply chain management | 0.36$^{***}$ | 0.27$^{***}$ | 0.24$^{***}$ | 0.35$^{***}$ | 0.47$^{***}$ | 1.00 | | | | |
| 4. Firm performance | 0.24$^{***}$ | 0.05 | 0.24$^{***}$ | 0.25$^{***}$ | 0.22$^{***}$ | 0.41$^{***}$ | 1.00 | | | |
| 5. Firm size | −0.02 | −0.25$^{***}$ | 0.15$^{*}$ | −0.01 | 0.07 | 0.19$^{**}$ | 0.53$^{***}$ | 1.00 | | |
| 6. Strategic flexibility | 0.39$^{***}$ | 0.27$^{***}$ | 0.23$^{***}$ | 0.40$^{***}$ | 0.13$^{*}$ | 0.30$^{***}$ | 0.40$^{***}$ | 0.22$^{***}$ | 1.00 | |
| 7. Quality management | 0.11 | 0.11 | 0.06 | 0.11 | 0.27$^{***}$ | 0.36$^{***}$ | 0.27$^{***}$ | 0.25$^{***}$ | 0.18$^{**}$ | 1.00 |

**Table A3**
Procedures for latent and operative prediction analysis.

| Latent prediction analysis |
|---|
| 1. Estimation of proposed research model parameters with training data (loadings $\lambda_{ij}$, weights $w_{ij}$, path coefficients $\beta_{i\_STD}$, unstandardized construct scores $X_i$ and $Y_i$) |
| 2. Calculation of measurement intercept ($b_i$) of construct scores ($X_i$ and $Y_i$) using multiple regression analysis with manifest items ($x_{ij}$ and $y_{ij}$) and construct scores ($X_i$ and $Y_i$) from training sample (step 1) |
| 3. Calculation of construct scores ($X_i$ and $Y_i$) using manifest items ($x_{ij}$ and $y_{ij}$) from validation sample and corresponding weights from training sample ($w_{ij}$) (step 1), as well as measurement intercept ($b_i$) (step 2) |
| 4. Calculation of unstandardized path coefficients ($\beta_i$) using standardized path coefficients ($\beta_{i\_STD}$) (step 1) and standard deviation ($SD_{x/y}$) of construct scores ($X_i$ and $Y_i$) from training sample (step 1):<br>$\beta_i = \beta_{i\_STD} * SD_y / SD_x$<br>x = exogenous variable, y = endogenous variable |
| 5. Calculation of structural intercept ($b_i$) of construct score of endogenous variable ($Y_i$) (step 1) using multiple regression analysis with construct scores ($X_i$ and $Y_i$) of training sample (step 1) |
| 6. Prediction of construct score of endogenous variable ($Y_i$) using construct scores of exogenous variables ($X_i$) (step 3), corresponding unstandardized path coefficients ($\beta_i$) (step 4), and structural intercept ($b_i$) (step 5) |
| 7. Calculation of correlation (r) and squared correlation ($r^2$) between predicted construct score of endogenous variable ($Y_i$) (step 6) and construct score of endogenous variable ($Y_i$) (step 3) |
| 8. Calculation of RMSE based on squared residual of construct score of endogenous variable ($Y_i$) (step 3) and predicted construct score of endogenous variable ($Y_i$) (step 6) |
| **Operative prediction analysis** |
| Steps 1–6: see latent prediction analysis |
| 7. Calculation of intercept ($b_i$) of each item ($y_{ij}$) of endogenous construct using simple regression analysis with manifest item score ($y_{ij}$) and unstandardized construct scores ($Y_i$) of training sample (step 1). |
| 8. Prediction of each item score ($y_{ij}$) for endogenous construct using predicted construct score of endogenous variable ($Y_i$) (step 6), corresponding loading ($\lambda_{ij}$) (step 1), and intercept ($b_i$) (step 7). |
| 9. Calculation of correlation (r) and squared correlation ($r^2$) between predicted item score of endogenous variable ($y_{ij}$) (step 8) and manifest item of endogenous variable from validation sample. |
| 10. Calculation of RMSE based on squared residual of manifest item of endogenous variable from validation sample and predicted item score of endogenous variable ($y_{ij}$) (step 8). |

## References


Barroso, C., Cepeda, G., & Roldan, J. (2010). Applying maximum likelihood and PLS on different sample sizes: Studies on SERVQUAL model and employee behavior model. In V. Esposito, W. Chin, J. Henseler, & H. Wang (Eds.), *Handbook of partial least squares: Concepts, methods and applications* (pp. 427–447). Berlin, Germany: Springer.

Benitez, J., & Ray, G. (2012). Introducing IT-enabled business flexibility and IT integration in the acquirer's M&A performance equation. *Proceedings of the 33rd International Conference on Information Systems, Orlando, Florida, USA* (pp. 1–21).

Benitez, J., & Walczuch, R. (2011). IT, proactive environmental strategy and firm performance: A resource-based analysis. *Proceedings of the 17th Americas Conference on Information Systems* (pp. 1–10). Michigan, USA: Detroit.

Benitez, J., & Walczuch, R. (2012). Information technology, the organizational capability of proactive corporate environmental strategy and firm performance: A resource-based analysis. *European Journal of Information Systems*, *21*(6), 664–679.

Benitez, J., Llorens, J., & Fernandez, V. (2013). The relationship between IT infrastructure leveraging, talent management and operational sustainability, and their effects on the business value of the operations strategy. *Proceedings of the 19th Americas Conference on Information Systems, Chicago, Illinois, USA* (pp. 1–8).

Benitez, J., Llorens, J., & Fernandez, V. (2015). IT impact on talent management and operational environmental sustainability. *Information Technology & Management*, *16*(3), 207–220.

Bose, I., & Pal, R. (2012). Do green supply chain management initiatives impact stock prices of firms? *Decision Support Systems*, *52*(3), 624–634.

Braojos, J., Benitez, J., & Llorens, J. (2015a). Impact of IT infrastructure on customer service performance: The role of micro-IT capabilities and online customer engagement. *Proceedings of the 19th Pacific Asia Conference on Information Systems, Singapore* (pp. 1–17).

Braojos, J., Benitez, J., & Llorens, J. (2015b). How do small firms learn to develop a social media competence? *International Journal of Information Management*, *35*(4), 443–458.

Byrd, T., & Davidson, N. (2003). Examining possible antecedents of IT impact on the supply chain and its effect on firm performance. *Information & Management*, *41*(2), 243–255.

Cenfetelli, R., & Bassellier, G. (2009). Interpretation of formative measurement in Information Systems research. *MIS Quarterly*, *33*(4), 689–707.

Chen, Y., Wang, Y., Nevo, S., Benitez, J., & Kou, G. (2015a). IT capabilities and product innovation performance: The roles of corporate entrepreneurship and competitive intensity. *Information & Management*, *52*(6), 643–657.

Chen, Y., Wang, Y., Nevo, S., Benitez, J., & Kou, G. (2015b). Improving strategic flexibility with information technologies: Insights for firm performance in an emerging economy. *Journal of Information Technology*, 1–16 (advance online publication).

Chen, Y., Wang, Y., Nevo, S., Jin, J., Wang, L., & Chow, W. (2014). IT capability and organizational performance: The roles of business process agility and environmental factors. *European Journal of Information Systems*, *23*(3), 326–342.

Chin, W. (2010). How to write up and report PLS analyses. In V. Esposito, W. Chin, J. Henseler, & H. Wang (Eds.), *Handbook of partial least squares: Concepts, methods and applications* (pp. 655–690). Berlin, Germany: Springer.

Chou, C., Wang, Y., & Tang, T. (2015). Exploring the determinants of knowledge adoption in virtual communities: A social influence perspective. *International Journal of Information Management*, *35*(3), 364–376.

Dao, V., Langella, I., & Carbo, J. (2011). From green to sustainability: Information technology and an integrated sustainability framework. *Journal of Strategic Information Systems*, *20*(1), 63–79.

Devaraj, S., Krajewski, L., & Wei, J. C. (2007). Impact of ebusiness technologies on operational performance: The role of production information integration in the supply chain. *Journal of Operations Management*, *25*(6), 1199–1216.

Elliot, S. (2011). Transdisciplinary perspectives on environmental sustainability: A resource base and framework for IT-enabled business transformation. *MIS Quarterly*, *35*(1), 197–236.

Ferrier, W. (2001). Navigating the competitive landscape: The drivers and consequences of competitive aggressiveness. *Academy of Management Journal*, *44*(4), 858–877.

Fiss, P. C. (2011). Building better causal theories: A fuzzy set approach to typologies in Organization research. *Academy of Management Journal*, *54*(2), 393–420.

Gefen, D., Straub, D., & Rigdon, R. W. (2011). An update and extension to SEM guidelines for Administrative and Social Science research. *MIS Quarterly*, *35*(2), iii–xiv.

Gigerenzer, G., & Brighton, H. (2009). Homo heuristicus: Why biased minds make better inferences. *Topics in Cognitive Science*, *1*(1), 107–143.

Green, K. W., Zelbst, P. J., Meacham, J., & Bhadauria, V. S. (2012). Green supply chain management practices: Impact on performance. *Supply Chain Management: An International Journal*, *17*(3), 290–305.

Hair, J., Ringle, C., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139–152.

Hair, J., Sarstedt, M., Ringle, C., & Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in Marketing research. *Journal of the Academy of Marketing Science*, *40*(3), 414–433.

Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The elements of statistical learning: Data mining, inference, and prediction* (2nd ed.). Berlin, Germany: Springer.

Henseler, J. (2015). *Is the whole more than the sum of its parts? On the interplay of Marketing and Design research.* Enschede, The Netherlands: University of Twente, 1–40.

Henseler, J., & Dijkstra, T. (2015). *ADANCO 1.1.1 Professional.* Kleve, Germany: Composite Modeling (http://www.compositemodeling.com).

Henseler, J., & Fassott, G. (2010). Testing moderating effects in PLS path models: An illustration of available procedures. In V. Esposito, W. Chin, J. Henseler, & H. Wang (Eds.), *Handbook of partial least squares: Concepts, methods and applications* (pp. 713–735). Berlin, Germany: Springer.

Henseler, J., Dijkstra, T., Sarstedt, M., Ringle, C., Diamantopoulos, A., Straub, D., ... Calantone, R. (2014). Common beliefs and reality about PLS: Comments on Ronkko & Evermann (2013). *Organizational Research Methods*, *17*(2), 182–209.

Henseler, J., Hubona, G., & Ray, P. (2016). Using PLS path modeling in New Technology research: Updated guidelines. *Industrial Management & Data Systems*, *116*(1), 1–23.

Hofer, C., Cantor, D. E., & Dai, J. (2012). The competitive determinants of a firm's environmental activities: Evidence from U.S. manufacturing industries. *Journal of Operations Management*, *30*(1–2), 69–84.

Hu, L. T., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, *3*(4), 424–453.

Melville, N., Kraemer, K., & Gurbaxani, V. (2004). Review: Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly*, *28*(2), 283–322.

Mignerat, M., & Rivard, S. (2009). Positioning the institutional perspective in Information Systems research. *Journal of Information Technology*, *24*(4), 369–391.

Mitra, S., & Datta, P. P. (2014). Adoption of green supply chain management practices and their impact on performance: An exploratory study of Indian manufacturing firms. *International Journal of Production Research*, *52*(7), 2085–2107.

Ordanini, A., Parasuraman, A., & Rubera, G. (2014). When the recipe is more important than the ingredients: A qualitative comparative analysis (QCA) of service innovation configurations. *Journal of Service Research*, *17*(2), 134–149.

Petter, S., Straub, D., & Rai, A. (2007). Specifying formative constructs in Information Systems research. *MIS Quarterly*, *31*(4), 623–656.

Ray, G., Muhanna, W., & Barney, J. (2005). Information technology and the performance of the customer service process: A resource-based analysis. *MIS Quarterly*, *29*(4), 625–652.

Rigdon, E. E., Becker, J. M., Rai, A., Ringle, C. M., Diamantopoulos, A., Karahanna, E., ... Dijkstra, T. (2014). Conflating antecedents and formative indicators: A comment on Aguirre-Urreta and Marakas. *Information Systems Research*, *25*(4), 780–784.

Ringle, C., Sarstedt, M., & Straub, D. (2012). A critical look at the use of PLS-SEM in MIS Quarterly. *MIS Quarterly*, *36*(1), iii–xiv.

Ringle, C., Wende, S., & Will, A. (2005). *SmartPLS 2.0.M3.* Hamburg, Germany: University of Hamburg (http://www.smartpls.de).

Roberts, N., & Thatcher, J. (2009). Conceptualizing and testing formative constructs: Tutorial and annotated example. *Data Base for Advances in Information Systems*, *40*(3), 9–39.

Roldan, J., & Sanchez, M. (2012). Variance-based structural equation modeling: Guidelines for using partial least squares in Information Systems research. In M. Mora, O. Gelman, A. L. Steenkamp, & M. Raisinghani (Eds.), *Research methodologies, innovations and philosophies in Software Systems Engineering and Information Systems* (pp. 193–221). Hershey, Pennsylvania, USA: IGI Global.

Saeidi, S., Sofian, S., Saeidi, P., Saeidi, S., & Saaeidi, S. (2015). How does corporate social responsibility contribute to firm financial performance? The mediating role of competitive advantage, reputation, and customer satisfaction. *Journal of Business Research*, *68*(2), 341–350.

Sarstedt, M., Ringle, C. M., & Hair, J. F. (2014). PLS-SEM: Looking back and moving forward. *Long Range Planning*, *47*(3), 132–137.

Setia, P., & Patel, P. (2013). How information systems help create OM capabilities: Consequents and antecedents of operational absorptive capacity. *Journal of Operations Management*, *31*(6), 409–431.

Shmueli, G., & Koppius, O. (2011). Predictive analytics in Information Systems research. *MIS Quarterly*, *35*(3), 553–572.

Shmueli, G., Ray, S., Velasquez, J. M., & Chatla, S. B. (2016). The elephant in the room: Evaluating the predictive performance of PLS models. *Working paper* (pp. 1–48).

Sousa, R., Amorin, M., & Rabinovich, E. (2015). Customer use of virtual channels in multichannel services: Does type of activity matter? *Decision Sciences*, *46*(3), 1–9.

Ton, Z., & Harrow, S. (2010). Mercadona. *Harvard Business School Case* (pp. 1–25) (9-610-089).

Veleva, V., Montanari, A., Clabby, P., & Lese, J. (2013). PerkinElmer: Old instrument reuse and recycling. *Richard Ivey Business School Case* (pp. 1–14) (IVEY-9B12M115-E).

Volberda, H. (1996). Toward the flexible form: How to remain vital in hypercompetitive environments. *Organization Science*, *7*(4), 359–374.

Wang, Y., Chen, Y., & Benitez, J. (2015). How information technology influences environmental performance: Empirical evidence from China. *International Journal of Information Management*, *35*(2), 160–170.

Woodside, A. G. (2013). Moving beyond multiple regression analysis to algorithms: Calling for adoption of a paradigm shift from symmetric to asymmetric thinking in data analysis and crafting theory. *Journal of Business Research*, *66*(4), 463–472.

Zhao, X., Lynch, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, *37*(2), 197–206.

Zhu, Q., & Sarkis, J. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *Journal of Operations Management*, *22*(3), 265–289.