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The Role of Innovation in Enhancing Customers Satisfaction and Retention: Evidence from Commercial Banks in Mfoundi Division, Cameroon

Ayuk Takemeyang[1]

[1] PhD, ICT University, Cameroon

Correspondence: Ayuk Takemeyang, PhD, ICT University, Cameroon.

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Abstract

In today's competitive banking landscape, innovation plays a crucial role in enhancing customers' satisfaction and retention. In this light, this study was out to examine the effect of innovation on customer satisfaction and retention in commercial banks in the Mfoundi Division of the Centre Region of Cameroon. To this effect, a survey design was adopted for the investigation that gave room for the collection of primary data from 384 customers of commercial banks in Mfoundi Division. These customers were selected randomly and the data obtained was analyzed using a series of multiple regressions. The results of this study showed that process, market and organizational innovations all had significant effects on customer satisfaction while product innovation had an insignificant effect. Also, the results illustrated the fact that innovation in terms of product, process, market and organizational innovations all had significant effects on customer retention. Finally, this study's results demonstrated the fact that that process, market and organizational innovations all had significant effects on customer satisfaction and retention as a collapsed variable while product innovation had an insignificant effect. The study concludes that innovation is a key driver of customers satisfaction and retention in commercial banks in Mfoundi Division, Cameroon.

Keywords: innovation, customer satisfaction and customer retention

1. Introduction

Innovation is a critical component of business strategy in today's fast-paced and competitive banking environment. Innovation is essential in improving customers satisfaction and retention. Commercial banks in Cameroon, particularly in Mfoundi Division which is the administrative headquarter of Cameroon, face intense competition, and innovation can be a key business strategy. Facing increasing competition in the market, most businesses seek to attain a competitive position in the market. To achieve this goal, most companies realized that customer satisfaction and retention was the focal point to concentrate. One of the strategies of achieving customer's satisfaction and retention is continuous innovation. Innovations and changes to business models are demanded to be more efficient and effective. Schumpeter (1934) advanced that innovation has to do with any new policy that an entrepreneur undertakes to reduce the overall cost of production or increase the demand for his product. Innovation means to create a new product or make and implement a new process; the main purpose of innovation is to gain sustainable competitive edge or improve the efficiency of the organisation and to get customer satisfaction (Barton, 2018).

Zafar & Naveed (2014) claimed that when a company makes an innovative product, customer satisfaction is achieved, and the loyalty of the customers also increases towards their products there by leading to retention. In this light, the value of the innovated product in the view of customer is enhanced. Innovation is a crucial element in the success of companies in a competitive environment through their satisfaction (Wang et al., 2016).

Nowadays the companies adopting innovation use internal and external technology resources to empower their businesses. In the words of Diaw & Asare (2018), customer satisfaction and retention are incredibly important for growing a sustainable business in an extensively competitive environment. Marketers are becoming more aware that it is more cost effective to make sure customers never get on the exit path to competitors in the first place and are implementing retention strategies (preemptive and proactive).

In recent years, the standing importance of innovation has been on the rise because consumers demand assorted or varied products of producers increasingly. Shane & Ulrich (2004) demonstrated that after introduction of an innovative product, it increases its features, the customer achieves these characteristics and value of the customer maximizes. When he or she is satisfied with the product they buy more products. Moreover, innovation maintains and expands the spot or position of a company in the market (Baldassarre et al., 2017). Innovation powers the business model of a company and enables the company to gain values from not only its own business, but also the businesses of other companies by using key assets, resources or opportunities (Galloway et al., 2017). Dibie et al. (2019) ascertained that organizations should be passionate about incorporating specific qualities that delivers satisfaction to their customers through dynamic innovation so as to keep attracting, retaining customers and increasing market share new customers. As attested by Yuni, Sumitro and Abd (2021), innovations in product can increase customer satisfaction and make customers commit to a brand (retention). Both technological and non-technological innovations have the ability to affect both external and internal effectiveness as new customers' needs are met (Samuelsson, 2023).

Cameroon operates many businesses that focus on activities running from primary through secondary and tertiary activities. Tertiary activities have to do with the provision of services such as banking services. The competition between commercial banks in Cameroon has been increasing for last few years making the attraction and retention of customers by banks a difficult mission. These banks compete with one another for customers and market share in order to survive. In the Mfoundi Division of the Centre Region of Cameroon these banks get success through customer satisfaction by continuously innovating the services rendered to their customers in order to satisfy and retain them.

Despite the numerous recompenses or benefits/pluses of innovation, most customers of some commercial banks in the Mfoundi Division are still unsatisfied by their bank services so switch to other banks (making their retention a very serious issue). Most researchers in order to contribute knowledge in this area focus on innovation and customers satisfaction have produced mixed results. So, this study is out to investigate the effect of innovation on customer satisfaction and customer retention in commercial banks in the Mfoundi Division.

2. Literature Review

2.1 Conceptual Literature Innovation

As viewed by Yuhan (2009), innovation is the foundation or presentation of value. When the word innovation is used, it captures the creation of something new by an organization that satisfies its customers and increases the market share. Innovation take account the formation of an idea as well as the adoption and execution of new ideas in processes, products and services. In the words of Pan & Zinkhan (2006), innovation is used for strategic orientation toward customer satisfaction, loyalty, and to gain market potential that increases the market share of the company. With motivation drawn from Diaw and Asare (2018), innovation in this study is captured in terms of product, process, market and organizational innovation.

Customers Satisfaction and Retention

Customer satisfaction is a business term which ascertains that the product which a company supplied to its customers is satisfying them (Naveed et al., 2013). Furthermost researchers agree that customer satisfaction refers to an attitude or evaluation formed by a customer comparing pre-purchase expectations of what they would receive from the product or service to their subjective perceptions of the performance they actually did receive (Pishgar-Komleh et al., 2013). The evaluative nature of customer's satisfaction specifies whether a product, trademark or store can meet expectations (Zain & Saidu, 2016).

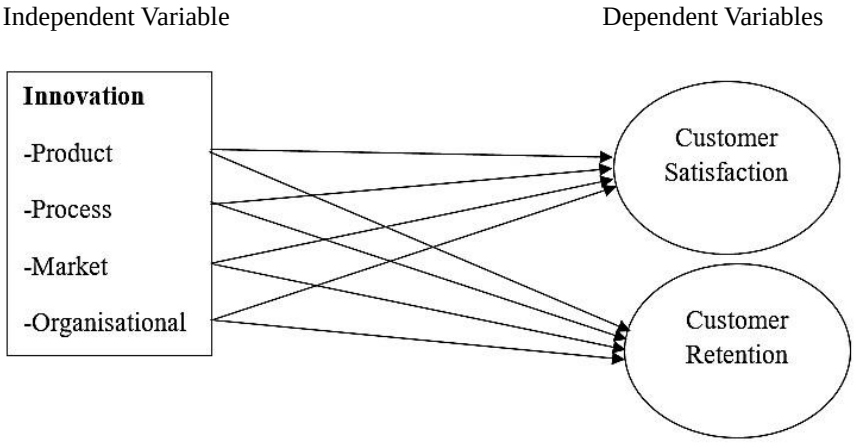

Figure 1. Link between Innovation, Customer Satisfaction and Customer Retention

Source: Author (2023) as Adapted from Diaw and Asare (2018).

Figure 1 shows the link that exists between innovation, customers satisfaction and customer retention. Innovation is captured with product innovation, process innovation, market innovation and organizational innovation as related to customers' satisfaction and retention.

2.2 Empirical Literature

Samuelsson (2023) studied innovation and effectiveness in Sweden and found out that both technological and non-technological innovations affected external and internal effectiveness as new customers' needs are met. Yuni, Sumitro and Abd (2021) conducted a study on the effect of product innovation on customers satisfaction and loyalty and concluded that innovations in product can increase customer satisfaction and make customers commit to a brand (retention), (2019) carried out a study to examine the effect of service innovation on customer satisfaction Indihome internet provider in Central Java through corporate reputation as variable intervening. The findings of this study revealed that innovation service is important in building corporate reputation offered to customers. Diaw & Asare, (2018) examined the effect of innovation on customer satisfaction and customer retention in the telecommunication industry in Ghana: customers' perspectives. Data was collected using questionnaire from 150 customers of MTN, Vodafone, Tigo-Airtel, Glo, and Expresso. The data was analyzed, and a significant positive relationship was found between innovation and customer satisfaction and retention.

Daragahi (2017) conducted a study on the Impact of Innovation on Customer Satisfaction: A Study of the Cosmetics Producer in Tehran. The simple random sampling method was used to select 387 customers of cosmetics. The results indicated that innovation in product presentation had a positive effect on the satisfaction of customers consuming cosmetics. Naveed et al. (2013) investigated the impact of innovation on customer satisfaction and brand loyalty: a case study of student of Faisalabad Pakistan. Data was collected through questionnaire from 85 university students, received questionnaires were tested through simple linear regression and correlation for appropriate findings. The results described the significant relationship of innovation with customer satisfaction and brand loyalty.

With literature fully reviewed, it could be established that most of the studies on innovation, customer satisfaction and retention were conducted in the developed world (Naveed et al., 2014; Daragahi, 2017; Kurniawan et al., 2019; Yuni, Sumitro & Abd, 2021; Samuelsson, 2023) with just one in Africa (Diaw & Asare, 2018).

3. Methodology

This paper adopted a survey research design. This research design was selected for this study as it helped to gather data from a sample of the population which was customer satisfaction of commercial banks in the Mfoundi Division of the Centre Region of Cameroon. This study made use of only the primary source of data collected through the uses of self-administered questionnaires. The population of this study was unknown as it constituted customers of Ecobank, NFC Bank, BICCEC Bank, Atlantic Bank, UBA Bank and Atlantic Bank. A sample size of 384 customers were selected as a sample size for an unknown population as per the sample size determination table by Krejcie and Morgan (1970).

3.1 Estimation Technique

Both the descriptive and inferential statistics were used in the analysis of the data collected using SPSS analytical tool. Inferentially, the Ordinary Least Square regression was used for the estimation where a series of

multiple regression were done as per the models presented in equations 2, 4 and 6.

In this light, through a multiple regression, innovation (independent variable) was regressed on customer satisfaction (dependent variable 1) and in order to test for its significance. That is, multiple independent variables PIN, PROS, MIN and OIN (product, process, market and organizational innovations respectively) on a dependent variable (customer satisfaction). This is expressed in equation 2.

$$Y_1 = \text{Customer Satisfaction}$$

$$Y1 = f\ (PIN, PROS, MIN\ \&\ OIN) \quad (1)$$

$$Y1i = \beta 0i + \beta 1\ PINi + \beta 2\ PROSi + \beta 3\ MINi + \beta 4\ OINi + \mu i \quad (2)$$

Secondly, innovation (independent variable) was regressed on customer retention (dependent variable 2) and in order to test for its significance. This implies regressing multiple independent variables PIN, PROS, MIN and OIN (product, process, market and organizational innovations respectively) on a dependent variable (customer retention). This relationship is expressed in equation 4.

$$Y_2 = \text{Customer Retention}$$

$$Y_2 = f\ (PIN, PROS, MIN\ \&\ OIN) \quad (3)$$

$$Y_{2i} = \beta_{0i} + \beta_1\ PIN_i + \beta_2\ PROS_i + \beta_3\ MIN_i + \beta_4\ OIN_i + \mu_i \quad (4)$$

Finally, innovation was regressed on both customer satisfaction and customer retention as one main dependent variable. For this to be done, the scores of customer satisfaction and customer retention were averaged (to obtain Y3 which is a collapsed variable).

This implies innovation in terms of product, process, market and organizational innovations demoted as PIN, PROS, MIN and OIN respectively were regressed on customer satisfaction and retention as a collapsed variable (Y3) as illustrated by equation 6.

Collapsed Variable (Y_3) = {Customer Satisfaction (Y_1) + Customer Retention (Y_2)}

$$Y_3 = f\ (PIN, PROS, MIN\ \&\ OIN) \quad (5)$$

$$Y_{3i} = \beta_{0i} + \beta_1\ PIN_i + \beta_2\ PROS_i + \beta_3\ MIN_i + \beta_4\ OIN_i + \mu_i \quad (6)$$

Where, β_0 is the constant term, β_1, β_2, β_3 and β_4 are the parameters to be investigated while μ is the error term.

3.2 A Priori Expectation

$\beta_0 \neq 0$, $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$ and $\beta_4 > 0$. The expectation here is that all the variables of the independent variable (innovation) are positively related to dependent variables (customer satisfaction and customer retention).

4. Results

4.1 The Effect of Innovation on Customer Satisfaction

$$Y_{1i} = \beta_{0i} + \beta_1\ PIN_i + \beta_2\ PROS_i + \beta_3\ MIN_i + \beta_4\ OIN_i + \mu_i \ \ldots\ldots\ldots\ldots (7)$$

Table 1. Innovation on Customers Satisfaction

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	8.615*	.801		10.801	.000
Product Innovation	.092	.075	.087	1.239	.216
Process Innovation	-0.396*	.081	-0.243	-4.922	.000
Market Innovation	.501*	.093	.347	5.404	.000
Organisational Innovation	.275*	.075	.268	3.645	.000
R	.564				
R-square	.318				
Adjusted R^2	.311				
F(4,379)	44.245				

Sig	.000[b]				
(*) 1% Level of Significance **a. Dependent Variable: Customer Satisfaction**					
b. Predictors: (Constant), Product Innovation (PIN), Process Innovation (PROS), Market Innovation (MIN) and Organisational Innovation (OIN)					

Based on the regression results presented in Table 1, there is a positive (0.092) but insignificant effect of product innovation on customer satisfaction. There is a negative (-0.396) but significant effect of process innovation on customer satisfaction. That is, a unit increase in process innovation leads to a 0.396 unit fall in the level of customer's satisfaction. In this same light, a positive (0.501) and significant effect could be observed between market innovation and customer satisfaction. This implies a unit increase in market innovation will lead to a 0.501-unit increase in customer's satisfaction. The results of market innovation are significant at 1% level of significance (P value < 0.01). Same goes for organizational innovation that indicates a positive (0.275) and significant effect on customer satisfaction. Specifically, a unit increase in organizational innovation leads to a 0.275-unit increase in the level of customer's satisfaction and these results are significant at 1% level of significance (P-value < 0.01).

The ANOVA results illustrate the fact that the regression equation in the model fits the data. Results show that F (4, 379) = 44.245, P-value of 0.000b is less than 0.01. This indicates that the overall regression model statistically predicts the outcome variable (i.e., it is a good fit for the data). The value of the adjusted R square is 0.311; which indicates that 31.1% changes in customer satisfaction are accounted for by the inclusive variables (product, process, market and organisational innovations) while 68.9% changes are accounted for by the error term. The significant part of these results is in line with the work of Naveed et al. (2014) who investigated the impact of innovation on customer satisfaction and brand loyalty: a case study of student of Faisalabad Pakistan.

As the results indicated the significant relationship of innovation with customer satisfaction and brand loyalty. Also, these results contradict the results of Daragahi (2017) who conducted a study on the impact of innovation on customer satisfaction: A study of the cosmetics producer in Tehran. The results indicated that innovation in product presentation had a positive effect on the satisfaction of customers consuming cosmetics.

4.2 The Effect of Innovation on Customer Retention

$$Y_{2i} = \beta_{0i} + \beta_1 PIN_i + \beta_2 PROS_i + \beta_3 MIN_i + \beta_4 OIN_i + \mu_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

Table 2. Innovation on Customers Retention

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
	B	Std. Error	Beta		
(Constant)	-0.719	.804		-0.894	.372
Product Innovation	-0.197*	.075	-0.152	-2.638	.009
Process Innovation	.308*	.081	.153	3.809	.000
Market Innovation	.611*	.093	.343	6.564	.000
Organisational Innovation	.615*	.076	.487	8.129	.000
R	.740				
R-square	.547				
Adjusted R^2	.543				
F(4,379)	114.598				
Sig	.000[b]				
(*) 1% Level of Significance **a. Dependent Variable: Customer Retention**					

b. Predictors: (Constant), Product Innovation (PIN), Process Innovation (PROS), Market Innovation (MIN) and Organisational Innovation (OIN)

Going bay the results presented in Table 2 as an outcome of equation (4), it indicates the fact that there is a negative (-0.197) but significant effect of product innovation on customer retention. That is, a unit increase in product innovation leads to a 0.197 units fall in the level of customer retention at 1% level of significance. There is a positive (0.308) and significant effect of process innovation on customer retention. That is, a unit increase in process innovation leads to a 0.308-unit increase in the level of customer's retention at 1% level of significance. In this same light, a positive (0.611) and significant effect was established between market innovation and customer retention. This implies a unit increase in market innovation will lead to a 0.611-unit increase in customer's retention. The results of market innovation are significant at 1% level of significance (P value < 0.01). Same is the case of organisational innovation that indicates a positive (0.615) and significant effect on customer retention. Specifically, a unit increase in organizational innovation leads to a 0.615-unit increase in the level of customer's satisfaction and these results are significant at 1% level of significance (P-value < 0.01).

In line with the ANOVA results, the model fits the data. Results show that F (4, 379) = 114.598, P-value of 0.000b is less than 0.01(1% level of significance). This indicates that the overall regression model statistically predicts the outcome variable (i.e., it is a good fit for the data). The value of the adjusted R square is 0.543; which is very good. This value implies up to 54.3% changes in customer retention is accounted for by the inclusive variables (product, process, market and organisational innovations) while just 45.7% changes are accounted for by the error term. The significant part of these results is in line with the work of Asante and Bayoh (2017) who investigated the effect of innovation on customer retention in the Ghanaian Telecommunication Industry. The results showed that innovation had a positive effect on customer retention.

4.3 The Effect of Innovation on Customer Satisfaction and Retention

$$Y_{3i} = \beta_{0i} + \beta_1 PIN_i + \beta_2 PROS_i + \beta_3 MIN_i + \beta_4 OIN_i + \mu_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

Table 3. Innovation on Customers Satisfaction and Retention

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
	B	Std. Error	Beta		
(Constant)	8.292*	.888		9.336	.000
Product Innovation	-0.006	.083	-0.004	-0.076	.940
Process Innovation	-0.243*	.089	-0.111	-2.716	.007
Market Innovation	.806*	.103	.416	7.842	.000
Organisational Innovation	.582*	.084	.424	6.965	.000
R	.730				
R-square	.533				
Adjusted R2	.528				
F(4,379)	108.186				
Sig	.000b				
(*) 1% Level of Significance **a. Dependent Variable: Customer Satisfaction and Retention**					
b. Predictors: (Constant), Product Innovation (PIN), Process Innovation (PROS), Market Innovation (MIN) and Organisational Innovation (OIN)					

As a result of analysis based on equation (6), the coefficient of product innovation is negative (-0.006) and insignificant. That is, a unit increase in product innovation leads to a 0.006 units fall in the level of customer satisfaction and retention as a collapsed variable. There is a negative (-0.243) but significant effect of process

innovation on customer satisfaction and retention (collapsed variable). That is, a unit increase in process innovation leads to a 0.243-unit decrease in the level of customer's retention at 1% level of significance. In this same light, a positive (0.806) and significant effect was established between market innovation and collapsed customer satisfaction and retention. This implies a unit increase in market innovation will lead to a 0.806-unit increase in collapsed customer satisfaction and retention.

The results of market innovation are significant at 1% level of significance (P-value < 0.01). The case of organizational innovation indicates a positive (0.582) and significant effect on combined customer satisfaction and retention. To be more specific, a unit increase in organizational innovation leads to a 0.582-unit increase in the level of customer satisfaction and retention (collapsed variable) and these results are significant at 1% level of significance (P-value < 0.01). The ANOVA results in Table 3 indicate that the model fits the data. Results show that F (4, 379) = 108.186, P value of 0.000b is less than 0.01(1% level of significance). This indicates that the overall regression model statistically predicts the outcome variable (i.e., it is a good fit for the data). The value of the adjusted R square is 0.528, which is very good.

This value implies up to 52.8% changes in customer satisfaction and retention is accounted for by the inclusive variables (product, process, market and organizational innovations) while just 47.2% changes is accounted for by the error term. These results are in line with the work of Diaw & Asare (2018) examined the effect of innovation on customer satisfaction and customer retention in the telecommunication industry in Ghana: customers' perspectives. The data was analyzed, and a significant positive relationship was found between innovation and customer satisfaction and retention.

5. Conclusion

This study was out to investigate the effect of innovation on customers' satisfaction and customer retention of commercial banks in the Mfoundi Division. The researchers proceeded by evaluating the effect of innovation on customer satisfaction. The result of this investigation illustrated the fact that process, market and organizational innovations all have significant effects on customer satisfaction while product innovation had an insignificant effect. Also, the research investigated the effect of innovation on customer retention and found out that innovation in terms of product, process, market and organizational all had significant effects on customer retention. Finally, the researcher assessed the effect of innovation on customer satisfaction and retention as a collapsed variable and the results indicated that process, market and organisational innovations all have significant effects on customer satisfaction and retention while product innovation had an insignificant effect.

6. Recommendations

In line with the conclusion, this paper presents the following recommendations; Firstly, the management of commercial banks should take into consideration process, market and organizational innovations as they were found to have significant effects on customer satisfaction. Special attention and investment should be given to product innovation so that in the future it might also lead to the desired results of improving the level of customer satisfaction. Secondly, with a focus on customer retention, innovation in terms of product, process, market and organizational innovations should be retained as strong determinants of customer retention. In this light, the management of commercial banks should bear in mind that when it comes to determining the level of customer satisfaction and retention, innovation should be paid full attention.

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Author Contributions

Ayuk Takemeyang conceived the topic and did the draft of the manuscript, Henry Jong Ketuma and Arrey Fanny Ayere reviewed the manuscript.

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests — The authors declare no competing interests.

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The Effect of Employee Training and Supervision on Employees Knowledge Sharing Behaviour in Federal Universities, Nigeria

Eni Naomi Isang[1], Prof. Inyang Benjamin J[1], Eteng Joy Umuolo[1], Ndatah Emem Udo[1], Chenui Armand Phobuh[2] & Odama Patrick Ojeka[2]

[1] Department of Business Management, University of Calabar, Nigeria

[2] Department of Accounting, University of Calabar, Nigeria

Correspondence: Eni Naomi Isang, Department of Business Management, University of Calabar, Nigeria.

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Abstract

The study examined the effect of employee training and employee supervision on employee knowledge sharing behaviour in federal universities. Learning institutions are faced with how to manage their employees; motivating people to share knowledge, identifying the key people to share their knowledge, organising existing knowledge and making knowledge easily accessible. Evidence from literature reviews has shown that inadequate implementation of human resource management variables is responsible for poor employee knowledge sharing behaviour in federal universities. This study was carried out, using Multiple Regression Analysis, to examine the effect of human resource management variables and employee knowledge sharing behaviour in University of Uyo in Akwa Ibom and University of Calabar in Cross River States, Nigeria and to identify gaps relating to employee training and supervision on employee knowledge sharing behaviour. Survey research design was employed in the study. A sample size of 364 was selected for the study using Taro Yamane formula while Bowler's Proportionate Allocation Formula was used to determine each sample size of 139 and 225 for UNIUYO and UNICAL respectively. The data collected were analysed using SPSS version 28. Results from the test of hypotheses showed that training as well as supervision has a significant positive effect on employee knowledge sharing behaviour UNIUYO and UNICAL in Nigeria. Based on the results, it was recommended that the management of the institutions should ensure regular training of staff to strengthen the knowledge capacity of the employees. It also suggested that adequate supervision should be enhanced in the institutions to improve employee attitude toward knowledge sharing by providing support and guidance to workers in discharging their duties and responsibility.

Keywords: employee training, supervision, knowledge sharing, employee willingness, employee intention and employees' behaviour

1. Introduction

Knowledge is the quality that empowers individuals and organisations to stay competitive in the borderless world of business. Organisational dependence on resources to obtain greater output has moved from physical resources to knowledge and skills resources. Knowledge is not only information but a source of resource with asset value that can support organisations to function efficiently. Knowledge residing within individual employees plays a critical role in improvement of structural capability in the form of organisational performance. Knowledge is regarded as a factor of production alongside land, labour, and capital and is considered as the most important resource in an organisation (Hassan, 2013). Human resource management variables are set of major tools for knowledge creativity through knowledge sharing by influencing human capital and improved organisational performance (Salma *et al*., 2012). Human resource management practices are the organisational activities that produce a pool of human talents to ensure that the resources are utilised for the attainment of

organisational goals (Inyang, 2022).

Human resource management discipline extracted its roots from organisational psychology and has proven to be an important practice for managing organisations and institutions' learning. The role of this practice has emerged to be strategic in due course of time. The role of human resource management has become indispensable in gaining competitive gain, especially in this era of globalisation and advanced technological progress. Human resource management practice is a process that utilises the skills and knowledge of employees in order to achieve organisational goals (Hassan, 2013). The practice of human resource management is concerned with all aspects of how people are employed and lead in organisations. It covers, among others, activities such as job design, compensation, performance appraisal, supervision and training.

Human resource management variables are crucial instruments for the realisation of productivity in a learning institution. Universities, like every other organisation, strive to survive in today's dynamic and complex business environment. Universities aim to develop and survive in the challenging market environment, and as such, make efforts to develop their strategic resources so that their goals can be achieved. Meanwhile, the idea of human resource management in universities is to render support services in achieving the goals of the universities. This could be because university employees are considered to be knowledgeable in teaching and research. The university is an environment for knowledge acquisition and dissemination. Knowledge is abstract; it cannot be seen or touched. Knowledge sharing entails communicating knowledge within a group of people with the aim of employing available knowledge to advance group performance.

Organisations are faced with how to manage their employees, and the problems are related to motivating people to share knowledge, identifying the key people to share and making knowledge accessible for the achievement of the overall goals (Logan, 2006). Academic institutions are confronted with a number of challenges (designing jobs to fit skills of employees and training programmes) that can be alleviated through sound knowledge management and sharing practices. The quality of higher education mainly depends on the quality and competence of the lecturers working in the institution. The academic staff is considered as a key element for the success of any education system (Yin, 1996). There are a variety of factors which facilitate and interfere with the knowledge sharing practices of lecturers working in higher institutions. The practices of human resource management in the university can either hamper or encourage the willingness of the lecturer to share their knowledge for the success of the institution.

2. Statement of the Problem

Some universities in Nigeria have not clearly identified the role of human resource practitioners in decision making process, thus the failure in the implementation of human resource management variables in university of Uyo and university Calabar, Nigeria. This study becomes necessary due to negligence and inadequate implementation of human resource variables which might have been responsible for inadequate employee knowledge sharing behaviour in university of Uyo and university of Calabar respectively. The focus of training in universities of Uyo and Calabar has been more on technical skills and less conceptual skills for the expression of knowledge sharing behaviour required to translate employee skills into innovation, initiative, willingness and competitive edge (Yew, 2013). This has led to the inability of the universities to proactively respond to economic and technological challenges in their environments.

Supervision practice is one of the areas lacking attention in federal universities in Nigeria. This has caused a struggle between superior and subordinate in federal universities in Akwa Ibom and Cross River States, leading to the indulgence of knowledge sharing behaviour at opposite directions, and the prevalence of knowledge hoarding which hinders employee initiative and intention behaviour required for survival, growth and expansion.

It is imperative for university administrators to train employees and develop their knowledge-base. This study was carried out to investigate the effect of training on employee knowledge sharing behaviour. The objectives are to examine the effect of training on employee knowledge sharing willingness in university of Uyo and university of Calabar and also to ascertain the effect of supervision on employee knowledge sharing intention in university of Uyo and university of Calabar.

3. Research Hypotheses

The following hypothesis are formulated thus:

1) There is no significant effect of training on employee knowledge sharing willingness in university of Uyo and university of Calabar.
2) Supervision does not have a significant effect on employee knowledge sharing intention in university of Uyo and university of Calabar.

4. Theoretical Framework

4.1 Ability Motivation Opportunity Theory

Ability motivation opportunity theory was developed by Appelbaum *et al*. (Appelbaum *et al*., 2000). The theory had been widely used in human resource management practices research as an added value to resource-based view of Penrose, 1959 (Ahmad, 2020). The ability motivation opportunity components are described as the resources needed by the employees to perform efficiently and effectively at workplace. Moreover, these elements are interrelated, suggesting the necessity for all components to exist at the workplace (Haque *et al*., 2021).

Ability is an essential factor influencing employee behaviour and task performance. It encompasses the employees' necessary knowledge, skills, and aptitudes to perform their job (Boxall & Purcell, 2011). Organisations can implement human resource management practices to guide employee behaviour towards specific organisational goals. It can be done through compensation practice that rewards the employees when they successfully achieve the desired goals. Mat *et al*. (2020) pointed out that skilled employees will not perform effectively if they are not motivated. Therefore, proper implementation of human resource management practices in an organisation will impact employee motivational level in terms of knowledge sharing behaviour. The theory suggests that employees who are given the opportunity to contribute and perform their job will produce more positive organisational outcomes (Ujma & Ingram, 2019). Opportunity is described as the engagement in job-related behaviour, which can be achieved through job design and involvement (Szule *et al*., 2021). This is apparently true with developing innovative workplace behaviour in the universities where employees are required to perform their job accordingly.

The theory encourages employees' desired behavioural outcomes at work such as their knowledge sharing behaviour (Nor & Abdullah, 2020). The study was underpinned by the Ability motivation opportunity theory which contributes to employee behaviour in the shape of developing and enhancing the ability and capability of employees, motivate them and improve opportunities for them to foster their knowledge sharing behaviour. Workers tend to perform better when they have the opportunity to apply their skills and motivation to a given work situation. Thus, working arrangements can provide employees with the opportunity to influence the decision-making process of an institution and motivate them to share their task-specific knowledge through an environment such as that of trust.

The relevance of this theory to the study is based on the assumption that, academic staff in federal universities in Nigeria are the main contributors of knowledge sharing. The academic workforce needs to be equipped through suitable job design, compensation packages and constant training. With the application of appropriate human resource management practices, the academic staff knowledge sharing capacity will be broadened and renewed to enhance the universities' ability to achieve sustained competitive advantage.

5. Literature Review

5.1 Employee Training

Training is meant to assist employees acquire relevant skills, knowledge and abilities. It also helps employees become knowledgeable, effective and efficient in handling job-related problems in the organisation and the implementation of these programmes makes employees more valuable and useful. According to Armstrong (2009) training is defined as the systematic development of knowledge, skills and attitudes required by an individual to perform adequately at a given task or job to improve organisational performance. Similarly, Shamusudin *et al*. (2016) described training as a planned process for the purpose of modifying the attitude, knowledge and skill or behavioural traits of people through learning experiences that are designed to achieve effective performance in a range of activities.

Inyang and Akpama (2005) identified and explained methods of training as follows: on-the job training is where experienced employee or special instructor gives instructions to new employees within the scope of their job in the organisation. Vestibule training is where new employees are trained for specific jobs on special equipment in different locations in order to have pre- knowledge of the functions of such equipment before time. Classroom training involves the giving of instructions to a group of workers for general problem-solving purposes. Conference training entails organising a small group meeting to enable trainees to participate and the trainer knows in advance what knowledge and information he seeks from participants while apprentice training is where trainees are assigned to experienced tradesmen under standard agreement to acknowledge/skills for a period of time.

Good training programmes thus result in achieving effective and efficient employee knowledge sharing in organisation. According to Han *et al*. (2010) there is inadequate training of employees in most public institutions which has led to the inability of the institutions to proactively respond to economic and technological challenges of their environments. Chiang *et al*. (2011) noted that some employees develop themselves secretly by attending external courses relevant to their jobs and sometimes they are not upgraded having acquired higher skills necessary for the job rather they suffer termination of appointment. Owolabi and Abdul-Hameed (2011) observed that training of university staff has greatly increased their job performance, and consequently improved

the advantage of the institution in competing favourably. In the same vein, Bennett (2010) noted that employee training relates to performance. As noted earlier in the literature by Shamusudin *et al*. (2016) and Armstrong (2009) effective training and development can substantially correct poor recruitment system that introduces unqualified workforce into an organisation. Ubi *et al*. (2017) observed that continuous training of individual gives rise to a renewed mind and introduction of discoveries that may add value to existing knowledge.

The focus of human resource training is on developing people who are capable of tapping internal and external information and turning it into useful organisational knowledge (Ogedegbe, 2014). Training for knowledge sharing can be reactive or proactive. Training is proactive when it fosters the creativity and initiative of employees and helps to prevent human resource obsolescence while reactive tends to correct employees' inefficiency and ineffectiveness (Mooghali, 2012). Ahmed *et al*. (2016) opined that well-trained employee can develop, share and use knowledge to enhance institutional performance effectively through knowledge commitment and turnover. Moreover, according to Dewan and Abdul-Halim (2017) human resource management practices can provide a positive signal to employee mindset about organisation concerned toward their well-being and desires to establish long-term relationship which encourage employees to exhibit positive attitudes and behaviours including knowledge sharing behaviour.

Similarly, Faize *et al*. (2019) opined that training is a tool for improving employee behaviour in an organisation. Training as noted by the various scholars above is a sensitivity human resource tool which when properly implemented can encourage and enhance employee knowledge sharing willingness. Human resource management practices are gradually being recognised as essential organisational factors for promoting knowledge sharing behaviour of academic staff (Jyoti *et al.*, 2015). Existing literatures focused on recruitment and selection, employee participation, job security as well as promotion opportunity (Ananthalakshmi & Fadumo, 2014; Razak *et al*., 2015; Agarwala, 2003), while others focused on knowledge sharing altruism, reciprocal and subjective norms (Shamsudin *et al*., 2016). These authors apparently overlooked the aspects of job design and training as it relates to employee knowledge sharing behaviour. This study examined the influence of human resource management practices on employee knowledge sharing behaviour. This study is therefore a novel attempt to bridge the identified gap in literature.

5.2 Supervision

Supervision is a human resource practice where a superior oversees the activities of a junior employee in order to correct or advise where necessary for effective and efficient job performance. It is a provision of technical support and guidance to workers in discharging their duties and responsibility. A number of research have suggested that supervision encourages friendship, mutual trust, respect and increases employee satisfaction (Jamilu et al., 2015; Masui et al., 2019). The relationship with an immediate supervisor is a step towards employee trust and commitment. When employees observed fair treatment, they engaged in workplace social exchange as assumed by the social exchange theory. If the employees are keen on such treatment by their supervisor, then they will reciprocate the favorable treatment through their behaviour and attitude in sharing of their skill, knowledge, ideas, etc.

Supervision has become a strategy for human resource management nevertheless, little is recorded on how it improves the employees' behaviour in federal universities in Nigeria. Supervision is the instrument needed for preparing future skilled employees and also to strengthen learning capabilities, intelligence, shape organisation knowledge, and sustain the organisation competitive advantage according Ofobruku and Nwakoby (2015). Supervision is a relationship between a more experienced employee and a less experienced employee for purposes of sharing knowledge and insight with respect to a specific task or duties. In academic settings, supervision is used in both teaching and non-teaching staff (Ilevbare, 2016).

Masui et al. (2019) who stated that organisations are social systems where human resources are the most important factors for effectiveness and efficiency utilisation of other resources, also considered a supervisor as a person who facilitates personal and professional growth of an employee by sharing the knowledge and insight that have been learned through the years. Knowledge sharing is a key mechanism for organisations success according to Masui et al. (2019). Therefore, workplace relationships such as supervision, compensation, job design should be encouraged to promote knowledge sharing. Beer (2018) established influence of supervision on employee knowledge sharing as well as related activities in universities. Akosile and Olutokun (2019) also agreed with the findings of Beer (2018) that supervision has influence on knowledge sharing among academics. It is imperative that supervision as a human resource management tool can foster and encourage employee knowledge sharing behaviour among their colleagues which can produce highly competitive advantage for the universities.

5.3 Employee Knowledge Sharing Willingness

Employee knowledge sharing willingness is the ability of an employee to share his skills, ideas and experience

without being compelled to do so. Relationships are built over time and increase employees' willingness to share knowledge. As relationship developed employee mind-set, it results in the development of trust which has been shown to contribute to the willingness to knowledge sharing according to Manus (2016). Social exchange theory argues that knowledge sharing occurs due to reciprocal exchanges between two or more individuals (Casimir, 2012). Organ *et al*. (2006) described organisational citizenship behaviour as individual behaviour that is discretionary, and not directly recognised by the formal reward system and in aggregate promotes the efficient and effective functioning of the organisation.

Knowledge is the ability, skill, understanding and information, which every individual requires in order to be able to function effectively and perform efficiently (King, 2009; Binafeigha & Peniel, 2018). Muhrdi *et al*. (2019) submitted that competitive advantage and success of an organisation lies on the people who are willing and ready to perform effectively and efficiently within the organisation. It follows therefore that for the employees in an organisation to be able to perform their duties and make meaningful contributions to the achievement of the organisational goals they need to acquire the relevant skills and knowledge.

Consequently, knowledge management is today seen as a crucial aspect for the performance of organisation, which is why organisations that manage and share their knowledge effectively are more resourceful (Maki, 2008). Armstrong (2009) agreed that competitive advantage can be mostly achieved and sustained through commitment and willingness of the employees to perform. Ghimai (2010) defined knowledge-based economy as circumstances where organisation and workforce acquire, create, disseminate and use knowledge more effectively for greater economic and social development. Knowledge provides great potential for institutions to strengthen their growth and development by providing more efficient ways of working and delivering effective information. Employee knowledge sharing willingness is very important for tertiary institutions to maintain and sustain competitive advantage in this global age of advanced knowledge-based economy.

5.4 Employee Knowledge Sharing Intention

Employee knowledge sharing intention refers to the desire of an employee who is knowledgeable and skilled and intents to share his potential with other individual or groups in organisation for attainment of overall objective. Intention is also considered as purpose, intent, objectives, aim and goals that influence employee behaviour to share their knowledge. Ajzen and Manstead (2007) pointed out that human action is influenced by a favorable or unfavorable evaluation of behaviour, perceived social pressure to perform or not perform the behaviour, and perceived capability to perform the behavior. Also, intention is an indication of how hard an individual is willing to try, how much of an effort an individual is ready to put in (Ru-chu & Shii-jer, 2011). Intention is the probability that an employee will perform a stated action. Social theory assumes that the most main direct determinant of behaviour is behavioural intention. Employee knowledge sharing intention is the effort or ability of an employee to create, initiate and innovate intellectual ideas within the organisation which can gain competitive advantage for the organisation through interaction.

Wang and Noe (2010) defined employee intention as a concept that addresses the application of a new idea and process. It is a fundamental ability to maintain a competitive advantage. Innovative behaviour is a major factor in the success of the organisation in this era of knowledge-based economy and globalisation. Ariawan *et al*. (2020) stated that, the rapid change and high level of environmental uncertainty, requires ability and skills of intention behaviour in knowledge sharing to be able to achieve growth and sustainability of an institution. Organisation that has the resources that are able to behave innovatively will be able to improve the performance and achievement of organisational goals (Ariawan *et al*., 2020). The nature of academic institutes makes it imperative for the academicians to impart knowledge either through research, teaching or its dissemination at both individual and collective level. The knowledge sharing practices in tertiary institutions comes in various forms like research, presentation, teaching, meeting etc., which promote institutional success.

Rorbertson and Hammersley (2004) pointed out that although knowledge sharing is a desirable goal, for many organisations, in practice it is difficult to achieve. They explained that employees are reluctant to share knowledge but are willing to do work activities that are required in their jobs. They further stated that most people who hoard their knowledge are almost fearful of losing their job or feel insecure. Many purposefully refuse to document procedures and information about certain tasks because they do not want to lose their knowledge power to others. They want to remain as the ones who 'know how' to do something when others do not. The knowledge sharing practices in the educational institutions also improve educational quality, institutional performance, as well as its contributed to the success of the nation (Akosile & Olatokun, 2019).

Omar and Ahmad (2019) stated that employees show different organisational work behaviour depending on their satisfaction and work environment. In addition, some individuals may share their experience and knowledge with others without thinking of the benefit they may gain from it (Eugene & Khalil, 2011). Conclusively, individuals within an organisation may share their knowledge freely without thinking of any strings attached if they are satisfied with organisational human resource practices. Employee knowledge sharing intention is a

rarely studied area, therefore, this study will contribute to knowledge by investigating the influence of human resource practices on employee knowledge sharing intention in universities of Uyo in Akwa Ibom and university of Calabar Cross River States, Nigeria.

6. Empirical Literature

Agbulu (2015) evaluated the human resource management practices in federal and state college of education Nigeria. Descriptive statistics was used and t-test for analyzing data. A total of 572 population was used without sampling and the findings showed that the federal and state colleges of education in the north-central zone to a great extent comply with approved guidelines on staff recruitment, ensures proper staff training and development, and appropriate staff appraisals and promotions, staff welfare and staff discipline is on the low practice. It was recommended among others that recruitment, appraisals and promotions, staff training and development, staff welfare and discipline practices should be given due attention for effective and efficient performance.

Abbas (2017) examined knowledge sharing and dissemination among academics in federal universities in Nigeria. The aim was to investigate the phenomenon of knowledge sharing among academic staff in four federal Nigerian universities, namely Bayero University, Kano; University of Maiduguri; University of Ibadan; and University of Port Harcourt. The research was a quantitative approach and 364 academic staff were sampled using administer questionnaire. The study found proof of knowledge sharing among academics in the four universities through workshops, seminars and conferences, affiliation of professional associations/societies and readiness to share knowledge and other resources with colleagues. The study recommended more intense modern technologies to increase awareness, improve knowledge sharing through research and teaching activities, since knowledge sharing is a critical factor in the survival of educational institutions across the globe.

Kenndy and Victor (2020) researched on knowledge sharing practices among lecturers in Nigeria universities. The objectives of the study were to examine the perceptions of lecturers about knowledge sharing, identify the benefits of knowledge sharing among lecturers, identify ways used in sharing knowledge by lecturers. And investigate the barriers militating against knowledge sharing. The study adopted descriptive survey design. A sample of 217 lecturers was collected across seven faculties in the university in Kwara. Data was analysed using descriptive statistics of frequency counts and percentage. Findings of the study revealed that lecturers have positive perceptions toward knowledge sharing. It was recommended that university management should create massive campaigns on the need for lecturers to embrace knowledge sharing among peers. This can be achieved through training, conferences, attendance, and seminars etc. on the need for knowledge sharing among them.

Sindhu and Perumal (2013) examined employee knowledge sharing behaviour in education sector in India. The objective was to investigate the knowledge sharing behaviour of teaching faculty members of engineering college, Chennai. Structured questionnaires were used to collect samples from 72 respondents. T-test analysis tool was used to evaluate the relationship between knowledge sharing behaviour of the lecturers and practices of the human resources. The result revealed that employees do not seem to hesitate in sharing information with their co-workers in terms of training, work experience, teaching strategy, etc. The educational institutions provided a platform for knowledge sharing, by providing necessary training, and other facilities for enabling people to meet and share knowledge. The study was preliminary research, therefore recommending further studies in the area of training.

Masui *et al*. (2019) studied academic staff behavioural intention to create knowledge by using policies in the universities of Tanzania. The objective of the study was to investigate the association between policy aspects and the intention to engage in the knowledge creation behaviour by academic staff in the universities. The study adopted theory of planned behaviour. A structured questionnaire was used to collect data from 202 respondents. Logit regressed and maximum likelihood estimation was used to analyse data. It was revealed that there was a significant association between availability of time, provision of space, rights and values and the intention to engage in knowledge creation behavior. The relationship between reward and mentoring and intention to engage in the behaviour was negative. The study recommended among others that training and mentoring should be properly instituted in the universities.

Iqbal (2015) investigated employee perception of human resource management practice and knowledge sharing behaviour in COMSATS institute of information technology, Pakistan. The objective of the study was to examine causative relationship between specific human resource practices and employee knowledge sharing. The study adopted structural equation models in analysing data. A total of 600 questionnaires were distributed to employees of the selected organisations of 390 were usable. The study shows a positive relationship between employee collaboration and employee knowledge sharing behaviour, while it recommended collaborative practice and trust to help employee knowledge sharing behaviour to improve capability in their organisation.

Ru-chu and Shii-jer (2011) investigated the knowledge sharing behaviour of teachers in Taiwanese high schools,

with the aim of observing factors responsible for knowledge sharing. A total of 210 questionnaires were distributed and analysis of variance and partial least square was used for analysis. The results showed among others, that attitude, subjective norm, behavioural control and intention influenced knowledge sharing behaviour of the Taiwanese teachers. Recognition and trust were emphasized to encourage effective knowledge sharing.

Fahad (2018) studied knowledge sharing among academics in higher education institution in Saudi Arabia. The objective was to observe individual and organisational factors affecting employee willingness to share knowledge. The study used survey technique to administer 140 questionnaire and multivariate regression was used to analysed data. The result showed that trust, leadership and attitude affected a person's willingness to share knowledge. It was recommended that trust, time and support through open communication and collaboration can enhance employee willingness of knowledge sharing.

Amini and Nwanosike (2018) studied knowledge synergy among lecturers in public universities in River State, Nigeria. Descriptive research design and stratified random sampling were adopted. A total of 764 lecturers were sampled and Z-test statistics was used to test the hypotheses. It was revealed out among others that lecturers practiced knowledge synergy to a very great extent in the three public universities through academic conferences, workshops, seminars, joint authorship, general staff meetings and one-on-one discussions. It was recommended among others that heads of department should always pair senior and junior lecturers in the discharge of teaching responsibilities to enrich their knowledge level.

Rehman *et al*. (2020) studied the role of trust and organisational commitment on human resource management and knowledge sharing behaviour of employees in Pakistan. The aim was to investigate the impact of human resource management practice on knowledge sharing behaviour among university faculty members. Questionnaires were distributed to 700 faculties members and structural equation models were also used to analyse the data. The study revealed a positive impact of human resource practices on knowledge sharing behaviour of faculty members. It therefore recommended that more socio-emotional relationships be developed to build trust and commitment in order to spur knowledge sharing among the employees in the faculties.

Bamigboye *et al*. (2018) investigated knowledge sharing and research output among academic staff in federal university of Agriculture, Abeokuta Nigeria. 127 academic staff were used for the study while questionnaires were used as instruments for data collection. Data was analysed using descriptive statistics such as frequencies, percentages, mean and standard deviation. Findings of the study revealed that the channels through which academic staff shared knowledge were high. It also showed that the level of research output among academic staff was also high and that there is a significant relationship between knowledge sharing and research output among academic staff. The study recommended among others, that the university management should provide avenue for academic staff to embrace knowledge sharing among the academic staff through training and conferences.

Salleh *et al*. (2017) researched on employee readiness, training transfer and work environment among academic staff in Malaysia. The objective of the study was to investigate the influence of training design on the readiness of academic staff to transfer knowledge. It was a cross-sectional research, and questionnaire was administered to 238 while the partial least square and structured equation model was used to analyse the data. The research findings revealed among others that ability, supervisor role training played significant roles in transferring training knowledge. The study recommended extensive training and motivation practices to be implemented.

Khalid (2017) studied knowledge sharing behaviour intentions of academics and their determinants among lecturers in Baghdad. The objective was to assess the attitudes, perceptions and behaviours of academics and the identification of factors that support or hinder knowledge sharing behaviour of academics within Baghdad University. A survey design was used to administered 326 questionnaires. AMOS Version 23 software and the structural equation modelling (SEM) software of IBM (Version 23) were used to examine the relationship. The study recommended that educational institutions seeking to entrench knowledge sharing strategies should encourage communication, training and the exchange of knowledge skills.

Emeribe (2020) studied human resource management variables and academic staff job effectiveness in the university of Calabar, Nigeria. The aim of the study was to examine the effect of some human resource variables on academic staff job effectiveness. A correlational research design was adopted for the study. The study comprises all the academic staff in the University of Calabar. A stratified random sampling technique was used to select total numbers of one hundred (100) respondents from the University of Calabar. The result revealed that the management of lecturers' appraisal/promotion and management of lecturers' in-service training significantly relate to their' job effectiveness in the university. It was recommended that the university management should ensure that lecturers are appraised and promoted appropriately to enhance their lecturer's job performance. Also, the university management should make provisions for lecturer in-service training to enhance learning and improving lecturers' job effectiveness.

7. Gap in the Literature

Knowledge is lacking regarding the effect of human resource management variables and employee knowledge sharing behaviour in universities of Uyo and Calabar. Previous studies focused on the determinants, channels and barriers of employee knowledge sharing among academics. Khalid (2017) and Kennedy and Victor (2020) investigated these studies. There is paucity of studies conducted to measure how training and supervision affect employee knowledge sharing willingness and employee knowledge sharing intention in university of Uyo in Akwa Ibom and university of Calabar Cross River States, Nigeria. This is the gap this study intends to bridge.

The researcher added to existing knowledge by developing a conceptual framework to depict the variables under investigation. Existing studies adopted SEM-PLS and correlation, Z-test and Chi-square in analysing results. This study adopted Probit and Logit Regression analysis to evaluate the effect of human resource management variables on employee knowledge sharing behaviour.

8. Materials and Methods

Survey research design was employed to serve as guidelines for data collection, analysis, discussion of findings and interpretation of the data collected from the field. The researcher used descriptive statistics to rank the respondent socio-demographic status and perception of human resource management practices and employee knowledge sharing behaviour in federal universities in Nigeria. The population of the study consisted of 3,995 academic staff from the two federal universities in Akwa Ibom and Cross River States. This statistic comprised (UNICAL 2474 and UNIUYO 1521) academic staff. This population was further sub divided into strata: Graduate assistant — lecturer 1 and Senior lecturer- Professor from the two universities. It was not possible for the researcher to investigate the total population; therefore, sample size was drawn using Taro Yamane statistics formula. Sample was selected from teaching staff of the universities drawn from the budget and planning departments, and human resource unit.

The teaching staff were selected from the two federal universities in Akwa Ibom and Cross River States in South-South Nigeria. Hence, the total sample size of the study drawn among teaching staff of the Universities was three hundred and sixty-four staff (364) and has been proportionally shared based on their population size (225 and 139) for Unical and Uniuyo respectively. The questionnaire was designed in 5- point Likert scales of strongly agreed (SA) = 5, Agreed (A) =4, undecided (U) =3, disagreed (D) 2 and strongly disagreed (SD) = 1. Exploratory factor analysis was conducted to determine the validity of the construct. The result of the analysis revealed that constructs in the instruments were valid, the p-value of the study constructs were less than 0.05. Furthermore, the Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity (KMO and Bartlett's Test) range from (0.854-0.966) which revealed the sampling adequacy of the constructs as well as the closeness of fit between the construct measures and actual observations made with the instrument. Hence, the constructs in the instrument were considered valid for the analysis.

The reliability of the Instrument was established based on a pilot study. In measuring the reliability of the research instrument, the questionnaire was subjected to a pilot test. Thirty-six (36) copies of the questionnaire containing 30 questions were administered to thirty-six lecturers in University of Cross River State (UNICROSS), which represent 10 per cent of the sampled size. The Cronbach Alpha for internal consistency of the items of the questionnaire was conducted using the reliability procedure in Statistical Package for Social Sciences (SPSS) version 28. A high Cronbach alpha index indicates high reliability. A Cronbach alpha coefficient of at least 0.70 was acceptable, and the instrument was considered to have high reliability and therefore fit for the purpose of collecting data for the study. The multiple regression analysis was adopted to examine the effect of the dependent variables (employee knowledge sharing willingness and employee sharing intention) on the independent variables (employee training and supervision).

9. Analysis of the Results

The hypotheses were re-stated in the null and alternate forms using multiple regression analysis at 0.05 level of significance. The Statistical Package for Social Science (SPSS) version 28 was used to analyze data.

Hypothesis 1

H_0: Training does not have a significant effect on employee knowledge sharing willingness.

H_A: Training has a significant effect on employee knowledge sharing willingness.

The test of hypothesis two for the significance of training on employee knowledge sharing willingness reveals that the coefficient of this construct was 1.3543 with a z-stat of 1.5646 and probability of 0.0001. The p-value was significant at less than 1 per cent, indicating that the coefficient passes the significance test at 1 per cent level. Therefore, the study rejects the null hypothesis, implying that training has a significant positive effect on employee knowledge sharing willingness in university of Uyo and university of Calabar.

Multiple regression analysis results for the constructs of Employee training and supervision on employee

knowledge sharing behaviour.

Table 1.

	Probit			Logit			Extreme value		
Variable	Coef.	z-stat.	Prob.	Coef.	z-stat.	Prob.	Coef.	z-stat.	Prob.
Training	1.5347	1.5419	0.0002	1.3543	1.5646	0.0001	1.5145	1.5843	0.0001
Sup	1.5642	1.6782	0.0003	1.8432	2.2453	0.0002	1.1794	1.8552	0.0001
Pseudo R^2		0.7823			0.7495			0.7534	
LR statistic		54.443	0.0000		57.532	0.0000		52.893	0.0000
Akaike info criterion (AIC)			3.9764			3.9153			3.9537

Source: SPSS Version, 28.

Hypothesis 2

H_0: Supervision does not have a significant effect on employee knowledge sharing intention.

H_A: Supervision have a significant effect on employee knowledge sharing intention.

The test of hypothesis of the relationship between supervision (Sup) and employee knowledge sharing behaviour outcomes shows that the coefficient of the constructs was 1.8432 with z-stat of 2.2453 and a probability of 0.0002 respectively. The coefficient passed the significance test at the 5 percent level; therefore, the null hypothesis was rejected. This implies that supervision have a significant positive effect on employee knowledge sharing behaviour in Federal Universities in Akwa Ibom and Cross River States Nigeria.

10. Discussion of Findings

In testing hypothesis two, the coefficient of training was positive (c = 1.3543; z-stat = 1.5646) and significant at 5 per cent (0.05), with a p-value of 0.0001. This implies that training has a significant positive effect on employee knowledge sharing willingness in university of Uyo and university of Calabar. The result of this study agreed with the findings of Shamusudin *et a*l. (2016) that training has significantly positive effect on workers performance and enhances knowledge sharing in organisation. The finding is also in line with that of Faize *et al*. (2019) who found that training played a vital role in enhancing knowledge sharing and performance of workers. Similarly, Ubi *et al*. (2017) observed that continuous training of individuals gave rise to a renewed mind and the introduction of discoveries that may add value to existing knowledge. Ahmed *et a*l. (2016) opined that well-trained employees can develop, share and use knowledge to enhance institutional performance effectively.

The test of hypothesis two shows that the coefficient of supervision was positive with (c = 1.8432, z-stat = 2.2453) and a p-value of 0.0002 respectively. Thus, the coefficient passed the significance test at the 0.05 percent level. This result implies that supervision have a significant positive effect on employee knowledge sharing behaviour in Federal Universities in Akwa Ibom and Cross River States Nigeria. This study's finding agrees with the study of Masui et al. (2019) that supervision plays a vital role in enhancing workers performance and knowledge sharing behaviour by providing technical support and guidance to workers in discharging their duties and responsibility. The study was also supported by the findings of Ofobruku and Nwakoby (2015) who stated that supervision is a relationship between a more experienced employee and a less experienced employee for purposes of sharing knowledge and insight with respect to a specific task or duties for improve performance.

11. Conclusion

Human resource management practices have continued to play a vital role in institutions globally. However, this study explored the effect of employee training and supervision on employee knowledge sharing behaviour in university of Uyo in Akwa Ibom and university of Calabar in Cross River States, Nigeria. Two human resource management variables (employee training and supervision) were studied to examine their effect on employee knowledge sharing behaviour and this was measured in terms of knowledge sharing willingness and employee knowledge sharing intention. The result showed that human resource management variables have a significant positive effect on employee knowledge sharing behaviour in university of Uyo in Akwa Ibom and university of Calabar in Cross River States, Nigeria.

Specifically, the study concluded that employee training and supervision have a significant positive effect on

employee knowledge sharing willingness and intention in the two institutions. The importance of human resource management practices on employee knowledge behaviour cannot be overemphasized, as it contributes to organisations achieving sustained competitive advantage.

12. Recommendations

The following recommendations were made:

1) Management of the universities of Uyo and Calabar should provide regular training to build and enhance the human capacity to meet the demands in the education sector and promote employee knowledge sharing willingness in these universities.
2) Adequate supervision should be enhanced in the institutions to improve employee intention toward knowledge sharing by providing support and guidance to workers in discharging their duties and responsibility.

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A Review of Smart Logistics Operations Management and Future Research Directions

Chijing Deng[1]

[1] Shenzhen Xiyi Trading Co., Ltd., Guangdong 518000, China

Correspondence: Chijing Deng, Shenzhen Xiyi Trading Co., Ltd., Guangdong 518000, China.

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Abstract

Smart logistics utilizes the Internet of Things (IoT) and intelligent information technologies to achieve real-time monitoring, comprehensive control, intelligent optimization, and automation throughout the entire logistics process. This paper reviews the four developmental stages of smart logistics, from the intelligentization of individual logistics functions to the intelligentization of the entire logistics operation process, and then to the comprehensive optimization of the logistics process from a supply chain perspective. Through the analysis of typical cases such as the retail AI fresh produce system jointly developed by Walmart and Codelong Technologies, and the “smart factory” jointly developed by Geek+ and Siemens Shanghai, this paper explores the applications and management model innovations of smart logistics at different stages. Additionally, future research directions for smart logistics are proposed, including technological innovation, adaptation of operational models, and the development of new business processes.

Keywords: smart logistics, operations management, developmental stages, technological innovation, future research, Internet of Things (IoT), big data, artificial intelligence (AI), machine learning, automation, blockchain, supply chain collaboration, green logistics, sustainable development, intelligent decision-making, logistics platforms, sharing economy, logistics finance, risk management, performance evaluation, talent management, business process optimization, internationalization, intelligent manufacturing, ecosystem

1. Introduction

With the acceleration of global economic integration and the vigorous development of e-commerce, the logistics industry, as an important link between production and consumption, is facing unprecedented opportunities and challenges. As a vital component of the modern economic system, the logistics industry has shown rapid development in recent years. However, traditional logistics models have gradually revealed many problems in terms of efficiency, cost control, and customer experience. For example, manual operations in warehousing management lead to low efficiency and high error rates; the lack of real-time monitoring during transportation makes it difficult to respond to emergencies; and irrational route planning in the delivery phase increases transportation costs and time. These issues severely restrict the further development of the logistics industry.

Against this backdrop, smart logistics has emerged. By deeply integrating cutting-edge technologies such as the Internet of Things, big data, artificial intelligence, and blockchain, smart logistics has achieved intelligentization, automation, and high efficiency in the entire logistics process. IoT technology enables interconnectivity between logistics equipment and goods, facilitating real-time data collection and transmission; big data analysis provides precise data support for logistics decision-making; automation technology enhances warehousing and transportation efficiency; and blockchain technology ensures the security and transparency of supply chain information. The emergence of smart logistics not only improves logistics efficiency and reduces operating costs but also enhances customer satisfaction and provides strong support for the optimization of the entire supply chain.

However, the development of smart logistics is not only about the application of technology but also a renewal of operational management concepts. How to optimize operational management processes under the context of smart logistics and enhance corporate core competitiveness is a pressing issue for logistics companies. Researching the current status and future development directions of smart logistics operations management is of great significance for logistics companies to formulate strategic plans, optimize resource allocation, and improve operational efficiency. It also provides a new research direction and practical cases for academia. This study aims to provide theoretical support and practical cases for logistics companies to formulate smart logistics development strategies, and to offer references for academic research in the field of smart logistics operations management, promoting the further development of smart logistics theory and practice.

2. Basic Concepts and Technological Foundations of Smart Logistics

2.1 Definition and Connotation of Smart Logistics

Smart logistics is a modern logistics model that achieves intelligentization, automation, and high efficiency throughout the entire logistics process through the Internet of Things, big data, artificial intelligence, and blockchain technologies. It enhances the perception, decision-making, and execution capabilities of logistics systems through information technology, optimizes logistics processes, reduces costs, and improves efficiency and customer experience. Traditional logistics relies on manual operations and simple information technologies, resulting in low efficiency and lack of transparency. In contrast, smart logistics achieves equipment interconnectivity, intelligent decision-making, and automated operations through the Internet of Things, big data, and artificial intelligence, significantly enhancing the intelligence level of logistics systems. The core elements include intelligent equipment, information technology, data-driven decision support systems, and supply chain collaboration, which together form the ecosystem of smart logistics.

2.2 Key Technologies of Smart Logistics

The development of smart logistics depends on a series of key technologies that not only enhance the intelligence level of logistics systems but also provide strong support for operations management. IoT technology enables interconnectivity between equipment and goods through sensors and RFID tags, providing real-time data support for intelligent decision-making. Big data and analytics technologies mine massive amounts of data from logistics processes to optimize logistics processes and improve efficiency. Artificial intelligence and machine learning technologies are widely applied in intelligent warehousing and transportation systems, achieving automated route planning and traffic prediction. Automation and robotics technologies improve logistics efficiency in warehousing and transportation, such as automated warehousing systems and autonomous vehicles. Blockchain technology ensures transparent sharing of supply chain information through distributed ledgers, enhancing supply chain collaboration efficiency.

2.3 Technological Architecture of Smart Logistics

The technological architecture of smart logistics is divided into three layers: the perception layer, the network layer, and the application layer. These layers work collaboratively through data flow and information sharing. The perception layer collects real-time information from logistics processes through devices such as sensors, RFID tags, and cameras. The network layer uses wireless networks and satellite communication technologies to quickly transmit data from the perception layer to data centers. The application layer implements intelligent applications based on collected and transmitted data, such as intelligent warehousing management, transportation scheduling, and supply chain collaboration platforms. Data flows between layers, processed through big data analytics and artificial intelligence to generate decision instructions, which are fed back to the application layer. Blockchain technology ensures data security and credibility, achieving intelligent operations management in smart logistics through information sharing.

3. Developmental Stages of Smart Logistics

The development of smart logistics has evolved from basic functional intelligentization to ecosystem construction, as outlined below:

3.1 Stage One: Intelligentization of Logistics Functions

The initial stage of smart logistics focuses on the intelligent transformation of core logistics functions, including warehousing, transportation, and delivery. Automated shelving systems, robotic handling equipment, and intelligent inventory management systems have been introduced to achieve automated storage and real-time monitoring of goods in warehousing management. Transportation management has benefited from GPS and GIS technologies for real-time vehicle tracking and route optimization, enhancing transportation efficiency. The delivery segment has adopted drone delivery and smart parcel lockers to optimize last-mile delivery and improve customer experience. (Bloomberg, D. J., 2016)

3.2 Stage Two: Intelligentization of Logistics Operation Processes

As technologies mature, smart logistics has shifted towards the intelligentization of the entire logistics operation process. The automation and optimization of logistics processes have become key, with automation in loading, handling, and sorting operations. Real-time monitoring and dynamic adjustments have become possible, leveraging IoT and sensor technologies to monitor the status of goods and dynamically adjust logistics plans. Intelligent decision support systems utilize big data analytics and artificial intelligence algorithms to provide optimal decision-making solutions for logistics companies, enhancing operational efficiency and market competitiveness.

3.3 Stage Three: Comprehensive Optimization from a Supply Chain Perspective

Smart logistics has evolved to optimize logistics, information flows, and financial flows from a supply chain perspective. Supply chain collaboration and information sharing integrate data from upstream and downstream enterprises, breaking down information silos and increasing supply chain transparency and collaboration efficiency. Supply chain risk management uses big data and artificial intelligence technologies to predict potential risks and develop preemptive strategies. Green logistics and sustainable development have become important directions, with logistics companies optimizing transportation routes, adopting new energy vehicles, and promoting recyclable packaging to reduce environmental impact.

3.4 Stage Four: Construction of the Smart Logistics Ecosystem

The ultimate goal of smart logistics is to build an ecosystem that encompasses logistics, e-commerce, finance, manufacturing, and other sectors. The integration of logistics with multiple industries has created new models such as “logistics + e-commerce” and “logistics + finance,” enhancing operational efficiency across industries. The construction and operation of smart logistics platforms have become central, integrating resources and optimizing configurations to provide added-value services for logistics companies. The internationalization and globalization of smart logistics have promoted global collaboration in the logistics industry, enhancing corporate international competitiveness.

The developmental stages of smart logistics reflect a gradual evolution from basic technological applications to system integration, cross-industry integration, and globalization, driving the intelligentization and high-efficiency development of the logistics industry.

4. Case Studies of Smart Logistics Operations Management

4.1 Walmart and Codelong Technologies’ Retail AI Fresh Produce System

4.1.1 Case Background and Implementation Process

Walmart, as the world’s largest retailer, has always been a benchmark in supply chain management. However, with the rise of fresh produce e-commerce, the shortcomings of traditional fresh produce supply chains in terms of freshness preservation, inventory management, and delivery efficiency have gradually become apparent. To enhance the supply chain efficiency and customer experience of fresh produce, Walmart collaborated with Codelong Technologies to develop a retail AI fresh produce system. The system was piloted in 2019 and gradually rolled out to some stores in the United States and Canada. The core of the system is to use IoT devices to monitor the temperature, humidity, and transportation status of fresh produce in real-time and optimize inventory management and delivery routes through AI algorithms.

4.1.2 Technological Applications and Innovations

The system installs temperature and humidity sensors on fresh produce packaging and transportation vehicles through IoT technology to monitor product conditions in real-time, ensuring the quality of fresh produce during transportation and storage. Meanwhile, AI algorithms analyze historical sales data and real-time inventory information to achieve precise restocking and dynamic pricing. The system can predict demand based on weather, holidays, and other factors to optimize inventory levels. Additionally, by integrating GIS and traffic data, delivery routes are optimized to reduce transportation time and costs. Machine learning algorithms enable the system to automatically adjust delivery plans in response to emergencies.

4.1.3 Optimization of Operations Management

According to data released by Walmart, after the implementation of the AI fresh produce system, the inventory turnover rate of fresh produce increased by 25%, and the spoilage rate decreased by 15%. Delivery efficiency also improved significantly, with average delivery time shortened by 30%. Customer satisfaction increased substantially due to product freshness and supply stability, with fresh produce sales growing by 18%. Moreover, Walmart reduced logistics costs by 10% through system optimization, enhancing overall supply chain competitiveness. (Kimball, R., & Ross, M., 2011)

Table 1. Operational Data Comparison Before and After Implementation of Walmart's AI Fresh Produce System

Indicator	Before Implementation	After Implementation	Change Rate
Inventory Turnover Rate	4.0 times/month	5.0 times/month	+25%
Spoilage Rate	10%	8.5%	-15%
Average Delivery Time	3.5 hours	2.5 hours	-30%
Customer Satisfaction	85%	92%	+7%
Fresh Produce Sales	$10 million	$11.8 million	+18%

4.2 Geek+ and Siemens Shanghai's "Smart Factory"

4.2.1 Case Background and Implementation Process

Siemens, a global leader in industrial manufacturing, has always been committed to enhancing production efficiency and supply chain management through intelligent technologies. In 2018, Siemens collaborated with Geek+ to build the first "smart factory" in Shanghai, aiming to achieve intelligentization and high efficiency in production processes through automated warehousing and logistics systems. The factory adopted Geek+'s robotic and automated warehousing solutions, including shelf shuttles, handling robots, and intelligent sorting systems. During the implementation process, Siemens optimized the entire production process, deeply integrating the automated logistics system with the production management system to achieve full automation from raw material storage to finished product dispatch.

4.2.2 Technological Applications and Innovations

The factory utilizes shelf shuttles and automated stereoscopic warehouses to achieve efficient storage and rapid retrieval of raw materials and components. The system can automatically adjust inventory layout based on production plans to improve space utilization. Within the factory, handling robots and intelligent sorting systems are responsible for material transportation and sorting tasks. By real-time integration with the production management system, robots can accurately complete tasks with minimal human intervention. AI algorithms optimize the scheduling of robots and equipment to ensure the smoothness and efficiency of the production process. The system can dynamically adjust task priorities based on production progress to enhance overall production efficiency.

4.2.3 Optimization of Operations Management

According to Siemens' report, after the implementation of the smart factory, production efficiency increased by 30%, and inventory turnover rate improved by 40%. Meanwhile, the error rate in the production process decreased by 20% due to reduced human intervention. The collaborative optimization of the intelligent logistics system and production system reduced the overall operating costs of the factory by 25%. The successful implementation of the smart factory has provided a replicable template for Siemens' factory upgrades worldwide. (Ye, Q. F., 2021)

Table 2. Operational Data Comparison Before and After Implementation of Siemens' "Smart Factory"

Indicator	Before Implementation	After Implementation	Change Rate
Production Efficiency	100 units/hour	130 units/hour	+30%
Inventory Turnover Rate	3.0 times/month	4.2 times/month	+40%
Production Error Rate	5%	4%	-20%
Operating Costs	$1 million/month	$0.75 million/month	-25%

4.3 Summary and Insights from the Cases

4.3.1 Characteristics of Smart Logistics Applications at Different Stages

From the above two cases, it can be seen that the application of smart logistics at different stages has the following characteristics: In the initial stage, the focus is on the intelligent transformation of individual functional modules, such as the automation of warehousing management and real-time monitoring of transportation management. In the middle stage, the gradual intelligentization of logistics operation processes is achieved through automated equipment and intelligent systems to optimize logistics processes and improve overall efficiency. In the advanced stage, a comprehensive optimization of logistics, information flows, and

financial flows is achieved from a supply chain perspective to enhance supply chain collaboration efficiency and competitiveness.

4.3.2 Commonalities and Differences in Management Model Innovations

Both cases utilize big data analytics and AI algorithms to achieve precise decision-making, optimizing inventory management and logistics scheduling. They also extensively employ automated equipment and intelligent systems to reduce human intervention, increase efficiency, and improve accuracy. Furthermore, information sharing and system integration are used to achieve collaborative management among upstream and downstream supply chain enterprises, enhancing overall competitiveness. However, Walmart focuses more on the freshness preservation of fresh produce and customer experience, optimizing inventory management and dynamic pricing through AI. Siemens, on the other hand, focuses on the intelligentization of the production process, enhancing production efficiency through automated warehousing and logistics systems.

4.3.3 Lessons for Other Enterprises

Enterprises should select appropriate technologies based on their business characteristics, such as IoT, big data, AI, and automated equipment, and deeply integrate them into logistics management processes. Establishing a comprehensive data management system to optimize logistics processes and improve the scientific and precise nature of decision-making is essential. Information sharing and system integration should be used to achieve collaborative management among upstream and downstream supply chain enterprises, enhancing the overall efficiency and competitiveness of the supply chain. Smart logistics is a continuous development process, and enterprises should continuously explore the application of new technologies and optimize management models to adapt to market changes and demands.

5. Current Status and Challenges of Smart Logistics Operations Management

5.1 Current Status of Operations Management

Smart logistics operations management is in a stage of rapid development but also faces challenges in multiple aspects. From the current status, the application of smart logistics systems has made some progress. Many logistics companies have begun to introduce IoT, big data, and artificial intelligence technologies to enhance the automation and intelligence levels of logistics operations. For example, IoT technology is used to track goods in real-time and remotely monitor equipment, while big data analytics optimize transportation routes and inventory management. However, there are significant differences in the application of these technologies among enterprises of different sizes and types. Many small and medium-sized enterprises (SMEs) have slow progress in intelligent transformation due to cost and technical barriers. (Kimball, R., & Ross, M., 2011)

In terms of management model innovation, some leading companies have introduced automated warehousing systems and intelligent scheduling platforms to achieve automated logistics operations and intelligent decision-making. Meanwhile, supply chain collaboration management has become a trend, with companies optimizing cooperation efficiency among upstream and downstream enterprises through information sharing and collaborative platforms. However, management model innovation still faces challenges such as organizational restructuring and process reengineering, especially in cross-departmental collaboration and information sharing, where companies need to overcome internal resistance and increased management costs.

5.2 Challenges Faced

The development of smart logistics also faces challenges in multiple aspects. Technologically, the implementation of smart logistics systems relies on the integration and collaboration of various technologies, but the complexity of technological integration increases implementation difficulties. For example, compatibility of IoT devices, uniformity of data formats, and system stability are issues that need to be addressed. Additionally, data security and privacy protection are significant challenges for smart logistics. Logistics systems involve a large amount of sensitive information, and any data leakage can severely impact enterprises and customers.

Operationally, the construction and operation of smart logistics systems require substantial financial investment, which is a significant concern for SMEs in terms of cost control. Meanwhile, the rapid development of smart logistics has led to a shortage of professional talent, with a lack of compound talents who understand both logistics and information technology. Moreover, the implementation of smart logistics systems requires optimization and adjustment of existing business processes, which may face internal resistance and increased management costs.

Managerially, the implementation of smart logistics requires companies to restructure their organizational architecture and optimize management processes, placing higher demands on their management capabilities. For example, how to achieve information sharing and collaborative decision-making in cross-departmental collaboration, and how to maintain flexibility and innovation in a rapidly changing market environment, are management challenges that companies need to address.

5.3 Strategies and Suggestions

1) Technological Innovation and Upgrades

Enterprises should increase investment in technological innovation and actively introduce emerging technologies such as 5G, blockchain, artificial intelligence, and big data to enhance the intelligence level of logistics systems. By collaborating with research institutions and universities on industry-university-research joint projects, companies can accelerate the transformation and application of technologies while cultivating professional talent. For example, leveraging the low-latency and high-bandwidth characteristics of 5G technology can enable real-time monitoring and remote control of logistics equipment, significantly improving logistics operation efficiency and precision.

Additionally, companies should pay attention to the trend of technological integration and innovation, combining IoT, big data, cloud computing, and other technologies to achieve comprehensive intelligence in logistics systems. For example, through big data analytics and artificial intelligence algorithms, companies can optimize transportation routes, predict demand, and achieve intelligent scheduling, thereby reducing costs and improving customer satisfaction.

2) Operational Model Optimization

Enterprises should explore suitable operational models based on their actual conditions. For example, collaborating with third-party logistics service platforms to share resources and information can effectively reduce operational costs. Meanwhile, companies should strengthen talent cultivation and recruitment to enhance employees' technical skills and management capabilities. For example, by establishing multi-channel talent cultivation models, companies can train and deliver new types of smart logistics talent, enhancing the vitality of the entire industry chain.

In operations, companies should focus on data application and sharing, establishing smart logistics information management platforms to achieve comprehensive perception, precise identification, and real-time tracking of logistics information. For example, leveraging cloud GIS technology combined with IoT and big data can break down information barriers in traditional supply chains, improving logistics information transparency and response speed.

3) Management System Improvement

Enterprises should establish management systems adapted to the development of smart logistics, optimizing organizational structures and business processes. For example, setting up a dedicated smart logistics management department to be responsible for system planning, implementation, and operations can ensure the smooth progress of smart logistics projects. Meanwhile, companies should strengthen data management and information security protection to ensure the stable operation of logistics systems.

In management innovation, companies should focus on full-process transparency transformation to meet the requirements of digital operations. For example, by implementing comprehensive information management and introducing intelligent tools, companies can improve management efficiency and decision-making accuracy. Additionally, companies should strengthen integration with other field management systems to achieve comprehensive information management and resource sharing.

By adopting these strategies, companies can not only address the challenges in the development of smart logistics but also gain a competitive edge in the fierce market competition, driving the intelligentization and high-efficiency development of the logistics industry.

6. Future Research Directions for Smart Logistics Operations Management

Future research directions in smart logistics operations management will focus on technological innovation, operational model innovation, and the development of new business processes.

6.1 Technological Innovation Directions

In terms of technological innovation, with the continuous development of emerging technologies such as 5G and quantum computing, smart logistics will face new opportunities. For example, the low-latency and high-bandwidth characteristics of 5G technology will support real-time monitoring and remote control of logistics equipment, while quantum computing could play an important role in logistics optimization algorithms. The integration and collaborative innovation of technologies will also become a trend. The combination of IoT and blockchain technologies will achieve tamper-proof and transparent sharing of logistics information, while the integration of big data and artificial intelligence technologies will enhance the intelligent decision-making capabilities of logistics systems. Additionally, the research and application of intelligent equipment will be an important direction for smart logistics, with the widespread use of automated warehousing robots and intelligent transportation vehicles improving the efficiency and accuracy of logistics operations. (Ye, Q. F., 2021)

6.2 Operational Model Innovation Directions

Regarding operational model innovation, the integration of smart logistics with supply chain finance will provide new application scenarios for supply chain finance. By sharing and analyzing logistics data, financial institutions can better assess corporate credit risks and provide more precise financial services. The combination of smart logistics with the sharing economy will also bring new opportunities for the logistics industry. By sharing logistics resources, companies can reduce operational costs and improve resource utilization efficiency. The international operational models of smart logistics will also be a focus of future research, with companies exploring how to optimize logistics resource allocation and collaborative management on a global scale.

6.3 Development of New Business Processes

In terms of new business process development, green logistics will become an important direction for smart logistics. Companies need to explore how to use technological means to reduce the environmental impact of logistics activities and achieve sustainable development. The coordinated development of smart logistics and intelligent manufacturing will bring new opportunities for the manufacturing industry. By deeply integrating logistics and production, companies can achieve intelligentization and high efficiency in the production process. Business model innovation for smart logistics platforms will also be a hotspot for future research, with companies exploring how to achieve shared and optimized allocation of logistics resources through platform-based operations.

7. Conclusion

7.1 Research Summary

This paper systematically reviews the development process and current status of smart logistics operations management, analyzing the application status of smart logistics systems and innovations in operational management models. Through the case analysis of companies such as Walmart and Siemens, successful experiences and insights in smart logistics operations management are summarized. Future research directions for smart logistics operations management are also proposed, including technological innovation, operational model innovation, new business process development, and innovation in management theories and methods.

7.2 Research Contributions and Limitations

The theoretical contribution of this paper lies in systematically summarizing the current status and challenges of smart logistics operations management and proposing strategies and suggestions. The practical contribution is to provide reference cases and future development directions for logistics companies in smart logistics operations management. However, this study also has limitations, such as insufficient in-depth analysis of the application status of smart logistics systems and incomplete research on emerging technologies. Future research can further deepen the analysis of the application status of smart logistics systems and strengthen the research on emerging technologies.

7.3 Outlook for the Development of Smart Logistics

The future development trend of smart logistics will focus more on technological innovation and operational model innovation. With the continuous development of emerging technologies such as 5G and blockchain, smart logistics will face new opportunities. Meanwhile, the international operational models of smart logistics will become a focus of future research. The development of smart logistics will have a profound impact on the logistics industry, driving its intelligentization, automation, and high-efficiency development.

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Zero Waste: A New Sustainable Waste Management Philosophy in the 21st Century

Haradhan Kumar Mohajan[1]

[1] Associate Professor, Department of Mathematics, Premier University, Chittagong, Bangladesh

Correspondence: Haradhan Kumar Mohajan, Associate Professor, Department of Mathematics, Premier University, Chittagong, Bangladesh.

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Abstract

Zero waste is a system of principles that focuses on waste prevention to redesign resource lifecycles so that materials are reused, and wastes and pollutions are minimal that maximizes employment opportunities through the creation of relevant jobs. It is an idealistic concept that has become an aspirational goal for tackling waste problems. It indicates a 100% recycling and a 100% recovery of all resources from waste materials. It provides the greatest degree of local economic self-reliance that stimulates sustainable production and consumption, optimum recycling, and resource recovery. It is implemented in various sectors, such as waste management and treatment, mining, manufacturing, and urban development. It is one of the promising and effective ways to solve the waste management and recycling issues that represents a new planning method for the 21st century.

Keywords: zero waste, circular economy, environmental pollution, recycling, reuse

1. Introduction

In our society waste is unavoidable but objectionable. A complete reliable and efficient waste management method has not been achieved yet (Gutberlet, 2008). The waste generated from the industries, households, consumption, and constructions are the potential reason for environmental degradation in many parts of the world (Abedin & Jahiruddin, 2015). Waste management stands on the 5R principles: Refuse, Reduce, Reuse, Recycle, and Restore (Mohajan, 2020, 2021b). It is estimated that circular economy strategies through the zero waste (ZW) management will provide more than $4 trillion in global economic benefits with 30-40% global greenhouse gas (GHG) emissions reduction (CCME, 2018).

The concept of ZW offers waste management, initially from the avoiding of trash, recycling, reduction and recovery of second-hand material. It is a process that designs and manages products systematically to avoid and eliminate the volume and toxicity of waste and materials to conserve and recover all resources, and not to burn or bury these (Kaza et al., 2018). It is pragmatic and visionary, and local and global target. It stimulates sustainable production and consumption, optimum recycling and resource recovery, and restricts mass incineration and landfilling (Zaman, 2015). It is a strategic vision of a community where all the raw materials in the system will be recycled, and will not end in an incinerator and landfills (Hazra, 2009).

Zero waste indicates that all materials are reused until the optimum level of consumption is reached (Mohajan, 2025a). It is a policy, a path, a direction, a process, and a target is a concept that aims to eliminate all waste (Townsend, 2010). It can also generate local jobs and business opportunities. Therefore, it is resource-efficient economy where material flows are cyclical and everything is reused and recycled harmlessly back into the nature (Raksha et al., 2018). It is also used in mining and resource extraction industries as an innovative technique to eliminate waste by applying advanced technologies, such as ZW polymer technology and ZW metal processing (Antrekowitsch & Steinlechner, 2011). It aims to rethink the way we produce and consume for the preservation

of the value and energy embedded in our resources to flourish the civilization (Awasthi et al., 2021).

2. Literature Review

A literature review is an overview of previously published works that is a piece of academic writing which demonstrate knowledge and understanding of the academic literature on a specific topic placed in context (Baglione, 2012). It involves researching, analyzing, and evaluating sources to identify relevant theories, methods, and gaps in the research (Galvan, 2015). Atiq Uz Zaman has realized that the scope of the ZW studies is diverse, and a ZW concept is constantly developing through various programs, plans, policies, and strategies. He has also wanted to identify priority areas of ZW strategy and to develop national zero waste guidelines that can be useful to policy and decision makers in developing the evidence-based ZW guidelines (Zaman, 2015). Abhishek Kumar Awasthi and his coauthors have discussed the aspects of waste management from a variety of perspectives and disciplines for rapid carbonization of agricultural waste, and several conceptual threads (Awasthi et al., 2021).

Paweł Dziekański and his coworkers have evaluated the spatial differentiation of the relationship between the green economy and the ZW concepts to reduce the burden on the environment by creating attractive conditions for living and business activities (Dziekański et al., 2023). Somnath Hazra has observed that the increasing rate of economic growth in the developing country increases per capita income that has a positive impact on the standard of living and population growth of the developing country, and the volume of waste increasing at an alarming. He emphasizes on the problems, disposal, and treatment of waste to develop the sustainable industrial ecology (Hazra, 2009). Julian Kirchherr and his coauthors have shown that ZW principles contribute to the circular economy that is an economic system that replaces the “end-of-life” concept with reducing, reusing, recycling and recovering materials in production, distribution and consumption phase of their life cycle (Kirchherr et al., 2017).

Katarina Novakovic and her coworkers have realized that the recycling of plastic packaging waste being a significant concern for the general public and governments worldwide. They have evaluated the present situation and have highlighted the bottlenecks that are limiting efficient recovery of plastic packaging waste using currently available systems. They have proposed that based on polyethylene terephthalate (PET), polypropylene (PP), high-density and low-density polyethylene new approaches of packaging are required to achieve a ZW circular economy for all plastic packaging (Novakovic et al., 2023). Raksha B. S. and her coauthors have noticed that the increase in the globalization and urbanization has led to increase in the lifestyle of the people that has led to an increase in the waste generation. They have wanted to realize the idea of ZW through an intensive literature review (Raksha et al., 2018).

3. Research Methodology of the Study

Research is a careful investigation, analysis, and interpretation of facts. It is creative and systematic work undertaken to increase the stock of knowledge. The goal of research is to discover new facts, revise theories, and apply new knowledge to practical problems (Sha, 2019). Methodology is a planned and structured procedure for solving a theoretical or practical problem. Research methods are specific procedures for collecting and analyzing data (Franklin, 2012). In this study a qualitative research method has used to establish ZW policy in the society (Silverman, 2011).

4. Objective of the Study

Zero waste is a principle that inspires discarded materials for reuse as commodities rather than for disposal, and conserving these commodities through waste prevention, reusing, recycling, composting, and other technologies (Hermansson, 2007). It has multiple perspectives, such as clean production, atmospheric protection, and resource conservation. The concept of it indicates that no material would be discarded as worthless (Murray, 2002). Therefore, ZW means no “waste” would be wasted under the circular economy system. The ZW policy is not properly implementing in the poor and developing countries (Zaman, 2015). Main objective of this article is to discuss ZW to eliminate material waste itself (Mohajan, 2025b). Other minor objectives of the study are as follows (Mohajan, 2018):

1) to highlight on ZW and its historical background,

2) to focus on ZW management, and

3) to discuss importance of ZW philosophy.

5. Zero Waste

At present many strategies of waste prevention, management, treatment, and assessment are identified to implement ZW environment in the society (Mohajan, 2021c). The ZW concept refuses incinerators, and landfills, and tries to bring an end to the throwaway society, instead of creating sustainable communities (Nizar et al., 2018). The ZW is defined as the conservation of all resources by means of responsible production, consumption,

reuse, and recovery of all products, packaging, and materials without burning them and with no discharges to land, water, and air that threaten the environment and human health (Zaman & Ahsan, 2019).

The ZW is one of the most studied and the most debated topic of waste management research in the last decades (Mohajan, 2015). It is a manifesto for the redesign of the material economy, and it is a set of tactics for realizing its principles in practice (Murray, 2002). It does not see "waste" as a substance that must be disposed of or incinerated but considers waste as a resource that should be used repeatedly. It is a visionary concept that advocates a systematic process of designing out waste and recovering resources from waste (Greyson, 2007). A ZW approach can reduce waste management emissions by 84%. Landfills and incinerators are a major source of GHG emissions (Glavic & Lukman, 2007).

6. Historical Background of ZW

From the time of the first Eve, it took human history over 3 million years to reach 1 billion people in the early 1800s. Now, we gain 1 billion people every 12-14 years and the world's population grows by more than 200,000 each day and at present the world population become more than 8 billion, and half of them live in urban areas (Zaman & Lehmann, 2011; Mohajan, 2021d). The ZW movement began in the 1970s and 1980s with the work of US chemist Paul Palmer and US sociologist Daniel Knapp. It is created from the term Total Quality Management (TQM) for practices of production without any defects (Snow & Dickinson, 2003). It is based on the basis of the 5Rs: refuse, reduce, reuse, recycle, and rot. The term "zero waste" was coined by Paul Palmer in 1973 for recovering resources from chemicals, and he was also a founder of the Zero Waste Institute (Palmer, 2004).

In 1995, Daniel Knapp, founder of Urban Ore, took attempts to maximize materials recovery and minimize wasting by reusing, recycling, and composting everything currently being wasted. He has shared news of the Australian Capital Territory as "No Waste by 2010" to become the first program of its kind in the world, and Canberra became the first city in the world to adopt an official ZW target (Connett, 2013). In the same year, Lynn Landes set up the "Zero Waste USA" website that aimed at changing waste habits on an individual level, and the Grass Roots Recycling Network (GRRN) was also started by Bill Sheehan (Phillips et al., 2011). The Zero Waste New Zealand Trust established in 1997 that supported waste minimization initiated the ZW movement in New Zealand (Tennant-Wood, 2003).

In 2000, the larger ZW movement began to take place through the ZW conference that was held at the Kaitaia Community Centre in Kaitaia, New Zealand. In the same year, Del Norte County, California took on the first comprehensive ZW plans in the USA (Connett, 2013). In 2003, an international Zero Waste International Alliance (ZWIA) was formed in Beaumaris, Wales that has given the first working definition of ZW in 2004 that is developed further in a peer reviewed panel in 2009 as "*ZW means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them*" (ZWIA, 2009).

7. Zero Waste Management

Zero waste management focuses on reducing waste through the increased recycling, composting, donating, energy recovery, advanced waste treatment technologies, and reuse to mitigate the negative environmental impacts of waste with new cost efficiencies (Yoshida et al., 2012). It is a combination of integrated design and waste management philosophies. Recycling is one of the most important aspects of ZW that can reduce GHG emissions at the energy and transportation sectors (Gutberlet, 2008).

About one-third of the global waste is managed in environmentally unsafe manners, such as littering, open dumping, open burning, and unsanitary landfill (Mohajan, 2021a). About 85% of the global collected waste is sent to landfills, including uncontrolled landfills and open dumping, and only 15% of the collected waste is recycled (Zaman, 2023). The ZW does not mean that we would not create any "waste" in the transition of resource extraction, production, and consumption. But it means "no waste" would be wasted under the circular economy system (Achterberg et al., 2016).

8. Importance of ZW Philosophy

Zero waste systems reduce greenhouse gases (GHGs) by saving energy by reducing energy consumption associated with extracting, processing, and transporting raw materials and waste through the elimination of the need for landfills and incinerators (Song, 2016). It helps in the management of wastes in an efficient and environmentally friendly manner. It improves physical health and wellbeing, and reduces toxic chemicals (Lehmann, 2011).

Zero Waste encompasses producer responsibility, eco-design, waste reduction, reuse and recycling, all within a single framework (Ahsan & Zaman, 2014). It breaks away from the inflexibility of incinerator-centered systems and offers a new policy framework capable of transforming current linear production and disposal processes into

'smart' systems that utilize the resources in municipal waste and generate jobs and wealth for local economies (Murray, 2002). Millions of people of the world depend on collecting and recycling waste. In 2025, about $375 billion is used for the worldwide waste management (Kaza et al., 2018).

9. Conclusions

Zero waste is a goal to end the generation of toxic and unnecessarily wasteful products through systemic redesign to reuse and recycling of discards for the creation of new products with many more new jobs. It stands on the basis of efficient technology and efficient social management through the coordination among producers and consumers, and governments and citizens. Incinerators release toxic dioxins and burning waste releases greenhouse gases (GHGs). Zero waste is a holistic approach to tackle waste problems in the 21st century, but it is still in development. Due to the increasing waste problems the global humanity is thinking to establish zero waste environments in the society, but at the same time, it is also very challenging to achieve.

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Big Data Empowering Supply Chain Management: From Theory to Practice

Minghui Chen[1]

[1] Shenzhen Shemanquban Supply Chain Co., Ltd., Guangdong 518000, China

Correspondence: Minghui Chen, Shenzhen Shemanquban Supply Chain Co., Ltd., Guangdong 518000, China.

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Abstract

With the rapid development of the digital economy, big data technology has brought unprecedented opportunities for supply chain management. This paper takes Shenzhen Shemanquban Supply Chain Co., Ltd. as a case study to explore the application and effects of big data technology in supply chain management. Through the construction of a big data platform, the paper has optimized key links such as demand forecasting, inventory management, and logistics distribution. The results show that big data-driven optimization strategies have significantly improved the efficiency and competitiveness of the supply chain, with inventory turnover rate increased by 28%, logistics costs reduced by 18%, and overall operating costs decreased by 15%. This paper not only provides a new perspective for supply chain management theory but also offers valuable references and insights for the digital transformation and practical application of enterprises.

Keywords: big data, supply chain management, demand forecasting, inventory optimization, logistics distribution, digital transformation, data analysis, collaborative decision-making, cost savings, corporate competitiveness, intelligent supply chain, practical application

1. Introduction

1.1 Research Background

In the context of globalization and increasingly fierce market competition, the importance of supply chain management has become more prominent. Efficient supply chain management can not only reduce costs and improve customer satisfaction but also enhance a company's market responsiveness and competitiveness. However, traditional supply chain management faces many challenges, such as information asymmetry, demand uncertainty, inventory overstock, and low logistics distribution efficiency. In recent years, the rise of big data technology has brought new opportunities for supply chain management. Big data technology can handle large volumes of diverse data and provide more precise decision-making support for enterprises through advanced analytical tools and algorithms, thereby achieving intelligent and efficient supply chain management.

1.2 Research Significance

This study aims to explore how big data can empower supply chain management by optimizing key links such as demand forecasting, inventory management, and logistics distribution to enhance the overall efficiency and competitiveness of the supply chain. Taking Shenzhen Shemanquban Supply Chain Co., Ltd. as a case study, this paper analyzes the application effects of big data technology in actual supply chain management to provide reference for other enterprises. Through this study, we hope to enrich the theory of supply chain management, explore the application mechanisms of big data technology in the supply chain, and provide practical guidance for the digital transformation of enterprises.

2. Literature Review

Supply chain management refers to the network of all links from raw material suppliers to end customers, including suppliers, manufacturers, distributors, retailers, and customers. Its goal is to optimize the collaborative operations of each link to achieve cost minimization, customer satisfaction maximization, and the fastest market response speed. However, traditional supply chain management faces challenges such as information asymmetry, demand uncertainty, complex inventory management, and low logistics distribution efficiency. With the development of big data technology, supply chain management has ushered in new opportunities. Big data is characterized by its large volume, high velocity, diverse variety, and veracity. It can provide more precise decision-making support for supply chain management through data collection, storage, processing, and analysis technologies.

Domestic and international research has generally focused on the application of big data in areas such as demand forecasting, inventory optimization, logistics distribution, and supplier selection. However, most existing studies concentrate on theoretical discussions and model building, lacking systematic analysis of the practical application effects of enterprises, especially for small and medium-sized enterprises. This study constructs a big data-based supply chain optimization theoretical model, emphasizing the importance of information sharing, collaborative decision-making, and value creation. It aims to fill this gap through empirical research and provide theoretical and practical support for the digital transformation of supply chain management.

3. Research Methods

3.1 Case Study Method

This study selects Shenzhen Shemanquban Supply Chain Co., Ltd. as the research object. By conducting an in-depth analysis of its business processes, we identify the key pain points in supply chain management. As a typical supply chain management company, its business covers multiple links such as procurement, warehousing, logistics distribution, and customer service. Through the case study method, we can gain an in-depth understanding of the challenges faced by the company in actual operations, such as inaccurate demand forecasting, inventory overstock or stockouts, and high logistics costs. This provides a specific context and problem orientation for subsequent research.

3.2 Data Analysis Method

During the research process, we collected three years of historical data from Shenzhen Shemanquban Supply Chain Co., Ltd., including sales data, inventory data, logistics data, and customer feedback across multiple dimensions. Using big data technologies such as data mining and machine learning algorithms, we conducted in-depth analysis of these data. By constructing predictive models and optimization algorithms, we analyzed market demand trends, the rationality of inventory levels, and logistics distribution efficiency, providing data support and decision-making basis for supply chain optimization.

3.3 Comparative Analysis Method

To evaluate the actual effects of big data technology in supply chain management, this study employed comparative analysis. By comparing supply chain performance indicators before and after optimization, such as inventory turnover rate, logistics costs, and customer satisfaction, we intuitively demonstrated the improvements brought by big data technology. The pre-optimization data reflected the company’s operational status under traditional management models, while the post-optimization data showed the performance enhancements after the application of big data technology. This comparative analysis clearly presented the practical contributions of big data technology in improving supply chain efficiency and competitiveness.

4. Overview of Shenzhen Shemanquban Supply Chain Co., Ltd.

4.1 Company Profile

Shenzhen Shemanquban Supply Chain Co., Ltd. was established on June 7, 2022. It is a modern enterprise dedicated to providing efficient supply chain management services. With a core commitment to optimizing supply chain processes, reducing costs, and enhancing customer satisfaction, the company offers one-stop solutions ranging from procurement and warehousing to logistics distribution. Since its inception, the company has rapidly gained prominence in the highly competitive market, thanks to its innovative management model and technological applications, and has gradually become an influential supply chain service provider in the industry.

4.2 Supply Chain Status

The supply chain structure of Shenzhen Shemanquban Supply Chain Co., Ltd. encompasses suppliers, logistics partners, and a broad customer base. The company has established long-term and stable relationships with multiple high-quality suppliers to ensure a steady supply of raw materials and products. At the same time, it collaborates closely with several well-known logistics partners, forming a nationwide logistics distribution network that can efficiently deliver products to customers. The customer base is primarily concentrated in industries such as home goods, electronics, and apparel, with customers distributed widely, including

e-commerce platforms, retailers, and corporate clients.

However, as market competition intensifies and customer demands become more diverse, the company's supply chain management faces numerous challenges. First, market demand fluctuates significantly, increasing the difficulty of accurate demand forecasting and complicating inventory management. Second, inventory overstock is a prominent issue, occupying a large amount of capital and increasing warehousing costs and inventory loss risks. Additionally, logistics costs are relatively high, and distribution efficiency needs improvement, especially during peak periods when the timeliness and accuracy of logistics distribution are hard to guarantee. These challenges pose higher requirements for the company's supply chain management and prompt the company to actively explore innovative solutions to enhance the overall efficiency and competitiveness of the supply chain.

5. Construction and Application of the Big Data Platform

5.1 Architecture Design of the Big Data Platform

To effectively apply big data in supply chain management, Shenzhen Shemanquban Supply Chain Co., Ltd. has constructed an integrated big data platform. This platform consolidates multiple systems and data sources to achieve data collection, storage, processing, and analysis, providing strong technical support for supply chain optimization.

- **Data Collection Layer**: Integrates data from ERP, WMS, TMS, and other systems, and connects with IoT devices (such as sensors and RFID tags) to obtain real-time logistics and inventory information.
- **Data Storage Layer**: Uses distributed storage technologies (such as Hadoop and Spark) to efficiently store and manage large-scale datasets.
- **Data Processing Layer**: Conducts data cleaning, transformation, and correlation analysis to ensure data quality and consistency.
- **Data Analysis Layer**: Utilizes machine learning algorithms (such as linear regression and neural networks) and data visualization tools to build predictive models and optimize each link of the supply chain.

5.2 Application of Big Data in Supply Chain Management

In terms of demand forecasting, Shenzhen Shemanquban Supply Chain Co., Ltd. adopted a hybrid forecasting model combining time-series analysis and machine learning algorithms (such as linear regression and neural networks) to more accurately capture demand changes. This method increased the demand forecasting accuracy rate from the traditional 70% to over 85%, significantly reducing inventory overstock and stockout risks and optimizing inventory management efficiency.

In inventory management, the company established a dynamic inventory replenishment model based on demand forecasting data, monitoring inventory levels in real-time and automatically adjusting replenishment plans to ensure that inventory can meet market demand without excessive overstock. Through this dynamic management approach, the inventory turnover rate increased from 4.5 times per year to 5.8 times per year, and inventory costs decreased from 20% of sales to 16%, effectively improving capital utilization efficiency and customer satisfaction.

Table 1.

Indicator	Before Optimization	After Optimization	Improvement Rate
Inventory Turnover Rate	4.5 times/year	5.8 times/year	28.9%
Inventory Costs	20% of sales	16% of sales	20.0%

In the logistics distribution link, the company used path optimization algorithms (such as genetic algorithms and ant colony algorithms) combined with real-time traffic data to optimize delivery routes, avoiding traffic congestion and improving delivery efficiency. This measure reduced logistics costs from 12% of sales to 10% and increased delivery punctuality rates from 85% to 95%, significantly enhancing customer experience and overall supply chain efficiency.

Table 2.

Indicator	Before Optimization	After Optimization	Improvement Rate
Logistics Costs	12% of sales	10% of sales	16.7%
Delivery Punctuality	85%	95%	11.8%

Through the application of big data technology, Shenzhen Shemanquban Supply Chain Co., Ltd. has achieved significant results in demand forecasting, inventory management, and logistics distribution, not only enhancing the efficiency and competitiveness of the supply chain but also providing strong support for the company's digital transformation.

6. Optimization Strategies of Big Data Empowering Supply Chain Management

Driven by big data technology, Shenzhen Shemanquban Supply Chain Co., Ltd. has significantly enhanced the efficiency and competitiveness of supply chain management through a series of innovative strategies. The following will focus on three core optimization strategies: big data-driven demand-driven supply chain, collaborative inventory management strategy, and intelligent logistics distribution optimization.

6.1 Big Data-Driven Demand-Driven Supply Chain

1) **Strategy Description**: Centered on customer demand, the company uses big data analysis to achieve precise production and replenishment. By integrating historical sales data, market trends, promotional activities, and macroeconomic data through the big data platform, the company constructs a hybrid forecasting model to more accurately predict market demand and reduce the impact of demand fluctuations on the supply chain.

2) **Implementation Details and Effects**:

- **Data Integration and Analysis**: The company collects historical sales data from ERP, CRM, and sales platforms, and combines external data (such as market research reports and social media data) for analysis. Using time-series analysis and machine learning algorithms (such as linear regression and neural networks), a hybrid forecasting model is constructed, taking into account seasonal, trend, and random factors. This process not only improves the accuracy and reliability of the data but also significantly enhances the precision of demand forecasting. For example, by analyzing sales data during promotional activities, the company can adjust production plans in advance to avoid stockouts or overstock.
- **Dynamic Adjustment of Production Plans**: Based on the forecasting results, production plans and replenishment strategies are adjusted in real-time to ensure that inventory levels match market demand. Through big data analysis, the accuracy of demand forecasting increased from 70% to over 85%, reducing the risks of inventory overstock and stockouts due to demand fluctuations. Precise forecasting has increased inventory turnover rates by 28% and reduced inventory costs by 20%.
- **Customer Feedback Loop**: A customer feedback mechanism is established to collect customer opinions and market dynamics in real-time, further optimizing the forecasting model. Through customer satisfaction surveys and social media analysis, the company can adjust product strategies in a timely manner to improve customer satisfaction. For example, the on-time delivery rate of customer orders increased from 85% to 95%, significantly enhancing customer satisfaction. (De Mauro, A., Greco, M., & Grimaldi, M., 2019)

Table 3.

Time Period	Traditional Method Accuracy	Big Data Method Accuracy	Improvement Rate
2023 Q1	68%	83%	+15%
2023 Q2	70%	85%	+15%
2023 Q3	72%	87%	+15%
2023 Q4	71%	86%	+15%
2024 Q1	73%	88%	+15%

6.2 Collaborative Inventory Management Strategy

1) **Strategy Description**: Share data with suppliers to implement a VMI (Vendor Managed Inventory) model, reducing inventory overstock. Through the big data platform, the company shares inventory data and sales information with suppliers in real-time, allowing suppliers to make replenishment decisions based on this data to ensure that inventory levels meet market demand without excessive overstock.

2) **Implementation Details and Effects**:

- **Data Sharing Platform Construction**: A supplier data sharing platform is established to share inventory levels, sales data, and demand forecasting information in real-time. Through API interfaces and data warehousing technology, the timeliness and accuracy of data are ensured. This platform not only improves

the efficiency of data sharing but also enhances collaboration between suppliers and the company.

- **Supplier Replenishment Strategy Optimization**: Suppliers adjust replenishment plans dynamically based on shared data. By analyzing fluctuations in sales data, suppliers can adjust replenishment timing and quantities in advance to reduce inventory overstock. For example, through the dynamic replenishment model, the inventory turnover rate increased from 4.5 times per year to 5.8 times per year, reducing inventory costs by 20%.
- **Safety Stock Strategy Adjustment**: Based on demand fluctuations and supply chain stability, dynamically adjust safety stock levels. Through big data analysis, the company can set safety stock more precisely, reducing inventory costs. For example, the inventory overstock rate decreased from 15% to 10%, and the on-time delivery rate of customer orders increased from 85% to 95%.

Table 4.

Indicator	**Before Optimization**	**After Optimization**	**Improvement Rate**
Inventory Turnover Rate	4.5 times/year	5.8 times/year	+28.9%
Inventory Costs	20% of sales	16% of sales	-20.0%
Inventory Overstock Rate	15%	10%	-33.3%
Customer Order On-Time Delivery Rate	85%	95%	+11.8%

6.3 Intelligent Logistics Distribution Optimization

1) Strategy Description: Use big data to optimize logistics network layout and improve distribution efficiency. The company uses path optimization algorithms (such as genetic algorithms and ant colony algorithms) combined with real-time traffic data to dynamically adjust delivery routes, avoiding traffic congestion and improving distribution efficiency.

2) Implementation Details and Effects:

- **Path Optimization Algorithm Application**: Using genetic algorithms and ant colony algorithms combined with real-time traffic data to optimize delivery routes. By analyzing historical delivery data and real-time road conditions, the algorithms dynamically adjust delivery paths to avoid traffic congestion. For example, through path optimization algorithms, logistics costs decreased from 12% of sales to 10%, and delivery punctuality increased from 85% to 95%. (S. Gunasekaran, A. Subramanian & M. M. Patel, 2016)
- **Intelligent Scheduling System Introduction**: Based on order priority and delivery distance, delivery tasks are reasonably arranged to improve resource utilization. Through the intelligent scheduling system, the company can optimize delivery task allocation based on the urgency of orders and delivery distance. For example, the average delivery time decreased from 3.5 hours to 3.0 hours, and transportation mileage was reduced by 15%.
- **Real-Time Monitoring and Adjustment**: Real-time monitoring of the delivery process through IoT devices and timely adjustment of delivery plans. Through GPS and sensor technology, the company can track vehicle locations and transportation status in real-time and adjust delivery routes as needed. For example, customer satisfaction with delivery services increased from 80% to 90%, and complaint rates significantly decreased.

Table 5.

Indicator	**Before Optimization**	**After Optimization**	**Improvement Rate**
Logistics Costs	12% of sales	10% of sales	-16.7%
Delivery Punctuality	85%	95%	+11.8%
Average Delivery Time	3.5 hours	3.0 hours	-14.3%
Transportation Mileage	1000 km/day	850 km/day	-15.0%

Through the implementation of the above optimization strategies, Shenzhen Shemanquban Supply Chain Co., Ltd. has achieved significant results in demand forecasting, inventory management, and logistics distribution.

These strategies not only enhance the overall efficiency and competitiveness of the supply chain but also provide strong support for the company's digital transformation. By deeply integrating big data technology, the company can better cope with market demand changes, optimize resource allocation, improve customer satisfaction, and ultimately achieve intelligent supply chain management.

7. Empirical Research and Results Analysis

To comprehensively evaluate the effects of big data-empowered supply chain management optimization strategies, we systematically collected and analyzed sales data, inventory data, and logistics data from Shenzhen Shemanquban Supply Chain Co., Ltd. from 2022 to 2024. These data cover various links of the company's supply chain management, including procurement, warehousing, logistics, and sales. Through data cleaning and preprocessing, the accuracy and reliability of the data were ensured.

7.1 Data Collection and Processing

The data mainly come from the company's ERP system, WMS system, and TMS system, combined with some external data (such as market research reports and macroeconomic data) to enhance the comprehensiveness of the analysis. During the data cleaning process, we paid special attention to handling missing values and outliers. For missing values, interpolation methods were used to fill in the gaps to ensure data integrity. For outliers, statistical analysis was used for correction or removal to improve data quality. The preprocessed data provided a solid foundation for subsequent analysis, enabling us to more accurately evaluate the effects of optimization strategies.

7.2 Implementation Effects of Optimization Strategies

Through the implementation of big data-driven optimization strategies, the company has achieved significant results in inventory management and logistics efficiency. The inventory turnover rate increased from 4.5 times per year to 5.8 times per year, significantly reducing inventory overstock and lowering capital occupation costs. At the same time, the inventory overstock rate decreased from 15% to 10%, further optimizing inventory management efficiency. Accurate demand forecasting and dynamic replenishment strategies enable the company to better cope with market demand changes and reduce problems caused by insufficient or excessive inventory.

In logistics, logistics costs decreased from 12% of sales to 10%, and delivery punctuality increased from 85% to 95%. These improvements significantly enhanced customer satisfaction and reduced customer complaints. Through path optimization algorithms and intelligent scheduling systems, the company can more efficiently arrange logistics distribution, avoid traffic congestion, and ensure timely delivery of goods to customers. This series of optimization measures not only improved logistics efficiency but also directly translated into economic benefits for the company. (S. Gunasekaran, A. Subramanian & M. M. Patel, 2016)

The overall operating costs of the company decreased by 15%, and the net profit margin increased from 8% to 9.5%. This improvement not only enhanced the company's market competitiveness but also provided strong support for its sustainable development. Through big data optimization strategies, the company can more precisely allocate resources, reduce unnecessary expenditures, and achieve cost savings and profit growth.

Customer satisfaction increased from 80 points to 88 points, and the customer churn rate decreased by 5%. This improvement significantly enhanced customer loyalty and laid a solid foundation for the company's long-term development. By accurately forecasting demand, efficiently managing inventory, and optimizing logistics distribution, the company can better meet customer needs and stand out in the fierce market competition. The increase in customer satisfaction not only reduced customer churn but also brought more business opportunities and word-of-mouth effects for the company.

8. Discussion and Insights

The empirical study of Shenzhen Shemanquban Supply Chain Co., Ltd. shows that the application of big data technology in supply chain management can significantly enhance the operational efficiency and competitiveness of enterprises. However, to fully leverage the empowering role of big data, companies need to focus on several key factors and address corresponding challenges.

8.1 Key Factors for Big Data Empowering Supply Chain Management

The Importance of Data Quality and Data Sharing Mechanisms: High-quality data is the foundation for big data analysis. In this study, Shenzhen Shemanquban Supply Chain Co., Ltd. significantly improved the accuracy and reliability of data through data cleaning and preprocessing. However, the improvement of data quality depends not only on technical means but also on the establishment of effective data sharing mechanisms. By sharing data with suppliers and partners, the company can achieve collaborative optimization of the supply chain and further enhance overall efficiency. For example, by sharing inventory data and sales information in real-time, suppliers can make more precise replenishment decisions, reducing inventory overstock and stockout risks. Therefore, data sharing mechanisms are not only technical integrations but also a reflection of trust and

cooperation between companies.

The Necessity of Talent and Technological Investment: The application of big data technology requires professional data analysis talents and technical support. Shenzhen Shemanquban Supply Chain Co., Ltd. established a professional data analysis team by recruiting and training data scientists, data engineers, and machine learning experts. These talents not only have a deep technical background but also can transform data analysis results into practical business strategies. At the same time, the company invested significant resources in the construction and optimization of technical platforms to ensure the effective application of big data technology. For example, through distributed storage technologies and advanced data analysis tools, the company can efficiently process and analyze large amounts of data. Therefore, talent and technological investment are key to big data empowering supply chain management, and companies need to make long-term strategic layouts in these areas.

8.2 Challenges and Countermeasures for SMEs Applying Big Data

Challenges: SMEs face many challenges in applying big data technology. First, lack of funding limits the company's investment in technical platform construction and talent recruitment. Second, the shortage of technical talents makes it difficult for SMEs to form professional data analysis teams, thereby affecting the application effects of big data technology. Finally, weak data foundations are also a major issue. Many SMEs lack a complete data management system, making data collection and integration difficult. These challenges collectively restrict the application and promotion of big data technology by SMEs.

Countermeasures: To overcome these challenges, SMEs can take a variety of countermeasures. First, government support is crucial. The government can reduce the cost for SMEs to apply big data technology through policy support and financial subsidies. For example, providing tax incentives, special subsidies, or low-interest loans can help SMEs solve funding problems. Second, industry-university-research cooperation is an effective way to solve the shortage of technical talents. By cooperating with universities and research institutions, SMEs can share resources and jointly conduct research and application of big data technology. For example, companies can cooperate with universities to carry out internship programs or joint research projects to cultivate and attract data analysis talents. Finally, cloud service leasing provides SMEs with a low-cost way to obtain big data processing and analysis capabilities. By leasing cloud services, SMEs can reduce the pressure of technological investment, quickly deploy big data platforms, and enhance data processing capabilities. (Dezi, L., Santoro, G., Gabteni, H., et al., 2018)

8.3 Future Research Directions

Deep Integration of Big Data with Artificial Intelligence and the Internet of Things: Future research can further explore the deep integration of big data with artificial intelligence and the Internet of Things to achieve intelligent supply chain management. Through machine learning and deep learning algorithms, companies can further improve the accuracy of demand forecasting and the optimization effects of the supply chain. For example, using neural network algorithms to analyze historical sales data and market trends can more accurately forecast market demand. At the same time, the Internet of Things technology can monitor the status of each link in the supply chain in real-time, providing richer data support. Through the interconnection of sensors and devices, companies can achieve real-time monitoring and optimization of logistics, warehousing, and production processes.

Construction and Application of Cross-Enterprise Supply Chain Big Data Platforms: Future research can also focus on the construction and application of cross-enterprise supply chain big data platforms. By establishing a unified data platform, upstream and downstream companies in the supply chain can share data and optimize collaboratively, thereby enhancing the efficiency and competitiveness of the entire supply chain. For example, by sharing demand forecasting data and inventory information, suppliers can make more precise production plans, reducing inventory overstock and stockout risks. At the same time, big data platforms can support collaborative decision-making between companies, optimizing the overall layout and resource allocation of the supply chain. Through cross-enterprise data sharing and collaborative cooperation, companies can not only enhance their own competitiveness but also promote the digital transformation of the entire industry.

9. Conclusion

9.1 Research Summary

Through the empirical study of Shenzhen Shemanquban Supply Chain Co., Ltd., this research has verified the effectiveness of big data empowering supply chain management. The results show that big data technology has significantly improved the accuracy of demand forecasting, the level of inventory management, and the efficiency of logistics distribution. Through accurate demand forecasting, the company can better cope with market demand changes and reduce inventory overstock and stockout risks. Dynamic inventory management strategies increased the inventory turnover rate by 28.9% and reduced the inventory overstock rate by 33.3%. At

the same time, logistics costs decreased by 16.7%, and delivery punctuality increased by 11.8%. These optimization measures not only enhanced the efficiency of the supply chain but also directly translated into economic benefits for the company, enhancing its market competitiveness. (Dezi, L., Santoro, G., Gabteni, H., et al., 2018)

9.2 Practical Significance

This study provides practical experience and reference for SMEs to apply big data, promoting the digital transformation of enterprises. Through detailed data analysis and implementation of optimization strategies, this study demonstrates the practical application effects of big data technology in supply chain management, offering valuable insights for other SMEs. SMEs can overcome the challenges of insufficient funding and technical talent shortages through government support, industry-university-research cooperation, and cloud service leasing, achieving effective application of big data technology. Through big data empowerment, SMEs can enhance operational efficiency, strengthen market competitiveness, and achieve sustainable development.

9.3 Research Limitations and Outlook

Despite the verification of the effectiveness of big data empowering supply chain management through the case of Shenzhen Shemanquban Supply Chain Co., Ltd., this study still has limitations. First, the study is limited to a single company, and future research can be expanded to collaborative studies of multiple companies in the supply chain to explore the application effects of big data in cross-enterprise supply chains. Second, this study mainly focuses on links such as demand forecasting, inventory management, and logistics distribution, and future research can further explore the application of big data in areas such as green supply chains and supply chain finance. Through research in these areas, a more comprehensive theoretical and practical support can be provided for the comprehensive digital transformation of supply chain management.

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Sustainable Development Practices and Prospects in the Fashion Accessories Industry

Piao Chen[1]

[1] Guangdong Ason Jewelry Co., Ltd., Guangzhou 510000, China

Correspondence: Piao Chen, Guangdong Ason Jewelry Co., Ltd., Guangzhou 510000, China.

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Abstract

In the context of global sustainable development, the fashion accessories industry is facing unprecedented opportunities and challenges. With the increasing environmental awareness of consumers and the global emphasis on environmental protection, sustainable development has become an inevitable trend for the fashion accessories industry. This paper conducts an in-depth study on the current status and practices of sustainable development in the fashion accessories industry, including the widespread application of environmentally friendly materials, the green optimization of production processes, and the active fulfillment of corporate social responsibility. Through case analysis of leading companies in the industry, the paper summarizes successful experiences in sustainable development and makes scientific predictions for future market trends. Finally, the paper proposes strategies to promote sustainable development in the industry, aiming to provide references for fashion accessories companies to achieve green transformation in the global market and help the industry move towards a more environmentally friendly and sustainable future.

Keywords: sustainable development, fashion accessories, environmentally friendly materials, industry prospects, market trends, policy support, technological innovation, consumer education

1. Introduction

In the context of global sustainable development, the fashion accessories industry is facing unprecedented opportunities and challenges. With the increasing environmental awareness of consumers and the global emphasis on environmental protection, sustainable development has become an inevitable trend for the fashion accessories industry. The traditional fashion accessories industry, characterized by its rapidly changing styles and extensive market coverage, has provided consumers with a wide range of choices. However, it has also led to resource wastage, environmental pollution, and social equity issues. The existence of these problems not only causes irreversible damage to the environment but also poses a threat to the long-term stable development of the industry. Therefore, how to achieve coordinated development of the economy, society, and environment while meeting consumer needs has become an important issue that the fashion accessories industry urgently needs to solve.

In recent years, the concept of sustainable development has gradually taken root in people's hearts, and consumers' attention and demand for environmentally friendly and sustainable products have been increasing continuously. This has not only brought new market opportunities to the fashion accessories industry but also put forward higher requirements for it. Companies within the industry need to re-examine their production models, supply chain management, and product design to adapt to the new market demands and environmental standards. Against this backdrop, more and more companies have begun to actively explore the path of sustainable development, striving to achieve green transformation through the use of environmentally friendly materials, optimization of production processes, and fulfillment of corporate social responsibility.

2. Overview of Sustainable Development

2.1 Definition and Connotation of Sustainable Development

Sustainable development aims to achieve a balance between the economy, society, and the environment. The concept originated from the 1987 report "Our Common Future", which emphasizes meeting the needs of the present without compromising the ability of future generations to meet their own needs. In the fashion accessories industry, sustainable development faces many challenges: the rapid changes in fashion trends and large-scale production lead to excessive consumption of resources and an increase in waste, chemical pollution in the production process threatens the health of workers and the environment, and there are also urgent issues to be solved, such as insufficient protection of labor rights.

Sustainable development is crucial for the fashion accessories industry. From an environmental perspective, the use of environmentally friendly materials, optimization of production processes, and improvement of resource utilization efficiency can reduce dependence on natural resources and waste emissions, thereby alleviating environmental pressure. From a social standpoint, ensuring labor rights and improving working conditions helps promote social equity and harmony. From an economic point of view, sustainable development can reduce the long-term operating costs of enterprises, enhance brand image, and strengthen market competitiveness, meeting the growing consumer demand for environmentally friendly products. Therefore, sustainable development in the fashion accessories industry is not only an inevitable choice to address environmental and social challenges but also a key for enterprises to achieve long-term stable development. Companies need to take active measures to promote green transformation to achieve coordinated development of the economy, society, and the environment.

3. Current Status of Sustainable Development in the Fashion Accessories Industry

3.1 Application of Environmentally Friendly Materials

The application of environmentally friendly materials is one of the key links in achieving sustainable development in the fashion accessories industry. In recent years, with the increasing awareness of environmental protection and the progress of technology, the use of stainless steel, recyclable metals, and biodegradable plastics has gradually become popular. According to industry reports, currently about 30% of fashion accessories manufacturers have started using stainless steel as the main material, a proportion that has increased by 15% over the past five years. Stainless steel, due to its corrosion resistance and recyclability, has become the preferred material for many accessories manufacturers.

The use of recyclable metals is also on the rise. According to data from market research institutions, in 2024, the use of recyclable metals in the fashion accessories industry accounted for 25% of the total metal materials, and it is expected to rise to 35% by 2030. The use of recyclable metals not only reduces dependence on primary mineral resources but also lowers energy consumption and environmental pollution in the mining and smelting processes. (Vogue, 2023)

The emergence of biodegradable plastics has provided a new solution to the problem of traditional plastics that are difficult to degrade. Currently, the use of biodegradable plastics in the fashion accessories industry is about 10%, and this proportion is growing at an annual rate of 5%. Biodegradable plastics not only have good biodegradability but can also simulate the performance and appearance of traditional plastics to a certain extent. For example, FRAME launched a full series of biodegradable plastic accessories in 2024, which received positive market feedback, with product sales increasing by 30% year-on-year.

However, despite the progress made in the use of these environmentally friendly materials, there are still some challenges in their application in the fashion accessories industry. On the one hand, the relatively high cost of some environmentally friendly materials limits their large-scale application to a certain extent. For example, the price of high-performance biodegradable plastics is 30% to 50% higher than that of traditional plastics, making it difficult for many small and medium-sized enterprises to bear. On the other hand, the performance and appearance of environmentally friendly materials sometimes fail to fully meet the design requirements of fashion accessories. For example, the luster and texture of some recyclable metals may not be as good as that of traditional precious metals, affecting the market competitiveness of the products. In addition, the supply chain for environmentally friendly materials is not yet perfect, and the stability of supply and the consistency of quality need to be improved.

At the same time, the development and application of new types of environmentally friendly materials have a broad prospect. With the continuous progress of science and technology, more and more innovative materials are being developed, providing more choices for the fashion accessories industry. For example, some new types of plastics based on plant fibers or bio-based materials not only have good biodegradability but can also simulate the performance and appearance of traditional plastics to a certain extent. According to industry experts, in the next five years, the use of these new types of environmentally friendly materials in the fashion accessories industry is expected to increase from the current 5% to 20%. In addition, the application of nanotechnology also

brings new possibilities for improving the performance of materials, such as nano-composite materials can enhance the strength and wear resistance of accessories without increasing weight. The emergence of these new types of environmentally friendly materials is expected to further promote the sustainable development of the fashion accessories industry, but it also requires the joint efforts of enterprises, research institutions, and government departments to overcome obstacles in technology, cost, and market, and promote their widespread application. (Table 1)

Table 1. Application of Environmentally Friendly Materials

Type of Environmentally Friendly Material	**Usage Proportion (2024)**	**Annual Growth Rate**
Stainless Steel	30%	3%
Recyclable Metals	25%	2%
Biodegradable Plastics	10%	5%
New Types of Environmentally Friendly Materials	5%	8%

In summary, the application of environmentally friendly materials plays an important role in the sustainable development of the fashion accessories industry. Although there are still some challenges at present, with the continuous progress of technology and the changing market demand, the development and application of new types of environmentally friendly materials have a broad prospect and are expected to provide strong support for the green transformation of the industry.

3.2 Green Production Processes

In the sustainable development practices of the fashion accessories industry, the optimization and implementation of green production processes are the cornerstones of environmentally friendly production. By improving production processes and strengthening energy management, companies can not only improve production efficiency but also significantly reduce their environmental impact. At the same time, the effective treatment and recycling of waste are also indispensable parts of green production processes, which help reduce resource wastage and environmental pollution and promote the sustainable development of the industry.

3.2.1 Optimization of Production Processes and Energy Management

The traditional production processes in the fashion accessories industry are often associated with high energy consumption and pollution. In recent years, with the increasing awareness of sustainable development, more and more companies have begun to focus on optimizing production processes and improving energy management. For example, by introducing automated production equipment and advanced manufacturing technologies, companies can achieve refined and efficient production processes, thereby reducing energy consumption and waste generation. According to industry reports, companies that adopt automated production lines have seen an average increase in production efficiency of 30%, while energy consumption has decreased by 20%.

In terms of energy management, companies have further reduced their carbon footprint in the production process by installing energy-saving equipment and optimizing energy use processes. For example, a large jewelry manufacturer, Lao Pu Huang Jin, has installed solar panels and an intelligent energy management system in its factory. By optimizing energy allocation and use efficiency, the company has reduced its annual carbon dioxide emissions by about 500 tons. In addition, companies also conduct regular energy audits and employee training to ensure the effective implementation of energy management measures, further promoting the progress of green production.

3.2.2 Practices in Waste Treatment and Recycling

Waste treatment and recycling are important components of green production processes. In the fashion accessories industry, waste generated during the production process mainly includes metal scraps, plastic waste, and packaging materials. To reduce the environmental impact of these wastes, companies have adopted a series of recycling measures.

By establishing internal recycling systems, companies can remelt metal scraps to produce new accessories. According to industry statistics, effective waste recycling and reuse can reduce waste emissions by more than 40%, while reducing raw material procurement costs by about 30%. This internal recycling not only reduces waste emissions but also improves resource utilization efficiency. (Harper’s Bazaar, 2024)

In addition, companies also cooperate with professional recycling companies to ensure that plastic waste and packaging materials are properly treated. For example, China Gold has partnered with an environmental recycling company to convert plastic waste generated during the production process into recycled plastic

granules for the production of new packaging materials. This measure not only reduces plastic waste pollution to the environment but also enhances the company's environmental image and increases consumer trust in the brand. It is estimated that through this cooperation, the company can reduce the emission of about 100 tons of plastic waste per year.

In waste treatment, companies also focus on using environmentally friendly treatment methods, such as biodegradation and harmless treatment technologies. For example, for organic waste that cannot be recycled, companies use biodegradation technology to convert it into organic fertilizer for greening and agricultural planting. According to relevant research, organic waste treated by biodegradation technology can be completely decomposed into high-quality organic fertilizer within 6 months. For waste containing heavy metals or other harmful substances, companies use harmless treatment technologies to ensure that they do not cause secondary pollution to the environment during the treatment process. According to statistics from environmental protection departments, after the adoption of harmless treatment technologies, the emission of harmful waste from companies has been reduced by 90%. (Table 2)

Table 2. Type of Waste and Value

Type of Waste	**Data Indicator**	**Value**
Metal Scraps	Reduction in Waste Emissions	More than 40%
Reduction Costs	Reduction in Raw Material Procurement Costs	30%
Plastic Waste	Annual Reduction in Plastic Waste Emissions	100 tons
Organic Waste	Complete Decomposition Time	6 months
Harmful Waste	Reduction in Harmful Waste Emissions	90%

3.3 Fulfillment of Corporate Social Responsibility

3.3.1 Protection of Labor Rights and Community Participation

The protection of labor rights is one of the core contents of corporate social responsibility. In the fashion accessories industry, many production processes rely on a large amount of labor, especially hand-made and assembly processes. Therefore, ensuring that workers' labor rights are fully protected not only helps to improve production efficiency and product quality but also enhances the company's social image and market competitiveness. According to a report from the International Labor Organization (ILO), about 70% of companies in the global fashion accessories industry have implemented labor rights protection measures, including providing a safe working environment, reasonable wages, and sufficient rest time. For example, GRAFF, an internationally renowned jewelry brand, has established an internal labor rights supervision mechanism to ensure that its workers work no more than 48 hours a week in its global factories and have at least one day off. In addition, the brand also provides vocational training and promotion opportunities for workers to help them improve their skills and career development.

Community participation is also an important part of corporate social responsibility. By actively participating in community activities and supporting local community development, companies can establish good social relationships and enhance the social value of their brands. Many fashion accessories companies have won widespread social recognition by supporting educational projects, environmental protection activities, and community construction.

3.3.2 Sustainable Supply Chain Management and Consumer Education

Sustainable supply chain management is a key link in ensuring the sustainable development of the fashion accessories industry. The fashion accessories industry involves a complex supply chain, from raw material procurement to product manufacturing, and then to sales and logistics. Each link in the supply chain can have an impact on the environment and society. Therefore, companies need to establish a comprehensive supply chain management system to ensure that all links in the supply chain meet sustainable development standards. According to a survey by the Global Supply Chain Management Association (GSCMA), about 60% of fashion accessories companies have implemented sustainable supply chain management measures, including auditing the environmental and labor standards of suppliers, sustainable procurement of raw materials, and energy conservation and emission reduction in the logistics process. For example, Tiffany & Co, an international jewelry brand, has signed a sustainable development agreement with suppliers, requiring them to use environmentally friendly materials in the production process and ensure the protection of labor rights. At the same time, the brand has also optimized its logistics network to reduce carbon emissions during transportation.

(Harper's Bazaar, 2024)

Consumer education is another important aspect of promoting sustainable development in the fashion accessories industry. With the increasing environmental awareness of consumers, more and more consumers tend to choose sustainable products. Therefore, companies need to effectively educate consumers to improve their understanding and awareness of sustainable products and guide them to make more environmentally friendly choices.

4. Case Analysis of Sustainable Development Practices in the Fashion Accessories Industry

4.1 International Leading Company Cases

4.1.1 Pandora's Sustainable Development Strategy and Practices

Pandora is a globally renowned fashion accessories brand that has incorporated sustainable development into its core strategy in recent years, integrating it into every stage of the product life cycle. In terms of raw material procurement, Pandora prioritizes certified environmentally friendly materials, such as recyclable metals and biodegradable plastics. In 2024, the proportion of environmentally friendly materials used in its products reached 45%, an increase of 10 percentage points over the previous year. The company has established long-term cooperative relationships with suppliers and regularly audits their environmental and labor standards. In 2024, the compliance rate of suppliers with environmental and labor standards reached 95%, an increase of 5 percentage points over the previous year.

In the product design stage, Pandora uses the Life Cycle Assessment (LCA) tool to optimize design and reduce resource consumption and waste generation. Through lightweight design, the average weight of products has been reduced by 15%, thereby reducing energy consumption and raw material demand in the production process. In the production stage, Pandora has invested in building advanced green factories that use clean energy and efficient production technologies. The energy utilization efficiency of these factories is 30% higher than that of traditional factories, and the waste recycling rate has reached 90%.

In market promotion, Pandora has won the trust and support of consumers by being transparent about its sustainable development practices. The company has detailed its sustainable development strategy and achievements on its official website and social media platforms, allowing consumers to clearly understand the environmental attributes and social value of its products. In 2024, the sales of Pandora's sustainable product series increased by 25% year-on-year.

4.1.2 Swarovski's Green Transformation and Market Promotion

Swarovski is another international fashion accessories brand that has performed outstandingly in the field of sustainable development. Its green transformation began in 2018 and mainly focuses on product innovation, optimization of production processes, and market promotion. In terms of product innovation, Swarovski has invested a large amount of resources in the research and development of new types of environmentally friendly materials and sustainable product designs, and has successfully developed a series of accessories based on biodegradable plastics and recyclable metals. According to market research reports, the satisfaction of consumers with these new types of environmentally friendly products has reached 85%, 15 percentage points higher than that of traditional products.

In the optimization of production processes, Swarovski has introduced automated production equipment and advanced manufacturing technologies to optimize production processes, reducing energy consumption in the production process by 20% and waste emissions by 40%. In addition, the company has established an internal recycling system to remelt metal scraps generated during the production process and use them to produce new accessories, further reducing resource wastage. (Table 3)

In market promotion, Swarovski has won the trust and support of consumers by being transparent about its sustainable development practices. The company has detailed its sustainable development strategy and achievements on its official website and social media platforms, allowing consumers to clearly understand the environmental attributes and social value of its products. In 2024, the sales of Swarovski's sustainable product series increased by 30% year-on-year.

Table 3. Market promotion data

Item	**Pandora**	**Swarovski**
Proportion of Environmentally Friendly Materials Used	45% (+10%)	-
Supplier Compliance Rate	95% (+5%)	-
Reduction in Product Weight	15%	-

Increase in Energy Utilization Efficiency of Green Factories	+30%	-
Waste Recycling Rate	90%	-
Consumer Satisfaction with New Types of Environmentally Friendly Products	-	85% (+15%)
Reduction in Energy Consumption in Production Process	-	20%
Reduction in Waste Emissions in Production Process	-	40%
Year-on-Year Increase in Sales of Sustainable Product Series	25%	30%

4.2 Domestic Leading Company Cases

4.2.1 Sustainable Development Practices of Guangdong Aisen Accessories Co., Ltd.

Guangdong Aisen Accessories Co., Ltd. is one of the leading companies in China's fashion accessories industry and has achieved significant results in sustainable development in recent years, realizing a win-win situation between economic and environmental benefits.

In terms of raw material procurement, the company prioritizes recyclable metals and environmentally friendly plastics and has established long-term cooperative relationships with several suppliers. Through a strict audit mechanism, the company ensures the compliance of suppliers with environmental and labor standards. According to the company's 2024 Sustainability Report, the proportion of environmentally friendly materials used in its products has reached 35%, an increase of 5 percentage points over the previous year. In addition, the company also actively participates in the formulation of industry standards to promote the sustainable development of the entire industry. (Harper's Bazaar, 2024)

In the optimization of production processes, the company has invested in building a modern green factory, adopting advanced production equipment and energy-saving technologies, and introducing automated production lines, which have significantly improved production efficiency and energy utilization efficiency. According to the company's internal data, the energy utilization efficiency of the green factory is 25% higher than that of traditional factories, and the waste recycling rate has reached 85%.

In supply chain management, the company has established a transparent supply chain system and regularly audits suppliers for environmental and labor standards to ensure that each link in the supply chain meets the requirements of sustainable development. In 2024, the compliance rate of suppliers with environmental and labor standards reached 90%, an increase of 5 percentage points over the previous year.

In market promotion, the company has won the trust and support of consumers by being transparent about its sustainable development practices. The company has detailed its sustainable development strategy and achievements on its official website and social media platforms, allowing consumers to clearly understand the environmental attributes and social value of its products. According to market research reports, the sales of the company's sustainable product series increased by 30% year-on-year in 2024.

4.2.2 Sustainable Development Practices of Shanghai Jingcai Accessories Co., Ltd.

Shanghai Jingcai Accessories Co., Ltd. is another fashion accessories company in China that has performed outstandingly in the field of sustainable development. In recent years, the company has achieved low-carbon and efficient production processes through a series of green transformation measures, while also enhancing the company's market competitiveness and social image.

In product innovation, the company has invested a large amount of resources in the research and development of new types of environmentally friendly materials and sustainable product designs, and has successfully developed a series of accessories based on biodegradable plastics and recyclable metals. According to market research reports, the satisfaction of consumers with these new types of environmentally friendly products has reached 80%, 10 percentage points higher than that of traditional products.

In the optimization of production processes, the company has introduced automated production equipment and advanced manufacturing technologies to optimize production processes, reducing energy consumption and waste generation. According to the company's internal data, energy consumption in the production process has been reduced by 20%, and waste emissions have been reduced by 35%. In addition, the company has established an internal recycling system to remelt metal scraps generated during the production process and use them to produce new accessories, further reducing resource wastage.

In supply chain management, the company has established a transparent supply chain system and regularly audits suppliers for environmental and labor standards to ensure that each link in the supply chain meets the requirements of sustainable development. In 2024, the compliance rate of suppliers with environmental and labor standards reached 88%, an increase of 8 percentage points over the previous year.

In market promotion, the company has won the trust and support of consumers by being transparent about its sustainable development practices. The company has detailed its sustainable development strategy and achievements on its official website and social media platforms, allowing consumers to clearly understand the environmental attributes and social value of its products. According to market research reports, the sales of the company's sustainable product series increased by 28% year-on-year in 2024.

Table 4. Comparison Table

Item	**Guangdong Aisen Accessories Co., Ltd.**	**Shanghai Jingcai Accessories Co., Ltd.**
Proportion of Environmentally Friendly Materials Used	35% (+5%)	-
Increase in Energy Utilization Efficiency	+25%	-20%
Waste Recycling Rate	85%	-
Supplier Compliance Rate	90% (+5%)	88% (+8%)
Year-on-Year Increase in Sales	+30%	+28%
Consumer Satisfaction with New Types of Environmentally Friendly Products	-	80% (+10%)

5. Strategies and Prospects for Sustainable Development in the Fashion Accessories Industry

5.1 Strategies to Promote Sustainable Development

In the process of moving towards sustainable development, the fashion accessories industry needs to adopt comprehensive strategies. These strategies should cover policy support and the establishment of industry standards, technological innovation and the construction of green supply chains, as well as consumer education and market guidance. Through multi-dimensional coordinated efforts, the green transformation of the entire industry can be effectively promoted to achieve coordinated development of the economy, society, and environment. Policy support is key to promoting sustainable development in the fashion accessories industry. Governments should introduce tax incentives and subsidy policies to encourage companies to use environmentally friendly materials and green technologies. For example, tax exemptions can be given to companies using recyclable materials, and special funds can be set up to support the research and development of sustainable technologies. Research shows that policy support can significantly enhance companies' enthusiasm for environmental protection.

The establishment of industry standards is equally important. Formulating unified sustainable development standards, such as referring to ISO 14001 and ISO 26000, can regulate corporate behavior and improve the overall level of the industry. Industry associations should organize training and certification activities to help companies understand and implement these standards. Reports show that companies following sustainable standards perform better in environmental performance and social responsibility, and their market share also increases.

Technological innovation is the core of achieving sustainable development. Companies should increase investment in the research and development of environmentally friendly materials and green production technologies, for example, developing new types of biodegradable plastics and recyclable metals to reduce dependence on traditional materials. At the same time, adopting automated production lines and intelligent energy management systems can improve energy utilization efficiency and reduce waste generation. Research shows that companies using green technologies have advantages in cost control and environmental performance.

Building a green supply chain is also a key link. Companies should establish close cooperation with suppliers, sign sustainable development agreements with them, and require them to use environmentally friendly materials and green technologies. Establishing a supply chain management system to monitor suppliers' environmental and social performance in real-time ensures the sustainability of the supply chain. Research shows that companies implementing green supply chain management perform better in reducing environmental risks and improving supply chain efficiency.

Consumer education is an important factor in promoting sustainable development. Companies should release information on sustainable development through their official websites, social media, and offline stores, hold offline activities and seminars to improve consumers' awareness and demand for sustainable products. Research shows that educated consumers are more inclined to choose sustainable products, with a purchase intention 30% higher than that of ordinary consumers. (Kate Fletcher & Lynda Grose, 2012)

Market guidance is also important. Companies should be transparent about their sustainable development practices, label the environmental attributes and social value of their products, and cooperate with environmental organizations to carry out sustainable development projects to enhance brand image and market competitiveness. Reports show that companies implementing market guidance strategies perform better in market share and brand value.

5.2 Future Market Trends and Outlook

In the future, the fashion accessories industry will develop in the direction of being environmentally friendly, transparent, and innovative. The increasing demand of consumers for sustainable products will prompt companies to enhance the environmental attributes and social value of their products. Strict regulations from governments and international organizations will push companies to comply with higher environmental and social responsibility standards. Technological innovation, especially the application of new materials and digital technologies, will help companies reduce resource consumption and environmental pollution, while also improving the transparency and efficiency of the supply chain. The intensification of market competition will require companies to innovate continuously to meet consumers' demand for sustainable products and enhance their competitiveness. The strengthening of industry cooperation will promote the sharing of resources and exchange of experiences among companies, governments, research institutions, and consumers, jointly promoting the green transformation of the industry.

6. Conclusion

This paper has thoroughly explored the current status of sustainable development in the fashion accessories industry, analyzed practical cases, and put forward corresponding strategies and future prospects. The research findings indicate that although the industry has made significant progress in the application of environmentally friendly materials, the optimization of green production processes, and the fulfillment of corporate social responsibility, it still faces numerous challenges. By analyzing the successful cases of leading international and domestic companies, this paper has summarized the key experiences of sustainable development, including effective practices in policy support, technological innovation, supply chain management, and consumer education. In the future, with the shift in consumer demand, the push of policy regulations, and the acceleration of technological innovation, the fashion accessories industry will face new development opportunities. Companies need to actively adapt to market changes, strengthen cooperation, and promote green transformation to achieve coordinated development of the economy, society, and environment.

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Innovation-Driven Development: The Growth Path of Shenzhen Xiongyu Rubber Hardware Products Co., Ltd.

Min Yang[1]

[1] Shenzhen Xiongyu Rubber Hardware Products Co., Ltd., Shenzhen 518000, China

Correspondence: Min Yang, Shenzhen Xiongyu Rubber Hardware Products Co., Ltd., Shenzhen 518000, China.

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Abstract

This paper examines the development journey of Shenzhen Xiongyu Rubber Hardware Products Co., Ltd. (hereinafter referred to as "Xiongyu Company"), analyzing its practices and achievements in technological innovation, management optimization, intellectual property protection, and sustainable development as well as the fulfillment of social responsibility. Xiongyu Company has continuously engaged in technological innovation to develop high-performance silicone rubber materials, thereby enhancing product quality and competitiveness. Management optimization measures, such as organizational restructuring and human resource management, have improved operational efficiency. Intellectual property protection strategies, including patent applications and trademark registrations, have safeguarded innovative outcomes. The fulfillment of sustainable development and social responsibility has enhanced the company's brand image. This paper summarizes its successful experiences and looks forward to future development directions, providing references for enterprises in the same industry.

Keywords: innovation-driven development, enterprise management, silicone rubber industry, sustainable development, technological innovation, management optimization, intellectual property protection, market competitiveness, industry-university-research cooperation, digital transformation, brand building, internationalization, social responsibility, green production, industry leadership

1. Introduction

Shenzhen Xiongyu Rubber Hardware Products Co., Ltd. (hereinafter referred to as "Xiongyu Company") was established in August 2015 and is located in Bao'an District, Shenzhen. It is a high-tech enterprise specializing in the research and development, production, and sales of high-performance silicone rubber products. The company has rapidly risen in the industry through technological innovation and management optimization.

The silicone rubber industry, as an important part of the new materials sector, has developed rapidly in recent years. According to a report by Smithers Rapra, the global silicone rubber market size increased from USD 15 billion in 2015 to USD 18 billion in 2020, with an average annual compound growth rate of 3.5%. This growth is attributed to the increasing demand for high-performance silicone rubber products in industries such as electronics, automotive, and medical. (Drucker, P. F., 1985)

Xiongyu Company has developed a series of high-performance silicone rubber materials through continuous R&D investment and industry-university-research cooperation, significantly enhancing product quality and market competitiveness. Meanwhile, the company has improved operational efficiency and market response speed through management optimization measures, such as organizational restructuring and lean production management. These practices have provided valuable experience for the company's own development and offer references for enterprises in the same industry and regional economic development.

This study employs literature research, case analysis, and interview methods, combining internal company data and publicly available information to conduct an in-depth analysis of Xiongyu Company's practices and

achievements in technological innovation, management optimization, intellectual property protection, and sustainable development.

2. Company Background and Development History

Shenzhen Xiongyu Rubber Hardware Products Co., Ltd. (hereinafter referred to as "Xiongyu Company") has rapidly emerged as a leading player in the highly competitive silicone rubber products market since its establishment in August 2015. The company's development history not only reflects its remarkable achievements in technological innovation, market expansion, and management optimization but also provides valuable references for enterprises in the same industry.

2.1 Background of Establishment

1) Entrepreneurial Motivation and Vision of the Founder

Xiongyu Company was founded by Mr. Yang Min, who has 20 years of experience in the silicone rubber industry and previously served as a senior executive in well-known enterprises. Based on his belief in the future development of the industry and his pursuit of innovation, Mr. Yang established Xiongyu Company, focusing on the research and development and production of high-performance silicone rubber products, with the aim of providing customers with high-quality products and solutions. His vision is to build Xiongyu into a globally leading supplier of silicone rubber products, driving industry development through technological innovation and excellent management.

2) Market Demand and Opportunities

At the time of Xiongyu Company's establishment, the global silicone rubber market was growing rapidly, with a market size of approximately USD 15 billion in 2015 and an estimated increase to USD 18 billion by 2020, at an average annual compound growth rate of 3.5%. This growth was driven by the rapid development of industries such as electronics, automotive, and medical. The electronics industry's demand for high-performance silicone rubber was increasing, especially in areas like 5G communication and smart home technology; the automotive industry's demand for heat-resistant and corrosion-resistant silicone rubber was also growing; and the medical industry's demand for high-performance silicone rubber products was on the rise. Xiongyu Company seized these opportunities and focused on the research and development and production of high-performance silicone rubber products.

3) Industry Competitive Landscape

Despite the strong market demand, the silicone rubber industry was highly competitive. In 2015, major global players included Wacker Chemie, Dow Corning, and other international giants, which had significant advantages in technology research and development, market share, and brand influence. Xiongyu Company entered the market from the mid-to-low-end segment and gradually improved product performance and market competitiveness through technological innovation and management optimization, moving towards the high-end market.

2.2 Development Process

1) Start-up Period (August 2015-2017)

In August 2015, Xiongyu Company was registered in Bao'an District, Shenzhen, with a registered capital of RMB 1.5 million. The company established a core team led by Mr. Yang Min and clarified its product positioning for high-performance silicone rubber products. It developed silicone rubber products suitable for electronics, automotive, and medical fields. The company gradually built a customer network through participating in industry exhibitions and holding product launch events and established cooperative relationships with several well-known domestic enterprises.

2) Growth Period (2018-2020)

In 2018, Xiongyu Company increased its R&D investment and established cooperative relationships with universities and research institutions, developing new types of high-temperature-resistant silicone rubber materials and environmentally friendly silicone rubber products. The company successfully entered the international market and signed a long-term cooperation agreement with a well-known German automotive parts supplier. The number of company employees increased from 50 to 100, and advanced management concepts were introduced to optimize the organizational structure. A performance assessment and incentive mechanism was established to improve operational efficiency and management level.

3) Maturity Period (2021-Present)

In 2021, Xiongyu Company's position in the silicone rubber industry gradually became established. According to a report by MarketsandMarkets, Xiongyu Company has become one of the important participants in the global silicone rubber market, with its market share steadily increasing in the mid-to-high-end market. The company's

performance in technological innovation, product quality, and customer satisfaction has been widely recognized in the industry. In order to further expand its international market presence, Xiongyu Company established an international business department in 2021, specifically responsible for the development and management of international markets. The company gradually improved its international market layout by setting up overseas offices and establishing local sales teams. Currently, the company's products are sold in multiple countries and regions in Europe, North America, Asia, and other areas, with its international market share increasing year by year. In 2021, Xiongyu Company began to implement a strategic transformation, gradually moving towards diversified development. The company not only continued to focus on the silicone rubber products field but also actively expanded related industrial chains, developing a series of hardware products that complement silicone rubber products. In addition, the company enhanced its comprehensive competitiveness through mergers and acquisitions, integrating industry resources. For example, in 2021, the company successfully acquired a well-known domestic hardware enterprise, further perfecting its product line.

Table 1. Global Silicone Rubber Market Size and Growth Trend (2015-2020)

Year	**Global Silicone Rubber Market Size (USD Billion)**	**Average Annual Compound Growth Rate (%)**
2015	15	3.5
2016	15.5	3.5
2017	16	3.5
2018	16.6	3.5
2019	17.3	3.5
2020	18	3.5

Table 2. Xiongyu Company's Main Product Sales Data (2015-2020)

Year	**Sales of Silicone Rubber for Electronics (RMB Ten Thousand)**	**Sales of Silicone Rubber for Automotive (RMB Ten Thousand)**	**Sales of Silicone Rubber for Medical (RMB Ten Thousand)**	**Total Sales (RMB Ten Thousand)**
2015	200	150	100	450
2016	300	200	150	650
2017	400	250	200	850
2018	500	300	250	1050
2019	600	350	300	1250
2020	700	400	350	1450

From Table, it can be seen that the global silicone rubber market maintained stable growth from 2015 to 2020, with an average annual compound growth rate of 3.5%. This growth was mainly driven by the rapid development of the electronics, automotive, and medical industries, which led to an increasing demand for high-performance silicone rubber products. Xiongyu Company seized this market opportunity and achieved significant sales growth through technological innovation and market expansion. From Table 2, it is evident that Xiongyu Company's main product sales increased continuously from 2015 to 2020, with the sales of silicone rubber for electronics, automotive, and medical applications all showing a steady upward trend. This indicates that the company's efforts in technological innovation and market expansion have yielded remarkable results, and its products have been recognized by the market in multiple fields.

3. The Importance of Technological Innovation

3.1 The Connotation and Extension of Technological Innovation

Technological innovation in the silicone rubber industry involves the application of new technologies, processes, or materials aimed at improving products, production processes, or services to meet market demand and enhance corporate competitiveness. This includes the development of new types of high-performance materials (such as heat-resistant and corrosion-resistant silicone rubber), optimization of production processes (such as the introduction of automated equipment), provision of customized solutions, and the introduction of lean production management, all of which drive comprehensive progress for enterprises in technology, products, and

markets.

3.2 The Driving Role of Technological Innovation in Corporate Development

Technological innovation has played a key role in the development of Xiongyu Company. By developing new materials and improving production processes, the company has created high-performance silicone rubber products that meet the demands of the high-end market and enhance market competitiveness. Technological innovation has also helped the company expand its product application fields from traditional areas to multiple industries such as electronics, automotive, and medical. Moreover, continuous technological innovation has established strong technological barriers, forming a number of core technologies and patents that enhance market competitiveness. Technological innovation has also reduced production costs and increased production efficiency, promoting growth in sales and market share. From 2015 to 2020, the company's sales grew from RMB 450,000 to RMB 1.45 million, with an average annual compound growth rate of 25%, and its market share increased from 1.2% to 2.5%.

3.3 Xiongyu Company's Technological Innovation Practices

Xiongyu Company places great emphasis on technological innovation, allocating more than 10% of its annual revenue to R&D. It has established a professional R&D team of over 50 people and equipped it with advanced laboratory facilities. The company collaborates with universities such as Shenzhen University and South China University of Technology to jointly undertake research projects and accelerate technological innovation. For example, the company has developed a new type of high-temperature-resistant silicone rubber material with a 30% increase in heat resistance, which is widely used in multiple fields. In addition, the company has introduced automated production equipment and intelligent production management systems, increasing production efficiency by 20% and reducing costs by 15%. These technological innovation achievements have not only improved the company's economic benefits but also enhanced its competitiveness in the market. (Tidd, J., Bessant, J., & Pavitt, K., 2015)

Table 3. Xiongyu Company's Technological Innovation Achievements and Economic Growth (2015-2020)

Year	R&D Investment (RMB Ten Thousand)	New Patent Applications	Sales (RMB Ten Thousand)	Market Share (%)
2015	45	5	450	1.2
2016	65	8	650	1.5
2017	85	10	850	1.8
2018	105	12	1050	2.0
2019	125	15	1250	2.3
2020	145	18	1450	2.5

4. Management Optimization and Corporate Development

4.1 Theoretical Basis of Management Optimization

Modern management theory emphasizes systematicness, scientific nature, and human-oriented approaches, focusing on the optimal allocation of internal corporate resources and the adaptability to external environments. Systems theory views a company as an organic whole, with interconnected and interdependent parts. Management optimization must start from the overall perspective and coordinate the relationships among various parts. Contingency theory advocates that management methods should be flexibly adjusted according to changes in the internal and external environments of the enterprise, as there is no one-size-fits-all management model. Human-oriented management theory emphasizes placing employees at the center, paying attention to their needs and development, and enhancing their work enthusiasm and creativity through motivation and training. Management optimization aims to improve corporate operational efficiency, reduce costs, enhance market competitiveness, and at the same time, increase employee satisfaction and corporate innovation capabilities. Its main principles include goal orientation, continuous improvement, and full participation. (Drucker, P. F., 1985)

4.2 Xiongyu Company's Management Optimization Measures

Xiongyu Company has significantly improved its operational efficiency and market competitiveness through management optimization. The company has shifted from a traditional hierarchical management structure to a flat management structure, reducing management levels, shortening decision-making processes, and increasing

management efficiency and response speed. At the same time, it has redefined departmental responsibilities and authorities, optimized inter-departmental collaboration processes, avoided overlapping responsibilities and buck-passing phenomena, and motivated employees.

In human resource management, the company has established a scientific talent recruitment and selection mechanism. Through multi-channel recruitment and structured interviews, it ensures the selection of the most suitable candidates for each position. The company has developed a comprehensive employee training and development system, covering new employee onboarding training, job skill training, and career planning, to enhance employees' professional skills and overall quality. In addition, the company has implemented a performance assessment and incentive mechanism. By setting clear performance goals and evaluation indicators, regularly assessing employee performance, and providing corresponding salary adjustments, promotion opportunities, and rewards based on performance results, it encourages employees to work hard.

In production operation management, the company has conducted a comprehensive analysis of the production process, eliminated unnecessary steps, optimized production layout, and reduced waste. The company has introduced lean production concepts, using tools such as kanban management and standardized operations to improve production efficiency and product quality. The company has established a strict supplier evaluation system, selecting high-quality suppliers to ensure the quality and stability of raw material supply. By establishing long-term cooperative relationships with suppliers and sharing information for collaborative procurement, it reduces procurement costs. The company has optimized inventory management by adopting advanced inventory management systems to monitor inventory levels in real-time, reducing inventory accumulation and capital occupation. In addition, the company has established a comprehensive quality management system, monitoring quality throughout the entire process from raw material procurement to product shipment. By obtaining international quality certifications such as ISO 9001, it has standardized quality management processes and ensured that product quality meets international standards. (Davenport, T. H., & Glaser, J., 2002)

In financial management, the company has established a strict cost control system. Through cost analysis and budget management, it controls various expense outlays. The company regularly conducts cost audits to identify weak links in cost control and takes measures to improve them. The company has optimized capital management, reasonably arranging the use of funds to improve capital utilization efficiency. The company has established a risk early warning mechanism to monitor market risks, financial risks, and other risks in real-time and take timely measures to address them. In addition, the company has introduced advanced financial management software to achieve automated processing and real-time monitoring of financial data, improving financial management efficiency and providing timely and accurate data support for decision-making.

4.3 The Improvement of Production Efficiency and Market Competitiveness through Management Optimization

Management optimization has significantly improved Xiongyu Company's production efficiency and market competitiveness. Through production process reengineering and the implementation of lean production, the company's production cycle has been significantly shortened. For example, the production cycle of a key product has been reduced from 10 days to 7 days, increasing production efficiency. At the same time, optimized supply chain management and cost control measures have reduced raw material procurement costs by 10% and inventory costs by 15%. Lean production has further reduced waste in the production process, lowering production costs. (Drucker, P. F., 1985)

Flat management has reduced decision-making levels, enabling management to make decisions more quickly. In the face of market changes, the company can complete the formulation of plans and resource allocation within a week, which is nearly half the time of traditional management models. Optimized supply chain management and production processes have enabled the company to respond to customer needs more quickly. Customer feedback issues can receive an initial response within 24 hours and a solution within 48 hours, significantly improving customer satisfaction.

The comprehensive quality management system has ensured the stability and reliability of product quality. By obtaining ISO 9001 certification, the company's product quality has been internationally recognized, reducing customer complaints by 30%. Through human resource management optimization, employee service awareness and capabilities have been enhanced. The company has established a customer service center to provide 24/7 online service, increasing customer satisfaction from 80% to over 90%.

Through management optimization, the company's product quality and service levels have improved, gradually establishing a brand image. The company has received several industry honors, significantly increasing brand awareness and reputation. Management optimization has led to significant improvements in production efficiency, product quality, and customer satisfaction for the company, significantly enhancing its comprehensive competitiveness. The company's market share has increased year by year, from 1.2% in 2015 to 2.5% in 2020. (Davenport, T. H., & Glaser, J., 2002)

Table 4. Xiongyu Company's Management Optimization Achievements and Economic Growth (2015-2020)

Year	R&D Investment (RMB Ten Thousand)	Sales (RMB Ten Thousand)	Market Share (%)	Production Cycle (Days)	Reduction in Procurement Costs (%)	Customer Satisfaction (%)
2015	45	450	1.2	10	-	80
2016	65	650	1.5	9	5	82
2017	85	850	1.8	8	7	85
2018	105	1050	2.0	7	10	88
2019	125	1250	2.3	6	12	90
2020	145	1450	2.5	5	15	92

From above table, it can be seen that management optimization has not only improved production efficiency but also significantly reduced production costs and increased customer satisfaction, ultimately promoting the growth of sales and market share. These data clearly demonstrate the significant role of management optimization in the growth of Xiongyu Company.

5. Intellectual Property Protection Strategy

5.1 The Importance of Intellectual Property Protection

In fierce market competition, intellectual property is a key component of a company's core competitiveness. It not only protects the company's technology, brand, and innovative achievements from unauthorized use or copying but also provides an incentive mechanism for corporate innovation. For example, Xiongyu Company protects its new silicone rubber materials and production processes through patents, ensuring that these core technologies are not easily replicated by competitors, thereby maintaining its market leadership. At the same time, through trademark registration, the company protects its brand image, enhances brand value, and strengthens market competitiveness.

5.2 Xiongyu Company's Intellectual Property Protection Status

As of 2023, Xiongyu Company has achieved significant results in intellectual property protection. The company has applied for a total of 50 patents, including 10 invention patents and 40 utility model patents. These patents cover new silicone rubber materials, production processes, and product designs, forming a strong technological barrier. For example, the company's newly developed high-temperature-resistant silicone rubber material has obtained an invention patent, significantly enhancing the market competitiveness of its products. In addition, the company has successfully registered multiple trademarks both domestically and internationally, effectively preventing brand infringement and misuse, and maintaining brand image. The company also focuses on copyright protection, registering and protecting technical documents and software to ensure the legal use of these intellectual properties.

5.3 Intellectual Property Protection Strategies and Measures

Xiongyu Company has established a comprehensive intellectual property protection system through a series of strategies and measures. The company has developed a long-term intellectual property strategy plan, clarifying protection goals and directions, and monitoring the application, maintenance, and use of intellectual properties in real-time through an information management system. The company adopts a comprehensive patent layout strategy, applying for patents not only in China but also in major international markets to ensure global protection of core technologies. The company actively takes trademark enforcement measures, combating infringement through legal means, and has established a comprehensive intellectual property dispute resolution mechanism, hiring professional legal teams to provide legal support. In addition, the company regularly organizes intellectual property training for employees to enhance their awareness of protection and signs confidentiality and non-compete agreements with employees to prevent the leakage of core technologies. The company has also established an intellectual property incentive mechanism to encourage employees to actively participate in innovation and intellectual property protection.

6. Sustainable Development and Social Responsibility

6.1 The Connotation and Significance of Sustainable Development

1) Definition and Dimensions of Corporate Sustainable Development (Economic, Social, Environmental)

Corporate sustainable development refers to the pursuit of economic benefits while taking into account social

and environmental benefits, achieving coordinated development of the economy, society, and environment. This concept covers three main dimensions:

Economic Dimension: Ensuring the company's long-term profitability and financial health. Xiongyu Company has achieved cost control and efficiency improvement through technological innovation and management optimization. For example, the company has significantly reduced production costs and increased production efficiency by introducing automated production equipment and optimizing production processes. At the same time, the company has continuously expanded into new market areas through market expansion and product innovation, ensuring stable growth in sales and market share.

Social Dimension: Focusing on employee rights, community participation, and public welfare. Xiongyu Company places high emphasis on employee career development and rights protection, providing a safe working environment and a fair compensation system. The company also actively participates in community construction and public welfare, giving back to society through donations and volunteer services. For example, the company donates school supplies to local schools every year to support education, enhancing the company's social image and brand value.

Environmental Dimension: Reducing the consumption of natural resources and the negative impact on the environment. Xiongyu Company has significantly reduced energy consumption and waste emissions in the production process through the implementation of energy-saving and emission-reduction measures and resource recycling. The company has also obtained the ISO 14001 environmental management system certification to ensure that its environmental management measures meet international standards. For example, the company has introduced efficient motors and lighting systems to reduce electricity consumption and established a comprehensive waste disposal and recycling system to ensure proper handling and reuse of waste.

2) Strategic Significance of Sustainable Development for Corporate Long-Term Development

Sustainable development strategy not only helps enterprises cope with increasingly strict environmental regulations and social expectations but also enhances the company's brand image and market competitiveness. By implementing sustainable development measures, enterprises can reduce operating costs, enhance innovation capabilities, improve employee satisfaction, and achieve higher economic benefits in the long term.

6.2 Xiongyu Company's Sustainable Development Strategy and Practices

1) Environmental Protection and Green Production

- Energy-saving and emission-reduction measures in the production process: Xiongyu Company has significantly reduced energy consumption by introducing energy-saving equipment and technologies and optimizing production processes. For example, the company has adopted efficient motors and lighting systems to reduce electricity consumption.
- Waste disposal and resource recycling: The company has established a comprehensive waste disposal and recycling system to ensure proper handling and reuse of waste. For example, waste generated during the production process is recycled for the production of lower-grade products, reducing resource waste.
- Environmental management system certification and implementation: Xiongyu Company has obtained the ISO 14001 environmental management system certification to ensure that its environmental management measures meet international standards. The company regularly conducts internal audits and management reviews to continuously improve environmental performance.

2) Fulfillment of Social Responsibility

- Employee rights protection and career development: The company focuses on employee rights protection and career development, providing a safe working environment and a fair compensation system. At the same time, the company also provides training and development opportunities for employees to enhance their professional skills.
- Community participation and public welfare: Xiongyu Company actively participates in community construction and public welfare, giving back to society through donations and volunteer services. For example, the company donates school supplies to local schools every year to support education.
- Supplier and partner social responsibility management: The company requires suppliers and partners to comply with social responsibility standards to ensure the sustainability of its supply chain. Through cooperation with suppliers, the company jointly promotes the practice of environmental protection and social responsibility.

3) Corporate Sustainable Development Performance Assessment

- Sustainable development indicator system construction: Xiongyu Company has established a comprehensive sustainable development indicator system covering three dimensions: economic, social, and

environmental. These indicators include energy consumption, waste generation, employee satisfaction, community participation, etc.

- Sustainable development performance monitoring and improvement: The company regularly monitors and assesses sustainable development performance, identifies problems through data analysis, and takes improvement measures. For example, the company identifies energy waste points in the production process through energy audits and takes measures for optimization.

7. Conclusion

Xiongyu Company has grown from a start-up to a leader in the silicone rubber industry, and its successful experience provides valuable references for enterprises in the same industry. The company has continuously engaged in technological innovation to develop high-performance silicone rubber materials and advanced production processes, significantly enhancing product quality and market competitiveness. At the same time, the company has improved operational efficiency, reduced costs, and enhanced market response speed through organizational restructuring, human resource management, production operation, and financial management optimization. Intellectual property protection measures have ensured the legality and exclusivity of innovative achievements, providing a solid guarantee for continuous innovation. In addition, the company has enhanced its brand image and market competitiveness by implementing a sustainable development strategy and also increased employee satisfaction and social recognition.

For enterprises in the same industry, Xiongyu Company's experience shows that continuous technological innovation is the key to maintaining competitiveness. Companies should increase R&D investment, establish innovation mechanisms, and promote product and technology upgrades. At the same time, by optimizing management processes and improving management efficiency, companies can reduce costs and increase operational efficiency. Intellectual property protection is an important guarantee for corporate innovation. Companies should strengthen intellectual property management and establish comprehensive protection mechanisms to ensure the legality and exclusivity of innovative achievements. In addition, companies should actively fulfill social responsibilities and promote sustainable development while pursuing economic benefits. Formulating a sustainable development strategy and balancing economic, social, and environmental benefits is the way for companies to achieve long-term stable development.

Looking to the future, Xiongyu Company will continue to increase its technological innovation investment, develop more high-performance and environmentally friendly silicone rubber materials, and promote product and technology upgrades. The company will continue to expand into international markets, enhance its brand's international influence, and further increase its market share through participating in international exhibitions and establishing overseas offices. At the same time, the company will promote the digital transformation of management by introducing advanced information technology and intelligent management systems to improve management efficiency and decision-making scientificity. In addition, the company will continue to deepen its sustainable development strategy and expand its social responsibility practices by implementing energy-saving and emission-reduction measures, resource recycling, and other measures to further reduce environmental impact and actively participate in more public welfare activities to give back to society.

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