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Effect of IoT Capabilities and Energy Consumption behavior on Green Supply Chain Integration

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Abstract: The Internet of Things (IoT) is the next generation of internet-connected information communication technologies (ICT). IoT typically integrates supply chain activities to enhance green supply chain performance (GSCP). Since every organization has different IoT capabilities in comparison with other organizations, GSCP can enable supply chain integration activities for enhanced performance. The implementation of an IoT system can reduce the consumption of organizational resources like energy, electricity, and time and can increase the operational speed to gain better logistics and, ultimately, improved supply chain performance. This study has developed and empirically tested the relationship between IoT capabilities, energy consumption behavior (ECB), supply chain integration, green training (GT), and supply chain practices. Such a multidisciplinary relationship has not previously been established in the literature. The proposed study can fulfill the literature gap and opens new horizons for interdisciplinary research. Data used in this study are collected through offline and online survey methods. A total number of 250 out of 400 respondents participated in the survey. Data has been analyzed through partial least square—structure equation modeling (PLS—SEM) technique. The results of this study empirically test the developed model. IoT has a positive effect on supplier integration (SI), and customer integration (CI). Furthermore, SI and CI have a mediating role between IoT and GSCP, and GT has a positive impact on GSCP. It is concluded that the implementation of IoT can integrate CI and SI to increase GSCP. GT and ECB can ultimately improve GSCP. Additionally, the use of technology and GT can motivate employees to save energy and protect the environment to increase GSCP.

Keywords: internet of things; energy consumption behavior; green training; green supply chain performance

1. Introduction

Internet of Things (IoT) is a prominent innovation in the field of information and communication technologies where IoT can connect different devices through the internet [1]. IoT can interlink different devices (such as sensors, networking devices, and vehicles) through different software to share their real-time data through the internet [2]. IoT also provides a platform to interlink different

processes, devices, and people located at different places around the world [3]. These days, most of the organizations are using information and communication technologies (such as entrepreneur resources planning (ERP), computers, email, smartphones, barcodes, fax, radio frequency identification (RFID), and many other advanced technologies) for communicating and sharing real-time information [3]. The functionality of these technologies can be increased through internet connectivity [4]. Whereas, IoT is an intelligent and autonomous solution compared to other information communication technologies [5] and can help business organizations to meet modern needs with ease and efficiency.

Information and communication technologies (ICT) help in managing and monitoring orders, packaging, distribution, transportation, storage, and return functions in supply chain management [6]. The IoT can interlink all these supply chain processes through the internet and can provide support for the global monitoring of such business activities. Additionally, the suppliers, customers, and manufacturers can communicate and exchange information with each other through IoT [1,3]. Furthermore, modern technologies like bar codes, RFID, and sensors are also revolutionizing the retail industry [7].

In the supply chain works available in previous literature, the relationship between ICT and supply chain integration has already been established to improve supply chain performance [6,8–10]. Furthermore, the relationship between IoT, supply chain integration, and SCP has also been previously established in the literature [11]. However, the most critical factors like energy consumption behavior (ECB) and green training (GT), that are the crucial elements in achieving a successful green supply chain performance (GSCP), are ignored in the previous studies. Typically, GSCP is concerned with environmentally friendly activities which differentiates it from traditional supply chain management. Considering this research gap, the study presented in this paper investigates and develops a relationship between IoT, SI, CI, ECB, GT, and GSCP and tests this relationship empirically.

Resource-based theory and contingency theory supports the need of the study presented in this paper since IoT and GT can enhance the organizational capabilities to create a competitive advantage to increase GSCP. Moreover, the combination of both theories can provide the guidelines to develop an environmentally friendly framework to increase GSCP. Thus, the relationship between IoT, SI, CI, GT, ECB, and GSCP is logically supported by two different theories. This study can fill the research gap identified in the available GSCP literature and open new horizons of improvement and gain in business for organizations and researchers.

The rest of the paper includes a literature review relevant to the studied variables, followed by the methodology, results, and conclusion.

2. Background and Related Work

2.1. Resource-Based Theory (RBT)

Resource-based theory is a managerial framework typically used to determine the strategic resources with the potential to deliver comparative advantage to a firm [12]. Competitive advantage is the ultimate objective of every organization and can be achieved through environmental scanning and matching the environment with organizational resources. The competitive behavior of organizations does not depend on only the external factors [13], but is the result of both the internal and external factors. The internal factors of an organization are their resources and capabilities. Resources are the value-creating strategies. Overall, RBT is the combination of different and unique collections of an organization's tangible and intangible resources and capabilities [14].

For every organization, resources and products are two different sides of the same coin. In this competitive era, organizations need to develop a focus on both resources and products at the same time to gain a sustainable competitive advantage. This is because most of the products require services that are based on resources and most of the time services require products. Therefore, it is difficult to separate both. A resource product matrix has also been developed in previous studies [15]. Here, the key to success is to understand and concentrate on both products and resources at the same time to

gain a sustainable competitive advantage [16]. In this study, IoT and GT are identified as having firm capabilities to enhance the supply chain integration and GSCP of an organization.

2.2. Contingency Theory

Contingency theory [17,18] claims that there is no perfect theory, method, or way to manage organizations or to make decisions. The contingency approach employs the reductionist approach as it suggests that organizational processes and methods should be divided into different independent processes, methods, and departments [19]. Therefore, organizations need to align their processes and methods to the environment. Moreover, the optimal decision can be affected by the internal and external environment to maximize organizational performance [20,21]. In the supply chain context, management, customers, and suppliers are the most crucial environmental elements in a manufacturing environment.

Structural contingency theory [17,22,23] develops the relationship between organizational strategy and organizational performance. If an organizational strategy fits in its organizational design and structure, then organizations can thrive and perform their operations efficiently. The structural contingency theory has focused on strategic management literature because it provides guidelines to align organizational structure, design, and strategy to maximize organizational performance [24–26]. Contingency theory allows individual partners of the supply chain to align their activities with each other to achieve SCP.

2.3. Internet of Things

In business management literature, IoT is used to facilitate organizations' modern needs [27,28]. IoT can enable organizations to align their resources on a single platform and track all their processes and activities efficiently [11,27]. In supply chain management, IoT has practical implications. It can be used to track products, maintain inventory, keep a record of buyers and suppliers, reduce theft and mishandling, in addition to many other benefits. Nowadays, most of the organizations have their own customized software to integrate their activities and to align their customers, suppliers, and team members, for sharing information, enhancing communication, and to smooth organizational activities. The supply chain ranges from traditional inventory registers and activities to a computerized system. Finally, IoT systems based on barcode scanners and RFID technology enable people to track, monitor, record, and analyze inventory details. This is achieved only due to IoT applications in the supply chain and to enhance the supply chain performance [29,30].

In this study, the relationship between IoT and SI and IoT and CI has been established. Since IoT can enable both suppliers and customers to integrate with the manufacturer, it can also help to enhance the interaction between manufacturer and supplier to understand the needs of the manufacturer, production planning, and inventory level. The manufacturer can order online or via email using information and communication technologies or with the use of IoT to order the products according to a product's design and its cost. All in all, IoT can positively affect SI, which can lead to GSCP [11,27]. In the same way, IoT also affects CI, since IoT can enable customers to interact and communicate with the manufacturers. IoT can also facilitate customers to book their products online and check the specification of products by using the internet. Furthermore, the customer can track their products in real time. Customers can get in contact with the manufacturer and can subsequently develop a strong relationship. This can result in customer satisfaction, loyalty, and the reordering of products from the same manufacturer which can result in certain manufacturers having a competitive advantage and improved financial performance. Therefore, the use of IoT can increase customer interaction, and CI can lead to enhanced supply chain performance and GSCP [11,27].

2.4. Energy Consumption Behavior

Energy consumption behavior explains the emotional and behavioral attitude of individuals, groups, and organizations toward utilizing energy resources for the planning, production, and delivery

of products and services [31]. Also, energy consumption behavior can be observed at individual and institutional levels while using different appliances like computers, electric lights, fans, air conditioners, heating equipment for buildings, and even the use of cars and other vehicles for personal and organizational purposes. Moreover, energy consumption behavior is the overall attitude regarding the use of any energy resources to gain personal, procedural, or economic benefits [32]. In this study, the relationship between IoT, energy consumption behavior and SI, and CI is investigated to enhance GSCP. IoT can motivate individuals and organizations to save energy by consuming less energy, either through electrical appliances, transportation, or energy consumption material, and to increase economic performance [32].

There are different types of energy that can be consumed at homes and institutions. The most crucial energy type is electricity. It is important to save electricity through the use of energy-efficient appliances. Nowadays, organizations are producing energy-efficient devices such as refrigerators, air conditioners, electric lights, computers, and many others. Since customers are currently demanding energy-efficient products to save electricity, this can result in protecting the environment and reducing the electricity bills on an individual as well as an institutional level. Furthermore, hydrogen fuel cell cars and liquid fuel transportation can save energy in the transportation sector. The ultimate goal is to save energy and to protect the environment while also saving costs to gain economic benefits [33].

Energy resources are limited around the world, with developing countries especially, such as Pakistan, facing serious energy shortages for many years. The recent energy crises have created an awareness in society to conserve energy. The awareness brings innovation to electrical appliances to save electricity. Organizations introduce new products that can work using batteries or less power [34]. Furthermore, organizations highlighted this innovation to attract their customers with the potential of lower electricity consumption and cost-saving benefits. The innovative products can prove to be more effective compared to traditional products [34,35].

Presently, organizations and individuals are producing energy for their needs via personal means. Nowadays, many organizations are also using solar energy. In countries like Pakistan, a shortage of electricity also encourages the householders to produce electricity through solar energy directly from the Sun or generate electricity through power generators. Such generation, storage, and utilization of self-produced electricity also reduces the demand for electricity from the government or private sectors and can also lessen the burden and reduce the shortage of electricity. Furthermore, such awareness can also change the energy consumption behavior of individuals and organizations [34,35].

2.5. Supply Chain Integration

In supply chain management literature, SCI is a new concept compared to the relationship between a manufacturer, supplier, and customer that is very established. However, this collaborative relationship is found to be unidimensional in the literature [36–39]. Moreover, a few studies have focused on the dynamic relationship between supply chain partners [40]. Furthermore, a few studies have considered the supply chain as a single system, instead of dividing the supply chain into different subsystems [41–46]. SCI reflects the flow of material and parts from one supply chain component to another [47]. Some authors suggest that SCI is a flow of cash, resources, and information in supply chain subsystems. However, in the previous literature, the strategic nature of SCI has been ignored. SCI can be divided into two dimensions of internal integration with manufacturers and external integration with suppliers and customers. However, external integration can be in both directions [41].

Integration can be implemented in the supply chain as the strategic process for collaboration with other supply chain partners to allow the flow of information and resources that can manage inter-organizational and intra-organizational processes and make organizational processes smoother. The ultimate goal of SCI is the flow of information, resources, money, products, and services to serve customers more effectively and efficiently and to result in speedy organizational processes and reduce operational costs [41,43,48,49].

SCI encourages supply chain partners to strategically collaborate. It can provide operational and strategic benefits [50]. SCI also motivates supply chain partners to share information, reduce supply chain risks, and increase contract duration and trust [51–53]. SCI highlights the importance of inter- and intra-organizational processes and their outcomes to achieve operational and organizational performance since the primary objective of SCI is customer satisfaction.

Customer and supplier integrations are typically considered as external integrations. CI and SI both can develop the strategic relationship between a manufacturer, supplier, and customer to develop inter-organizational strategies, processes, practices, and collaboration [54]. CI involves the competencies, practices, and coordination of critical customers, whereas, SI is related to competencies, practices, and integration with critical suppliers [48]. Both CI and SI can interact with customers and suppliers whereas a manufacturer can interact efficiently and synchronize processes to fulfill the requirements of their customers [41,55–57].

2.6. Customer and Supplier integration to Performance

Structural contingency theory explains that an organization's structure, design, methods, and strategies can fit with the external environment. In manufacturing, suppliers and customers are crucial elements of the external environment. In the supply chain, the manufacturer should develop, select, and implement strategies for their internal and external environment to achieve operational and organizational performance [58–60]. Therefore, organizations must respond to their internal (within the organization) and external environments (customer and suppliers) through organizational strategies to smooth organizational performance [41].

A stronger relationship between a customer and a manufacturer not only makes their customers loyal to them but it also enables an organization to understand the needs of their customers through information sharing. A manufacturer can forecast the demands, product design, production planning time, cost, inventory level, and customer needs. As long as a manufacturer and a customer have a close relationship with each other they can share information. So, CI can help a manufacturer to become customer-oriented through collaboration and information sharing to enhance operational, SCP, and organizational performance [11,41].

CI typically provides opportunities of leveraging the intelligence in the collaborative process as it enables an organization to understand its customers, create greater values for their customers, reduce costs, and allows for an understanding of the rapid change in customers' demands, market turbulence, and competitive strategies. CI can enhance the customers' satisfaction level as customers' views are involved in the planning, product design, and delivery processes and as a manufacturer takes information and feedback from its customers directly. Furthermore, customers also participate in product innovation and product development indirectly [61,62]; however, the ultimate goal of CI is customer satisfaction [63].

Supplier and manufacturer integration can develop a strategic collaboration between a supplier and a manufacturer. SI can enable a supplier to anticipate and understand the needs of its manufacturer and also to predict the rapid change in a manufacturers' demands. SI motivates a manufacturer and a supplier to share information, understand the manufacturers' capabilities, develop production plans, and to develop product delivery process, time, and costs. Therefore, SI plays a major role in planning, production, delivery, and services to achieve operational performance [11,41].

SI not only strengthens the relationship between a manufacturer and a supplier but it also improves the customer's satisfaction level, customer services, and customer loyalty since SI is directly related to product planning, product manufacturing, and product performance [64–66]. Furthermore, SI can enhance the communication between a supplier and a manufacturer to improve operational and organizational performance [54–67]. Additionally, SI can also improve communication, exchange information, strengthen the relationship, participate in planning, production capabilities, and inventory management to enhance operational and organizational performance. Therefore, both customer and supplier integration can enhance operational, supply chain, and organizational performance [11,41].

2.7. Green Training

Green human resource management practices are emerging trends in human resource management. Green human resource management practices have a positive effect on operational performance and GSCP [67,68]. Therefore, green training can create green awareness and environmentally friendly thinking among employees through green education, which can be implemented in the organizations [69]. With reference to the literature on green human resource management, GT can develop environmental understanding at all levels of employees (from top, senior, middle, to lower level) in an organization. Furthermore, employees can implement their green knowledge into their operational activities. GT can enable organizations to integrate their routine activities to green practices and play their role to protect the environment. So, the ultimate goal of GT is to achieve environmental performance [70,71].

In GT literature, it is highlighted that GT has a positive impact on greening the organization because GT enables all the employees to think about and move towards greener practices. Therefore, GT can lead to improving the green practices in the organization at all levels. Furthermore, GT also focuses on developing green teams in an organization to achieve environmentally friendly practices in an organization [72]. In Spain, GT-motivated organizations are focusing on advanced green practices and on protecting the environment and contributing to environmental performance [73].

In this study, GT was considered the moderated variable between SI, CI, and GSCP because both customers and suppliers are moving toward and demanding environmentally friendly production methods that can lead to economic and operational performance [74,75]. The relationship between GT and GSCP is also established in the previous study. Moreover, this study focuses on motivating suppliers to supply green raw material to a manufacturer and motivates a manufacturer to implement green production methods which can lead to a safe environment and bring economic performance and GSCP.

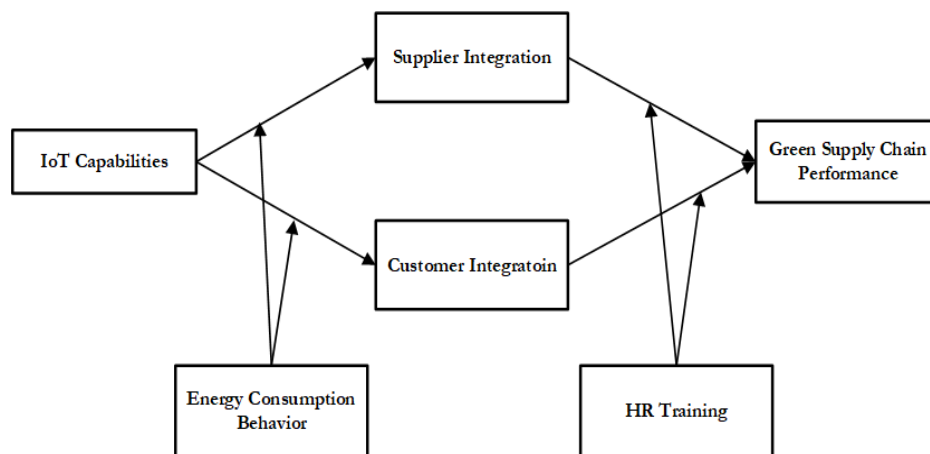Based on the above literature, the proposed research model is shown in Figure 1.

Figure 1. Proposed research model.

3. Methodology

3.1. Sample and Data Collection Procedure

In this study, partial least square—structure equation modeling (PLS—SEM) has been used to analyze the data. It is a new methodology on the exploratory stage relationships which can work on a small sample size. Considering this fact, this study analyzes the conceptual framework with modern statistical techniques to obtain greater accuracy in the results.

The target population of this study is the retail industry in Pakistan. The sample was taken from the utility, metro, and modern retail stores from five major cities, i.e., Faisalabad, Karachi, Peshawar,

Lahore, and Islamabad. The justification of the population is that, in modern trade too many customers and suppliers are involved in trading on a regular basis. Modern retail stores have a number of products and brands because they have more space and larger investments compared to other local stores. They are actively involved with customers and suppliers at the same time to create a balance between the demand and supply of products. Therefore, they need to manage their stores with the help of new technologies such as computers, scanners, and radio frequency identification (RFID) to increase their operational performance. This study focuses on IoT, SI, CI, ECB, GT, and GSCP; all these concepts are practically implemented in modern retail stores [76]. Hence, modern retail stores are a suitable population for this study. In the previous literature, the retail sector was considered as the targeted population for IoT, supply chain integration, and performance [11].

The sample is the subset of the population. In this study, 400 employees from modern trade stores have been selected through a simple random sampling technique; a probability sampling method. The demographics of the respondents are mentioned in Table 1. Both offline and online data collection methods were used. A questionnaire was designed based on the Likert Scale in this study. The offline questionnaire is distributed physically among employees while the online questionnaire link is forwarded through emails. A face to face survey has a better response rate compared to the online method, but the online survey method is free and the data collection is quick this way. Data were collected from February 2018 to May 2018. For an online questionnaire, one gentle reminder was sent to increase the response rate. In this study, a total of 400 questionnaires were distributed using both methods. The total number of completed filled questionnaires that were received was 250, that resulted in a total response rate of 62.5%.

Table 1. Profile of respondents.

Demographic Factor	Values	Frequency	Percentage
Gender			
	Female	62	25.0
	Male	188	75.0
Education			
	Intermediate	25	10.0
	Bachelor	62	24.5
	Masters	163	65.5
Age in Years			
	18–25	19	7.6
	26–35	115	46.0
	36–40	101	40.4
	Above 40	15	6.5
Experience in Years			
	1–3	24	9.6
	4–6	56	22.4
	7–9	90	36.0
	Above 9	80	32.0
Designation			
	Lower level Management	80	32.0
	Middle Level Management	120	48.0
	Upper Management	50	20.0

3.2. Why Use PLS-SEM? Use of Modern Tools and Software

In this study, a few computer applications were used. The survey is designed by using lime survey which is a web-based survey application. This application gives survey responses outputs in a comma-separated values (CSV) file. This CSV file can be directly imported to SmartPLS 3 [76]. Additionally, SPSS 24 was also used in this study to compute variables and find frequencies of the demographic variables. Microsoft Word 2016 was used for report writing. A Grammarly Premium account was used to check grammar and spell checking of the manuscript.

PLS-SEM was the main software used for empirical data analysis. There are two main reasons to choose PLS-SEM. First, the relationship between IoT, SI, CI, ECB, GT, and GSCP is at the exploratory stage and has not been established and empirically tested in the literature. PLS-SEM is more precise when presenting the variance of dependent variables. This software also helps test the relationship among different variables at their early exploratory stage [77–79]. Second, the sample size of this study is small for generalization. PLS-SEM enables one to calculate more precise variance on a small sample [80] since this software does not consider the assumptions of normality [81]. Furthermore, this study is also based on a small sample size; therefore, it is not possible to analyze statistical tests using covariance-based structural equation modeling software like AMOS. PLS-SEM resolves both of these problems. In this study, there were 5000 subsamples to bootstrap during analysis. Therefore, PLS-SEM is considered the suitable option to analyze the small sample size data at exploratory relationship stage.

3.3. Research Instrument

In this study, the research instrument has been developed by adapting those from previous studies. Only small changes needed to be made to the items. All items were measured on a Likert scale (five-point scale, anchored from strongly disagree to strongly agree). Items having factor loadings less than 0.6 were dropped and were not considered for further analysis. The reliability (Cronbach's Alpha and Composite reliability), validity, and factor loadings of items are mentioned in the following text.

Internet of Things (IoT): IoT has been measured using twelve items adapted from a previous study [11].

Supplier Integration (SI): SI has been measured using eleven items adapted from previous studies [41,82,83].

Customer Integration (CI): CI has been measured using nine items adapted from previous studies [41,82,83].

Energy Consumption behavior (ECB): ECB has been measured using ten items adapted from a previous study [32].

Green Training (GT): GT has been measured using ten items adapted from previous studies [69,72].

Green Supply Chain Performance (GSCP): GSCP has been measured using twelve items adapted from a previous study [84].

3.4. Common Method Variance

Common Method Variance is the variance attribute of the measurement method instead of the instrument variance method. The chances of common method biases are increased when data has been collected from the same respondents on a single questionnaire for both dependent and independent variables [85]. When the information about dependent and independent variables is collected from the same respondents at the same time, the common method bias has occurred. However, the common method bias can be reduced if the questionnaire has been divided into different pages for dependent and independent pages [85]. In this study, cross-sectional data has been collected for all study-relevant variables at the same time from the same respondents; therefore, it is necessary to check the common method bias in this study.

Common method bias can be reduced through different methods. First, Harman Method; second, Lindell and Whitney Method; third, the Bagozzi approach [86]. Common method bias can be analyzed through any of these methods. However, in this study, a correlational method (Bagozzi approach) was used to calculate the common method bias [86]. According to this method, if constructs have less than a 0.9 correlation with each other, then there is no common method bias. Therefore, the correlational values in Table 2 show that there is no common method bias in the study.

Table 2. Mean, standard deviation, and Fornell and Larcker criterion method for discriminant validity.

	Mean	**S.D.**	**CI**	**ECB**	**GSCP**	**GT**	**IoT**	**SI**
CI	3.40	0.491	0.727					
ECB	3.41	0.510	0.89	0.76				
GSCP	3.50	0.501	0.736	0.737	0.688			
GT	3.38	0.498	0.78	0.776	0.753	0.75		
IoT	3.36	0.540	0.78	0.775	0.87	0.774	0.691	
SI	3.40	0.489	0.781	0.784	0.77	0.988	0.788	0.737

3.5. Measurement Model

Structural equation modeling is based on two types of models; first, a measurement model and, second, a structural model. In the measurement model, the validity and reliability of an instrument is analyzed [87]. Here, validity is measured through content validity, convergent validity, and discriminant validity [78,88]. Whereas, reliability is measured through Cronbach's Alpha and composite reliability.

Reliability can be measured through Cronbach's Alpha value. It typically checks the consistency or internal consistency of items. In this study, the reliability of items is tested, and the values of Cronbach's Alpha test are mentioned in Table 3. The minimum acceptable value for Cronbach's Alpha test is 0.6 [89]. In this study, the Cronbach's Alpha values of each variable have a value greater than o.6. Therefore, all variables are reliable for further analysis. Figure 2 shows the Cronbach's Alpha values for the reliabilities of all variables.
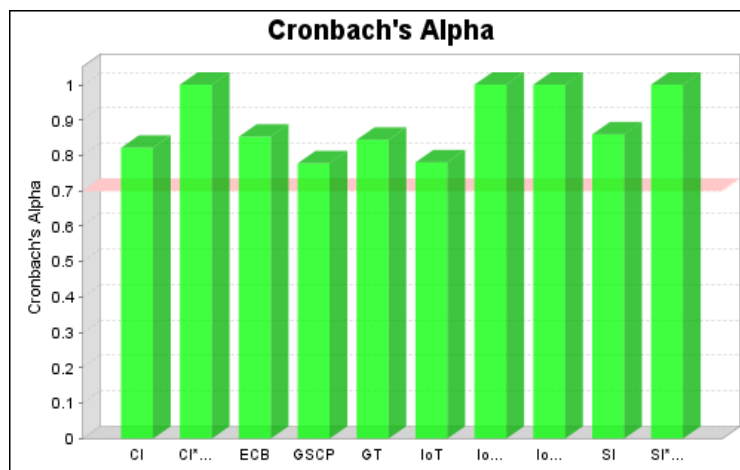

Figure 2. Cronbach's Alpha values of research variables.

Composite reliability is the consistency of all items of the specific construct [90]. It can be obtained through the PLS-SEM method. The results of composite reliability are mentioned in Table 3. The composite reliability is measured when items are reflective, while if the items have formative measures, then the variance inflation factor (VIF) can be measured [78,91]. In this study, reflective measures are used to measure both reliability and composite reliability. The minimum acceptable value for composite reliability is 0.6 [92]. In this study, the composite reliability values of each variable have a value greater than 0.6. All the constructs have a more than acceptable composite reliability value and that is why they are composite reliable. Figure 3 shows the composite reliabilities of all variables.

Table 3. Factor loadings, *t*-statistics, composite reliability (CR), and average variance extracted (AVE).

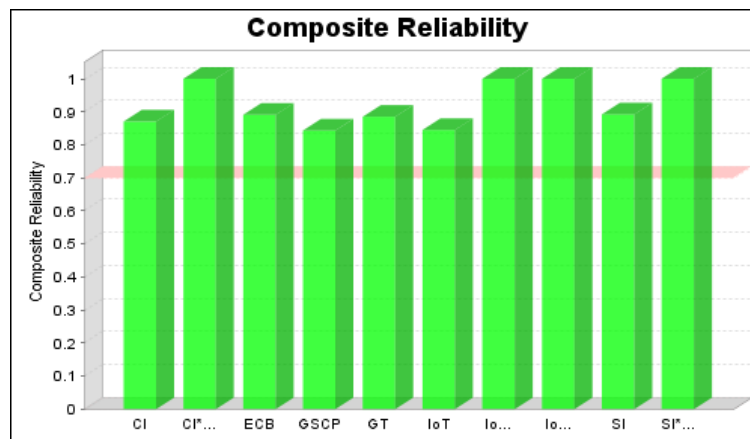| Construct	Item Loading	*t*-Statistics	Cronbach's Alpha	CR & AVE
Internet of Things (IoT)				
IoT 2	0.707	18.63		
IoT 3	0.704	16.36		
IoT 4	0.666	13.92		CR = 0.845
IoT 5	0.691	14.23	0.781	AVE = 0.477
IoT 7	0.619	11.15		
IoT 9	0.751	22.63		
Energy Consumption Behavior (ECB)				
ECB 10	0.710	15.92		
ECB 3	0.772	27.76		
ECB 4	0.780	23.66		CR = 0.891
ECB 5	0.714	17.46	0.853	AVE = 0.577
ECB 8	0.768	23.03		
ECB 9	0.811	31.79		
Supplier Integration (SI)				
SI 1	0.717	19.29		
SI 2	0.729	21.32		
SI 4	0.734	18.46		
SI 5	0.711	17.59	0.860	CR = 0.893
SI 6	0.743	22.74		AVE = 0.543
SI 7	0.765	23.53		
SI 9	0.756	25.05		
Customer Integration (CI)				
CI 2	0.705	15.88		
CI 3	0.731	19.74		
CI 4	0.766	30.25		CR = 0.871
CI 6	0.711	18.23	0.822	AVE = 0.529
CI 8	0.759	21.63		
CI 9	0.689	14.50		
Green Training (GT)				
GT 10	0.769	26.05		
GT 2	0.741	21.44		
GT 3	0.746	22.55		CR = 0.885
GT 5	0.746	18.29	0.845	AVE = 0.563
GT 8	0.728	20.24		
GT 9	0.769	21.96		
Green Supply Chain Performance (GSCP)				
GSCP 4	0.698	13.86		
GSCP 5	0.647	10.28		
GSCP 6	0.704	16.78		CR = 0.844
GSCP 7	0.666	8.449	0.778	AVE = 0.474
GSCP 8	0.710	13.18		
GSCP 9	0.702	11.41		

Figure 3. Composite reliabilities of research variables.

Content validity is the construct validity of items. The content validity is also called logical validity. The content validity is dependent on the grammar and content of the items. If the respondents can understand the content of all items and their logic, then the instrument has content validity. It can be analyzed through the factor loading of items [92,93]. If items have a factor loading greater than 0.6, then the instrument has content validity and respondents can understand the instrument. In Table 3, factor loading values show that all items have content validity.

Convergent validity refers to the theoretical relation of two constructs. It shows how many measures are related to each other. Convergent validity can be measured through factor loading. If the item has a factor loading greater than 0.6, then items have convergent validity [92,93]. In this study, the factor loading values are mentioned in Table 3; their values are greater than 0.6 for all items, demonstrating that all factors have convergent validity.

Discriminant validity is the opposite of convergent validity. It shows how much constructs are irrelevant to each other. Discriminant validity can distinguish between different constructs. Discriminant validity can be measured in two ways. First, the square root of the average variance extracted (AVE). If the values of the square root of AVE are more than the correlation values of latent variables, then items have discriminant validity [88,92]. In this study, the Fornell and Larcker method is used to analyze discriminant validity, as mentioned in Table 2. The values of the square root of AVE are also mentioned in Table 2. These values show that all items have discriminant validity. Figure 4 shows the average variance of extracted values of all variables.
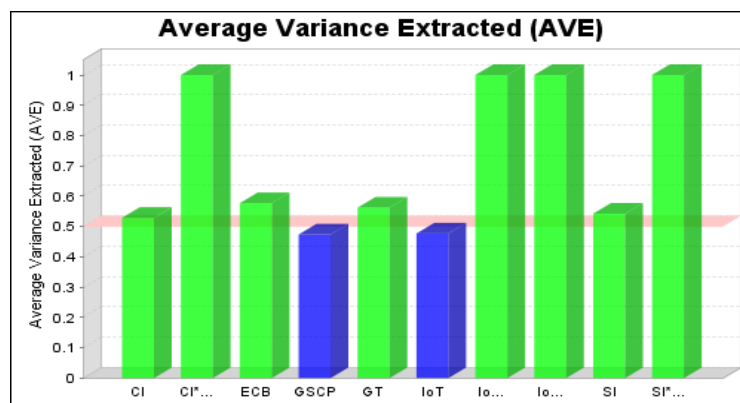

Figure 4. Average variance extracted of research variables.

The second way to measure the discriminant validity is using the factor loadings. If items have high factor loading, then they have discriminant validity [94]. In this study, all items have a factor loading higher than 0.6, as mentioned in Table 3. Therefore, all items have discriminant validity.

3.6. Structural Model

The structural model can be assessed through the explanatory factors (R^2) of the model with their significant values. The validation of the model with the explanatory factors is mentioned in Figure 5. PLS-SEM does not require any distribution assumptions or parametric technique to check the validity of data. It works on the bootstrapping method to test the significant value of path coefficients [95,96]. The default bootstrapping value in software is 500, which was recommended in the previous study to gain precise results [97,98]. However, in this study, 5000 subsamples underwent the bootstrapping method to get more precise results of path coefficients. The values of path coefficients, *t* values, and significant values are mentioned in Table 4.
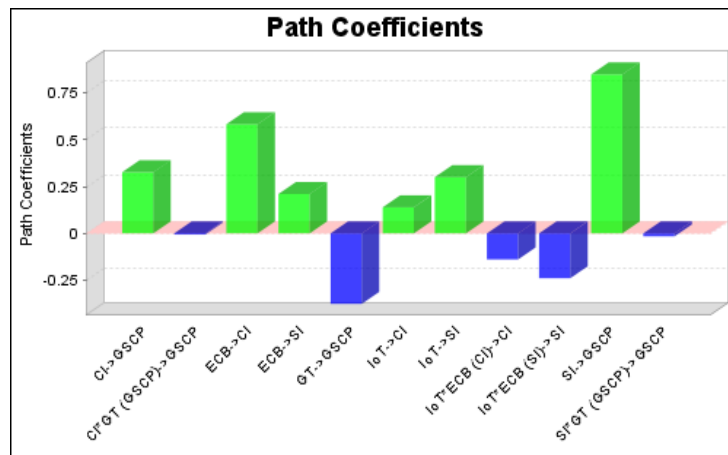

Figure 5. Path coefficients of research variables.

Table 4. Research model validation.

	Path Coefficients	*t*-Statistics	*p* Values	Results
CI → GSCP	0.326	4.603	0.000	Supported
ECB → CI	0.586	11.90	0.000	Supported
ECB → SI	0.210	3.122	0.002	Supported
GT → GSCP	−0.362	1.691	0.091	Supported
IoT → CI	0.141	3.148	0.002	Supported
IoT → SI	0.306	5.371	0.000	Supported
SI → GSCP	0.838	3.437	0.001	Supported
CI*GT (GSCP) → GSCP	−0.007	0.063	0.950	Not Supported
SI*GT (GSCP) → GSCP	−0.025	0.163	0.870	Not Supported
IoT*ECB (CI) → CI	−0.138	6.543	0.000	Supported
IoT*ECB (SI) → SI	−0.237	8.008	0.000	Supported
ECB → CI → GSCP	0.191	4.684	0.000	Supported
IoT → CI → GSCP	0.047	2.127	0.033	Supported
IoT*ECB (CI) → CI → GSCP	−0.045	3.875	0.000	Supported
ECB → SI → GSCP	0.178	2.164	0.030	Supported
IoT → SI → GSCP	0.256	2.928	0.003	Supported
IoT*ECB (SI) → SI → GSCP	−0.199	3.186	0.001	Supported

The ultimate goal of the structural model is to explain the variance of endogenous variables. The variance can be explained through R^2 [90,98]. There are no hard and fast rules for differentiating between low and high values of variance. In the literature, it was suggested that the range of R^2 values can be 0.02, 0.13, and 0.26 [99], showing a low-, medium-, and high-variance explanation, respectively. In this manner, the research model path coefficients of GSCP have high values of R^2. Figure 5 shows the path coefficient values of all variables.

In this study, PLS-SEM structural equation modeling shows all the path coefficient values regarding the variables and factor loadings of each item that it has calculated. Figure 6 shows the values of all items factors loadings and their path coefficients of GSCP.
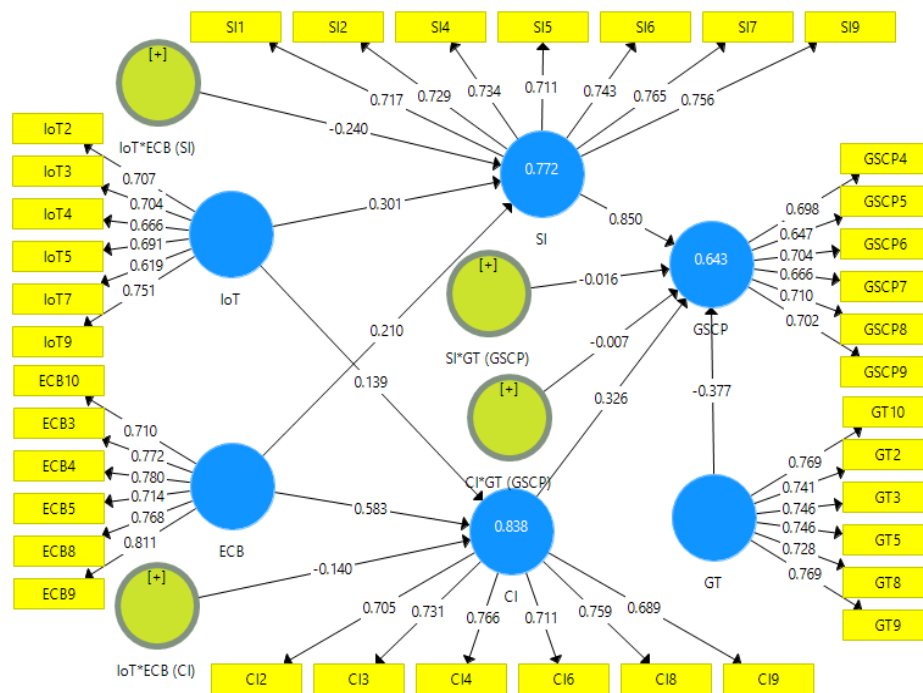

Figure 6. Path coefficients for green supply chain performance.

4. Discussion and Conclusions

In the field of supply chain management, supply chain integration is a practically implemented concept in every organization because supply chain integration aligns organizational activities, processes, customers, and suppliers with manufacturers. In previous literature on supply chains, the relationship between supply chain integration and supply chain performance was already established. There is a positive and significant relationship between SI and supply chain performance. Also, in the same way, the positive and significant relationships in CI and supply chain performance are already established in the previous literature [41,100]. In this study, the empirical results show a positive and significant effect of CI and SI on GSCP, that are consistent with previous studies.

Internet of Things (IoT) has a direct effect on SI and CI. Also, IoT has an indirect effect on supply chain performance with a mediating effect on SI and CI, as was found in supply chain literature [11]. In this study, IoT has been considered as an independent variable whereas CI and SI are considered as mediating variables between IoT and GSCP. The empirical results of this study show that IoT has a positive effect on both CI and SI. Furthermore, both CI and SI have mediating roles between IoT and GSCP since the results are significant and positive. The results are consistent with the earlier literature in the supply chain domain [11].

In this study, ECB has moderated the relationship between IoT, CI, and SI. This relationship was not investigated and developed in the previous literature. The moderated relationship of ECB is the major contribution of this study to knowledge. However, the results of the moderated effects are amazing; both interaction terms have a negative but significant effect. The negative interaction effect shows that the combined effect of ECB and IoT is less than the individual effect of IoT on CI and SI. The reason for this negative interaction effect is that the implementation of IoT can automatically create awareness to develop the energy consumption behavior. So, when both variables are taken together, respondents understand both variables as separate identities that are chronically different to each other.

This difference has created a negative and a significant interaction effect. On the other hand, the direct relationship between IoT and SI, and CI has a positive and significant effect.

Green training acts as a moderator in SI, CI, and GSCP. Such a relationship has not previously been considered in the preceding studies. It is the second contribution of this study. The empirical results show that GT can affect the GSCP directly. The direct relationship between GSCP practices and GT has a positive and significant effect in this study that was consistent with previous literature [69]. On the other hand, the moderator effect of GT between SI, CI, and GSCP is considered in this study, but it is not supported by the data. The results reflect the insignificant interaction effect of GT with IoT and GSCP. Therefore, GT has been observed as an independent variable instead of a moderator variable.

It can be concluded that the implementation of IoT is beneficial for a customer, supplier, and manufacturer in supply chain management to enhance supply chain performance. The use of the internet and computerized technology also saves energy and resources. Boosting GSCP can protect the environment and result in the better economic performance of organizations. IoT can affect supplier and customer integration of internal supply chain integration, which is affected by GT and ECB to improve GSCP. Contingency theory supports this study because there is no perfect solution to all the organizational problems. It can be divided into small parts or departments to resolve big issues or to solve the big game; one must divide the big game into small pieces and determine the components individually to address big issues through the use of organizational resources and capabilities.

5. Limitations and Future Directions

Every study has some limitations and as such this study is not free from limitations. This study is limited to only an external supply chain integration of SI and CI, while the internal supply chain integration regarding the organizational processes and activities has been ignored in this study. In future, internal supply chain integration can be considered with the external supply chain integration because both variables have their own and equal importance.

In this study, only cross-sectional data from five different cities in Pakistan have been taken, while in future longitudinal data at different times can be taken for a deeper analysis. Furthermore, data can be collected from other under-developed countries such as India, Sri Lanka, or Malaysia for a comprehensive investigation of the results. In this study, data has been collected through modern trade stores, while, in future, data can be collected from the manufacturing industry to generalize the framework of this study.

In this study, only the survey method has been used, which was analyzed using PLS—SEM, while, in future, interviews from a field expert can be used to add more variables and important factors. Other methodologies like interpretive structural modeling (ISM), and multicriteria decision making (MCDM) methodologies can be used in future studies. In addition, the mixed methodology can be used to conceptualize and analyze the framework.

Author Contributions: M.N.S contributed in investigation and writing this manuscript. A.K. contributed in research design. I.S.B contributed in supervision and editing the manuscript. R.K contributed in design the experiments and analysis of results. M.M.K contributed in conceptualization of idea and editing the manuscript. W.T. contributed in design of this research.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Atzori, L.; Iera, A.; Morabito, G. The internet of things: A survey. *Comput. Netw.* **2010**, *54*, 2787–2805. [CrossRef]
2. Edwards, C.; Hopkins, J. *The Australian Supply Chain Tech Survey Results*; SCLAA: Loganholme, Australia, 2018.
3. Borgia, E. The Internet of Things vision: Key features, applications and open issues. *Comput. Commun.* **2014**, *54*, 1–31. [CrossRef]

4. Mattern, F.; Floerkemeier, C. From the Internet of Computers to the Internet of Things. In *From Active Data Management to Event-Based Systems and More*; Springer: Berlin, Germany, 2010; pp. 242–259.

5. Constantinides, E.; Kahlert, M.; de Vries, S.A. The Relevance of Technological Autonomy in the Acceptance of IoT Services in Retail. In Proceedings of the 2nd International Conference on Internet of Things, Data and Cloud Computing, (ICC) 2017, Cambridge, UK, 22–23 March 2017.

6. Vanpoucke, E.; Vereecke, A.; Muylle, S. Leveraging the impact of supply chain integration through information technology. *Int. J. Oper. Prod. Manag.* **2017**, *37*, 510–530. [CrossRef]

7. Kahlert, M.; Constantinides, E.; de Vries, S. The relevance of technological autonomy in the customer acceptance of IoT services in retail. In Proceedings of the Second International Conference on Internet of things and Cloud Computing, Cambridge, UK, 22–23 March 2017; ACM: New York, NY, USA, 2017; p. 12.

8. Li, G.; Yang, H.; Sun, L.; Sohal, A.S. The impact of IT implementation on supply chain integration and performance. *Int. J. Prod. Econ.* **2009**, *120*, 125–138. [CrossRef]

9. Qrunfleh, S.; Tarafdar, M. Supply chain information systems strategy: Impacts on supply chain performance and firm performance. *Int. J. Prod. Econ.* **2014**, *147*, 340–350. [CrossRef]

10. Rai, A.; Patnayakuni, R.; Seth, N. Firm performance impacts of digitally enabled supply chain integration capabilities. *MIS Q.* **2006**, *30*, 225–246. [CrossRef]

11. De Vass, T.; Shee, H. The effect of "Internet of Things" on supply chain integration and performance: An organisational capability perspective. *Australas. J. Inf. Syst.* **2018**, *22*, 833–852. [CrossRef]

12. Barney, J. Firm resources and sustained competitive advantage. *J. Manag.* **1991**, *17*, 99–120. [CrossRef]

13. Barney, J. How marketing scholars might help address issues in resource-based theory. *J. Acad. Mark. Sci.* **2014**, *42*, 24–26. [CrossRef]

14. Fahy, J.; Smithee, A. Strategic marketing and the resource based view of the firm. *Acad. Mark. Sci. Rev.* **1999**, *10*, 1–21.

15. Wernerfelt, B. A resource-based view of the firm. *Strat. Manag. J.* **1984**, *5*, 171–180. [CrossRef]

16. Kozlenkova, I.V.; Samaha, S.A.; Palmatier, R.W. Resource-based theory in marketing. *J. Acad. Mark. Sci.* **2014**, *42*, 1–21. [CrossRef]

17. Lawrence, P.R.; Lorsch, J.W. The integrator. *Harv. Bus. Rev.* **1967**, 1–13.

18. Thompson, J. *Organizations in Action: Social Science Bases of Administrative Theory*; McGraw-Hill: New York, NY, USA, 2003.

19. Sinha, K.K.; Van de Ven, A.H. Designing work within and between organizations. *Organ. Sci.* **2005**, *16*, 389–408. [CrossRef]

20. Donaldson, L. *The Contingency Theory of Organizations*; Sage: Thousand Oaks, CA, USA, 2001.

21. Lawrence, P.R.; Lorsch, J.W. Differentiation and integration in complex organizations. *Adm. Sci. Q.* **1967**, *12*, 1–47. [CrossRef]

22. Chandler, A.D. Strategy and structure: Chapters in the history of the American enterprise. *Mass. Inst. Technol. Camb.* **1962**, *4*, 125–137.

23. Galbraith, J.R. Organization design: An information processing view. *Interfaces* **1974**, *4*, 28–36. [CrossRef]

24. Drazin, R.; Van de Ven, A.H. Alternative forms of fit in contingency theory. *Adm. Sci. Q.* **1985**, *30*, 514–539. [CrossRef]

25. Venkatraman, N.; Prescott, J.E. Environment-strategy coalignment: An empirical test of its performance implications. *Strat. Manag. J.* **1990**, *11*, 1–23. [CrossRef]

26. Milgrom, P.; Roberts, J. Complementarities and fit strategy, structure, and organizational change in manufacturing. *J. Account. Econ.* **1995**, *19*, 179–208. [CrossRef]

27. Madakam, S.; Ramaswamy, R.; Tripathi, S. Internet of Things (IoT): A literature review. *J. Comput. Commun.* **2015**, *3*, 164–173. [CrossRef]

28. Nunberg, G. *The Advent of the Internet*. Available online: http://courses.ischool.berkeley.edu/i103/s12/SLIDES/HOFIInternet1Apr12.pdf (accessed on 23 July 2012).

29. Yan, B.; Huang, G. Supply chain information transmission based on RFID and internet of things. In Proceedings of the ISECS International Colloquium on Computing, Communication, Control, and Management, Sanya, China, 8–9 August 2009; pp. 166–169.

30. Pang, Z.; Chen, Q.; Han, W.; Zheng, L. Value-centric design of the internet-of-things solution for food supply chain: Value creation, sensor portfolio and information fusion. *Inf. Syst. Front.* **2015**, *17*, 289–319. [CrossRef]

31.　Bahari, T.F.; Elayidom, M.S. An efficient CRM-data mining framework for the prediction of customer behaviour. *Procedia Comput. Sci.* **2015**, *46*, 725–731. [CrossRef]

32.　DeWaters, J.; Qaqish, B.; Graham, M.; Powers, S. Designing an energy literacy questionnaire for middle and high school youth. *J. Environ. Educ.* **2013**, *44*, 56–78. [CrossRef]

33.　Demirel, Y. Energy and energy types. In *Energy*; Springer: Berlin, Germany, 2012; pp. 27–70.

34.　Awan, A.B.; Khan, Z.A. Recent progress in renewable energy—Remedy of energy crisis in Pakistan. *Renew. Sustain. Energy Rev.* **2014**, *33*, 236–253. [CrossRef]

35.　Abbas, M.N. *Energy Crisis in Pakistan*; Naval Postgraduate School Monterey United States: Monterey, CA, USA, 2015.

36.　Paulraj, A.; Lado, A.A.; Chen, I.J. Inter-organizational communication as a relational competency: Antecedents and performance outcomes in collaborative buyer–supplier relationships. *J. Oper. Manag.* **2008**, *26*, 45–64. [CrossRef]

37.　Mabert, V.A.; Venkataramanan, M. Special research focus on supply chain linkages: Challenges for design and management in the 21st century. *Decis. Sci.* **1998**, *29*, 537–552. [CrossRef]

38.　Spekman, R.E.; Kamauff, J.W., Jr.; Myhr, N. An empirical investigation into supply chain management: A perspective on partnerships. *Supply Chain Manag. Int. J.* **1998**, *3*, 53–67. [CrossRef]

39.　Fawcett, S.E.; Magnan, G.M. The rhetoric and reality of supply chain integration. *Int. J. Phys. Distrib. Logist. Manag.* **2002**, *32*, 339–361. [CrossRef]

40.　Lee, H.L.; Whang, S. Winning the last mile of e-commerce. *MIT Sloan Manag. Rev.* **2001**, *42*, 54–62.

41.　Flynn, B.B.; Huo, B.; Zhao, X. The impact of supply chain integration on performance: A contingency and configuration approach. *J. Oper. Manag.* **2010**, *28*, 58–71. [CrossRef]

42.　Vickery, S.K.; Jayaram, J.; Droge, C.; Calantone, R. The effects of an integrative supply chain strategy on customer service and financial performance: An analysis of direct versus indirect relationships. *J. Oper. Manag.* **2003**, *21*, 523–539. [CrossRef]

43.　Naylor, J.B.; Naim, M.M.; Berry, D. Leagility: Integrating the lean and agile manufacturing paradigms in the total supply chain. *Int. J. Prod. Econ.* **1999**, *62*, 107–118. [CrossRef]

44.　Bowersox, D.J.; Morash, E.A. The integration of marketing flows in channels of distribution. *Eur. J. Mark.* **1989**, *23*, 58–67. [CrossRef]

45.　Hammer, M. Reengineering work: Don't automate, obliterate. *Harv. Bus. Rev.* **1990**, *68*, 104–112.

46.　Stevens, G.C. Integrating the supply chain. *Int. J. Phys. Distrib. Mater. Manag.* **1989**, *19*, 3–8. [CrossRef]

47.　Benton, W. *Webster's Third New International Dictionary of the English Language*; Unabridged; Encyclopaedia Britannica Inc.: Chicago, IL, USA, 1966.

48.　Bowersox, D.J.; Closs, D.J.; Stank, T.P. *21st Century Logistics: Making Supply Chain Integration a Reality*; Michigan State University: East Lansing, MI, USA, 1999; ISBN 0965865320.

49.　Frohlich, M.T.; Westbrook, R. Arcs of integration: An international study of supply chain strategies. *J. Oper. Manag.* **2001**, *19*, 185–200. [CrossRef]

50.　Sanders, N.R. Pattern of information technology use: The impact on buyer–suppler coordination and performance. *J. Oper. Manag.* **2008**, *26*, 349–367. [CrossRef]

51.　Ellram, L.M. The supplier selection decision in strategic partnerships. *J. Purch. Mater. Manag.* **1990**, *26*, 8–14. [CrossRef]

52.　Heide, J.B.; John, G. Alliances in industrial purchasing: The determinants of joint action in buyer-supplier relationships. *J. Mark. Res.* **1990**, *27*, 24–36. [CrossRef]

53.　Poirier, C.C.; Reiter, S.E. *Supply Chain Optimization: Building the Strongest Total Business Network*; Berrett-Koehler Publishers: Oakland, CA, USA, 1996.

54.　Stank, T.P.; Keller, S.B.; Daugherty, P.J. Supply chain collaboration and logistical service performance. *J. Bus. Logist.* **2001**, *22*, 29–48. [CrossRef]

55.　Saberi, S.; Kouhizadeh MSarkis, J.; Shen, L. Blockchain technology and its relationships to sustainable supply chain management. *Int. J. Prod. Res.* **2018**, 1–19. [CrossRef]

56.　Ben-Daya, M.; Hassini, E.; Bahroun, Z. Internet of things and supply chain management: A literature review. *Int. J. Prod. Res.* **2017**, 1–24. [CrossRef]

57.　Kingman-Brundage, J.; George, W.R.; Bowen, D.E. "Service logic": Achieving service system integration. *Int. J. Serv. Ind. Manag.* **1995**, *6*, 20–39. [CrossRef]

58. Accorsi, R.; Bortolini, M.; Baruffaldi, G.; Pilati, F.; Ferrari, E. Internet-of-things paradigm in food supply chains control and management. *Procedia Manuf.* **2017**, *11*, 889–895. [CrossRef]

59. Kotha, S.; Nair, A. Strategy and environment as determinants of performance: Evidence from the Japanese machine tool industry. *Strateg. Manag. J.* **1995**, *16*, 497–518. [CrossRef]

60. Tushman, M.L.; Nadler, D.A. Information processing as an integrating concept in organizational design. *Acad. Manag. Rev.* **1978**, *3*, 613–624.

61. Koufteros, X.; Vonderembse, M.; Jayaram, J. Internal and external integration for product development: The contingency effects of uncertainty, equivocality, and platform strategy. *Decis. Sci.* **2005**, *36*, 97–133. [CrossRef]

62. Song, M.; Di Benedetto, C.A. Supplier's involvement and success of radical new product development in new ventures. *J. Oper. Manag.* **2008**, *26*, 1–22. [CrossRef]

63. Homburg, C.; Stock, R.M. The link between salespeople's job satisfaction and customer satisfaction in a business-to-business context: A dyadic analysis. *J. Acad. Mark. Sci.* **2004**, *32*, 144. [CrossRef]

64. Petersen, K.J.; Handfield, R.B.; Ragatz, G.L. Supplier integration into new product development: Coordinating product, process and supply chain design. *J. Oper. Manag.* **2005**, *23*, 371–388. [CrossRef]

65. Koufteros, X.; Cheng, T.E.; Lai, K.-H. "Black-box" and "gray-box" supplier integration in product development: Antecedents, consequences and the moderating role of firm size. *J. Oper. Manag.* **2007**, *25*, 847–870. [CrossRef]

66. Ragatz, G.L.; Handfield, R.B.; Petersen, K.J. Benefits associated with supplier integration into new product development under conditions of technology uncertainty. *J. Bus. Res.* **2002**, *55*, 389–400. [CrossRef]

67. Cousins, P.D.; Menguc, B. The implications of socialization and integration in supply chain management. *J. Oper. Manag.* **2006**, *24*, 604–620. [CrossRef]

68. Daily, B.F.; Huang, S.-C. Achieving sustainability through attention to human resource factors in environmental management. *Int. J. Oper. Prod. Manag.* **2001**, *21*, 1539–1552. [CrossRef]

69. Teixeira, A.A.; Jabbour, C.J.; de Sousa Jabbour, A.B.; Latan, H.; de Oliveira, J.H.C. Green training and green supply chain management: Evidence from Brazilian firms. *J. Clean. Prod.* **2016**, *116*, 170–176. [CrossRef]

70. Paillé, P.; Chen, Y.; Boiral, O.; Jin, J. The impact of human resource management on environmental performance: An employee-level study. *J. Bus. Ethics* **2014**, *121*, 451–466. [CrossRef]

71. Muduli, K.; Govindan, K.; Barve, A.; Geng, Y. Barriers to green supply chain management in Indian mining industries: A graph theoretic approach. *J. Clean. Prod.* **2013**, *47*, 335–344. [CrossRef]

72. Daily, B.F.; Bishop, J.W.; Massoud, J.A. The role of training and empowerment in environmental performance: A study of the Mexican maquiladora industry. *Int. J. Oper. Prod. Manag.* **2012**, *32*, 631–647. [CrossRef]

73. Sarkis, J.; Gonzalez-Torre, P.; Adenso-Diaz, B. Stakeholder pressure and the adoption of environmental practices: The mediating effect of training. *J. Oper. Manag.* **2010**, *28*, 163–176. [CrossRef]

74. Jackson, S.E.; Schuler, R.S.; Jiang, K. An aspirational framework for strategic human resource management. *Acad. Manag. Ann.* **2014**, *8*, 1–56. [CrossRef]

75. Renwick, D.W.; Redman, T.; Maguire, S. Green human resource management: A review and research agenda. *Int. J. Manag. Rev.* **2013**, *15*, 1–14. [CrossRef]

76. Ringle, C.M.; Wende, S.; Becker, J.-M. *SmartPLS 3*; SmartPLS GmbH: Boenningstedt, Germany, 2015.

77. Petter, S.; Straub, D.; Rai, A. Specifying formative constructs in information systems research. *MIS Q.* **2007**, *31*, 623–656. [CrossRef]

78. Hair, J.F.; Ringle, C.M.; Sarstedt, M. PLS-SEM: Indeed a silver bullet. *J. Mark. Theory Pract.* **2011**, *19*, 139–152. [CrossRef]

79. Henseler, J.; Dijkstra, T.K.; Sarstedt, M.; Ringle, C.M.; Diamantopoulos, A.; Straub, D.W.; Ketchen, D.J., Jr.; Hair, J.F.; Hult, G.T.M.; Calantone, R.J. Common beliefs and reality about PLS: Comments on Rönkkö and Evermann (2013). *Organ. Res. Methods* **2014**, *17*, 182–209. [CrossRef]

80. Fornell, C.; Bookstein, F.L. Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *J. Mark. Res.* **1982**, *19*, 440–452. [CrossRef]

81. Astrachan, C.B.; Patel, V.K.; Wanzenried, G. A comparative study of CB-SEM and PLS-SEM for theory development in family firm research. *J. Fam. Bus. Strategy* **2014**, *5*, 116–128. [CrossRef]

82. Narasimhan, R.; Kim, S.W. Effect of supply chain integration on the relationship between diversification and performance: Evidence from Japanese and Korean firms. *J. Oper. Manag.* **2002**, *20*, 303–323. [CrossRef]

83. Morash, E.A.; Clinton, S.R. Supply chain integration: Customer value through collaborative closeness versus operational excellence. *J. Mark. Theory Pract.* **1998**, *6*, 104–120. [CrossRef]

84. Zhu, Q.; Sarkis, J.; Lai, K.-H. Confirmation of a measurement model for green supply chain management practices implementation. *Int. J. Prod. Econ.* **2008**, *111*, 261–273. [CrossRef]

85. Podsakoff, P.M.; MacKenzie, S.B.; Lee, J.-Y.; Podsakoff, N.P. Common method biases in behavioral research: A critical review of the literature and recommended remedies. *J. Appl. Psychol.* **2003**, *88*, 879. [CrossRef] [PubMed]

86. Bagozzi, R.P.; Yi, Y.; Phillips, L.W. Assessing construct validity in organizational research. *Adm. Sci. Q.* **1991**, *36*, 421–458. [CrossRef]

87. Barclay, D.; Higgins, C.; Thompson, R. The Partial Least Squares (pls) Approach to Casual Modeling: Personal Computer Adoption Ans Use as an Illustration. *Technol. Stud.* **1995**, *2*, 285–309.

88. Chin, W.W. The partial least squares approach to structural equation modeling. *Mod. Methods Bus. Res.* **1998**, *295*, 295–336.

89. Nunnally, J.C. *Psychometric Theory*; McGraw-Hill: New York, NY, USA, 1994.

90. Henseler, J.; Ringle, C.M.; Sinkovics, R.R. The use of partial least squares path modeling in international marketing. In *New Challenges to International Marketing*; Emerald Group Publishing Limited: Bingley, UK, 2009; pp. 277–319.

91. Kutner, M.H.; Nachtsheim, C.; Neter, J.; Li, W. *Applied Linear Statistical Models*; McGraw-Hill Irwin: New York, NY, USA, 2005.

92. Fornell, C.; Larcker, D.F. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* **1981**, *18*, 39–50. [CrossRef]

93. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E.; Tatham, R.L. *Multivariate Data Analysis*; Prentice Hall: Upper Saddle River, NJ, USA, 1998; Volume 5.

94. Chin, W.W.; Marcolin, B.L.; Newsted, P.R. A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Inf. Syst. Res.* **2003**, *14*, 189–217. [CrossRef]

95. Chin, W.W. How to write up and report PLS analyses. In *Handbook of Partial Least Squares*; Springer: Berlin, Germany, 2010; pp. 655–690.

96. Sanchez, G. *PLS Path Modeling with R*. 2013. Available online: https://www.gastonsanchez.com/PLS_Path_Modeling_with_R.pdf (accessed on 13 April 2018).

97. Wetzels, M.; Odekerken-Schröder, G.; Van Oppen, C. Using PLS path modeling for assessing hierarchical construct models: Guidelines and empirical illustration. *MIS Q.* **2009**, *33*, 177–195. [CrossRef]

98. Accorsi, R.; Cholette, S.; Manzini, R.; Tufano, A. A hierarchical data architecture for sustainable food supply chain management and planning. *J. Clean. Prod.* **2018**, *203*, 1039–1054. [CrossRef]

99. Cohen, J. *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed.; Routledge: Abingdon, UK, 1988; ISBN 9780805802832.

100. Huo, B. The impact of supply chain integration on company performance: An organizational capability perspective. *Supply Chain Manag. Int. J.* **2012**, *17*, 596–610. [CrossRef]

101. Fosso Wamba, S.; Angappa, G.; Papadopoulos, T.; Ngai, E. Big data analytics in logistics and supply chain management. *Int. J. Logist. Manag.* **2018**, in press. [CrossRef]

102. Verdouw, C.N.; Beulens, A.J.; Reijers, H.A.; van der Vorst, J.G. A control model for object virtualization in supply chain management. *Comput. Ind.* **2015**, *68*, 116–131. [CrossRef]

103. Liu, Y.; Wang, H.; Wang, J.; Qian, K.; Kong, N.; Wang, K.; Zheng, L.; Shi, Y.; Engels, D.W. Enterprise-oriented IoT name service for agricultural product supply chain management. *Int. J. Distrib. Sens. Netw.* **2015**, *11*, 308165. [CrossRef]