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Packaging as an Offline Method to Share Information: Evidence from the Food and Beverage Industry in the Republic of Korea

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Abstract: With the growing participation by diverse stakeholders in the total flow of products, as seen with supply chains and logistics, it is becoming increasingly complicated to decide what information is to be shared and who is to be a partner. The purpose of this study is to explore the role of packaging as an offline method to share information in the total channel. This is because packaging improves communication among stakeholders and is normally part of the first contact between them and the product. Thus, it has the strategic potential to share product information that meets stakeholders' needs. To accomplish this objective, we built a research framework that depicts four hypotheses and tested it with structural equation modeling (SEM). Data were collected by surveys and measured for statistical analysis. After identifying the role of packaging, we showed nine specific related variables and the information's perceived effects on stakeholders and their directions and relative values. This will help future researchers to discuss packaging's extended roles, the needs of information separation, and its priority to be shared to help executives develop packaging strategies as an offline means to share information. Additionally, as packaging is considered to be an information generator, it gives participants the opportunity to extend its roles and to assign additional information to the product along the offline flow of goods from manufacturers to end users.

Keywords: packaging; logistics; information sharing; structural equation

1. Introduction

Information sharing is a strategy to integrate stakeholders in the total channel, including supply chains and logistics [1]. It is essential for sharing useful and effective information with partners [2]. With the growth in participation by diverse stakeholders, it is becoming more complicated to determine which information is to be shared and who to include as a partner [3]. However, both costs and risks stemming from increasing complexity are limitations of information-sharing strategies [4], and stakeholders' profits are occasionally not practical or fall short of their expectations [5,6]. Packaging is, meanwhile, an essential strategy [7], and its positive impacts are comprehensively provided through logistic processes in supply chains [8–11] and on the efficiency of manufacturing, distribution, and goods handling [12]. By contrast, offline communication is achieved with packaging, which improves communication among stakeholders [13,14] because it is normally part of the first contact between them and the product.

The purpose of this study is to explore the role of packaging as an offline method to share information in the total channel. To accomplish this objective, it is necessary to separate packaging from manufacturing and treat it as a generator of product information. For example, the handling of goods

is product information, which is sharing within stakeholders rather than manufacturing information. This distinction in information enables diverse stakeholders to assign additional information to packaging along the offline flow of goods, ranging from manufacturers to end users. This helps us to answer the research questions: What is packaging's role in the sharing of information? What information is necessary? Who shares it with whom? And to what extent is shared information helpful and effective?

This research was comprised of four sections. For the first section, we built a research framework that depicts our hypotheses. For the second section, data were collected by surveys and measured for statistical analysis. For the third section, we tested the research framework with structural equation modeling (SEM) and described our results. In the last section, we conclude and discuss our findings, their implications, and the study's limitations and recommend further research.

2. Literature Review and Hypotheses Development

Information sharing produces more profit for stakeholders [15] and increases the cooperativity of their relationships [16]. Sharable information includes necessities such as tactical, strategic, and decisive information [17]; confidential ideas, plans, and processes [18]; and general data and knowledge [19–21]. Delivery information helps manufacturers reduce overages [22] and includes product quantities, delivery type, routes, shipment rates, transportation equipment-use plans, traceability, and loading capacity [23]. Sharing of scheduling and routing improves the efficiency of delivery, rapidly meeting customers' needs [24,25]. This sharing is more profitable to customers than to raw material suppliers [26,27] and improves delivery performance with positive communication among stakeholders [28]. Traceability is particularly essential information to be shared [29]. Manufacturing information affects forwarding agents who generate the delivery information's effect on customers and covers production planning, lead time, orders, demand data/forecasts, and procurement [30,31], as well as sales volume, inspection date, price, status, delay [32,33], daily orders [34], and made-to-order items [35]. Order sharing strengthens stakeholders' relations [36], demand forecast sharing produces practical benefits [37,38], and lead time sharing helps supply chain management to be more effective [39,40]. It is not profitable, however, to share lead time without customers' needs [41]. The sharing of manufacturing information is explored with sales and operations planning [42] and with a resource-based view [43]. Based on these considerations, we formulated the following hypotheses:

H1: *Delivery information has positive effects on customers who produce customer information.*

H2: *Manufacturing information has positive effects on forwarding agents who produce delivery information.*

Packaging design is represented by an integrated management model [44], and logistics-driven packaging is identified and its strategic potential described [45] and explored for supply chain needs [46]. This makes for efficient transportation [47] and a sustainable supply chain regarding transformation aspects [48]. Its system is examined for logistical and environmental performance [49], and returnable packaging is helpful for reverse resource exchanges [50–52]. Information is shared online using information and communication technologies (ICT) [53–56]. As for manufacturers, both manufacturing and product information are produced independently. However, the two types of information play different roles within total channels. Packaging is not affected by manufacturing but, rather, they are separate from each other. Therefore, well-defined packaging information is critical to meet stakeholders' expectations and achieve efficient supply chains [57]. Its extent is examined in the secondary packaging [58] and affects consumer perceptions of labels and brand names [59–61]. The use of a food consumption database is collected differently by the contact consumer [62]. There is a difference between how males and females perceive information from healthy food packaging [63]. The choice of cosmetic creams, although they are not a food or beverage, is influenced by product composition, product information, and brand image [64]. Both the customers' demographic changes and the growth in demand for healthy food have resulted in smaller packs, information about product origin, and quality/ecofriendly certification for personal needs, influencing manufacturer behaviors.

This trend illustrates the indispensable role of packaging [65] and its promotion of competitiveness [66]. Including product information on packaging communicates that information to customers [67], shares it with other stakeholders, and helps companies' logistical and supply chain needs by using ICT [68–70]. Based on these considerations, we formulated the following hypotheses:

H3: *Manufacturing information has positive effects on packaging that produces product information.*

H4: *Customer information has positive effects on packaging that produces product information.*

The research framework was set up with the above hypotheses, which are based on results of the previous literatures, as shown in Figure 1.

Figure 1. Research framework for H1 (hypothesis 1), H2 (hypothesis 2), H3 (hypothesis 3), and H4 (hypothesis 4).

3. Research Methodology

3.1. Operational Definition of Variables

All 25 variables were divided into four latent types: manufacturing information, delivery information, customer information, and product information. The 25 observed variables were generated from manufacturers, forwarding agents, customers, and packaging. Operational definitions of all variables are shown in Table 1.

Table 1. Definitions of variables.

Latent Variables	Observed Variables	Definition
Manufacturing information	Ma1	Production planning
	Ma2	Lead time
	Ma3	Order processing
	Ma4	Rate of production
	Ma5	Defective products
	Ma6	Production cost
Delivery information	De1	Consolidation service
	De2	Delivery scheduling
	De3	Delivery type
	De4	Transport path
	De5	Traceability and confirmation of delivery

Table 1. Cont.

Latent Variables	Observed Variables	Definition
Customer information	Cu1	Age
	Cu2	Gender
	Cu3	Residence
	Cu4	Average income
	Cu5	Consumption patterns
Product information	Pr1	Origin
	Pr2	Packaging material
	Pr3	Manufacturer
	Pr4	Security indication
	Pr5	Quality certification
	Pr6	Handling of goods
	Pr7	Ecofriendly certification
	Pr8	Packing unit/size
	Pr9	Labeling and advertising

3.2. Sampling and Data Collection

To conduct this research, we designed a questionnaire (see Appendix A). Respondents were categorized into manufacturers, forwarding agents, customers, and packagers, each of which has a different role in producing information. Packagers' tasks are particularly separate from those of manufacturers because manufacturers are involved in generating information from Ma1 (production planning) to Ma6 (production cost), whereas packagers are involved from Pr1 (origin) to Pr9 (labeling and advertising). Characteristics of the respondents are shown in Table 2. We informed the questionnaire respondents of the objective of our survey on the first page. They were asked to rank the 25 variables, from De1 (consolidation service) to Cu5 (consumption patterns), on a five-point Likert-type scale ranging from 1 = "of no importance" to 5 = "of major importance." The response rate was 21.4% (240/1121).

Table 2. Respondents' characteristics.

Category	Data		Service Years	Data	
Customer	60	25.0%	More than 15	96	40.0%
Manufacturer	68	28.3%	10 to 14	116	48.3%
Forwarding agent	58	24.2%	5 to 9	28	11.7%
Packager	54	22.5%	0 to 4	0	0%

3.3. Hoelter's Critical N

Hoelter's critical N index focuses on the adequacy of the sample size rather than the model fit [71,72]. An adequate sample size is shown in Table 3. A Hoelter 0.05 value indicates that a sample size exceeding 88 is adequate, and a Hoelter 0.01 value indicates that a sample size exceeding 104 is adequate. The sample size of 240 is adequate for this research.

Table 3. Hoelter's Critical N.

Model	HOELTER 0.05	HOELTER 0.01
Default model	88	104
Independence model	15	18

3.4. Measurement of Variables

Kurtosis is more reasonable than skewness in assessing the normality of data [73]. The normality of observed variables will be rejected when each critical ratio (CR) is greater than |1.645|, the test statistic of

the one-tailed side test ($\alpha = 0.05$) [74]. Non-normal distributed variables are Ma3 (order processing), Ma4 (rate of production), Ma5 (defective products), Ma6 (production cost), De2 (delivery scheduling), De3 (delivery type), De4 (transport path), Cu3 (residence), Cu4 (average income), Cu5 (consumption patterns), Pr1 (origin), Pr2 (packaging material), Pr3 (manufacturer), Pr4 (security indication), Pr8 (packing unit/size), and Pr9 (labeling and advertising). These variables cannot be used because each critical ratio of these observed variables is greater than $|1.645|$ at $\alpha = 0.05$. Therefore, nine variables that have normality were used for the research (Ma1, Ma2 (lead time), De1, De5 (traceability and confirmation of delivery), Cu1 (age), Cu2 (gender), Pr5 (quality certification), Pr6 (handling of goods), and Pr7 (ecofriendly certification)). Multivariate normality is accepted with a multivariate kurtosis of 1.439 and $\alpha = 0.01$. The assessment of normality is shown in Table 4.

Table 4. Assessment of normality.

Variable	Min	Max	Skew	Critical Ratio (CR)	Kurtosis	Critical Ratio (CR)
Ma1	1.000	5.000	−0.630	−3.986	−0.097	−0.308
Ma2	1.000	5.000	−0.528	−3.340	−0.275	−0.869
Ma3	2.000	5.000	−0.112	−0.711	−0.690	−2.181
Ma4	1.000	5.000	−0.869	−5.496	0.770	2.436
Ma5	1.000	5.000	−0.220	−1.391	−0.703	−2.224
Ma6	1.000	5.000	0.397	2.508	−0.677	−2.139
De1	1.000	5.000	−0.547	−3.457	0.300	0.949
De2	3.000	5.000	−0.459	−2.903	−0.715	−2.260
De3	1.000	5.000	−0.377	−2.382	−0.583	−1.843
De4	1.000	5.000	−0.651	−4.118	−0.586	−1.852
De5	1.000	5.000	0.492	3.110	−0.463	−1.463
Cu1	2.000	5.000	−0.565	−3.575	−0.254	−0.802
Cu2	2.000	5.000	−0.739	−4.673	−0.104	−0.329
Cu3	1.000	5.000	−0.529	−3.346	−0.661	−2.091
Cu4	1.000	5.000	−0.487	−3.080	−0.689	−2.179
Cu5	1.000	5.000	−0.934	−5.907	0.676	2.138
Pr1	2.000	5.000	−0.081	−0.513	−0.687	−2.171
Pr2	2.000	5.000	0.086	0.545	−0.965	−3.053
Pr3	2.000	5.000	−0.431	−2.728	−0.713	−2.255
Pr4	2.000	5.000	−0.292	−1.847	−0.880	−2.781
Pr5	2.000	5.000	−0.614	−3.882	−0.050	−0.159
Pr6	1.000	5.000	−0.593	−3.752	−0.408	−1.291
Pr7	2.000	5.000	−0.435	−2.754	−0.092	−0.292
Pr8	1.000	5.000	−0.400	−2.527	−0.937	−2.963
Pr9	2.000	5.000	0.051	0.321	−0.849	−2.683
Multivariate					6.827	1.439

4. Results

4.1. Reliability and Validity

Each Cronbach's alpha of the variables is greater than 0.7, and each average variance extracted (AVE) is greater than 0.5, as shown in Table 5. Both reliability and validity are confirmed with the results. Nine observed variables were selected to explain the four latent variables of manufacturing information, delivery information, customer information, and product information. Regression weights were used: Ma1 was weighted by 0.1, De1 was weighted by 1.0, Cu1 was weighted by 0.2, and Pr6 was weighted by 0.7.

Manufacturing information is mostly explained by Ma1 (production planning) and Ma2 (lead time) of six observed variables. Delivery information is mostly explained by De1 (consolidation service) and De5 (traceability and confirmation of delivery) from five observed variables. Customer information is mostly explained by Cu1 (age) and Cu2 (gender) from five observed variables. Product information

is mostly explained by Pr5 (quality certification), Pr6 (handling of goods), and Pr7 (ecofriendly certification) from nine observed variables.

Table 5. AVE and Cronbach's alpha.

Latent Variable	Observed Var.	Non-std. Estimate	Std. Estimate	Std. Error	Variance Error	Composite Reliability	Average Variance Extracted	Critical Ratio
Manufacturing information	Ma1	0.100	0.404	-	0.972	-	0.850	0.718
	Ma2	0.309	1.240	0.141	(0.633)	2.196		
Delivery information	De1	0.480	0.589	0.106	0.483	4.508	0.582	0.700
	De5	1.000	0.904	-	0.250	-		
Customer information	Cu1	0.200	0.908	-	0.133	-	0.812	0.749
	Cu2	0.205	0.894	0.019	0.166	10.565		
Product information	Pr5	0.561	0.692	0.065	0.344	8.568	0.556	0.793
	Pr6	0.700	0.599	-	0.833	-		
	Pr7	0.715	0.912	0.105	0.104	6.783		

4.2. Correlations

The latent variables have no correlations with each other. The result of correlation analysis is shown in Table 6.

Table 6. Results of correlation analysis.

	Manufacturing Information	Delivery Information	Customer Information	Product Information
Manufacturing information	1.000	-	-	-
Delivery information	0.196	1.000	-	-
Customer information	0.075	0.381	1.000	-
Product information	0.277	0.211	0.446	1.000

4.3. Hypothesis Test

Delivery information from forwarding agents is helpful to customers [23,29]. Manufacturing information is helpful to forwarding agents [7,30,31,33] and is effective for packaging agents [9,13,14]. Packaging is positively affected by customer information such as age and gender [57,65]. Each hypothesis is accepted based on the results of the hypothesis test, as shown in Table 7.

Table 7. Results of hypothesis test ($\alpha = 0.01$).

	Hypothesis	Estimate	Std. Estimate	Std. Error	Composite Reliability	
H1	Customer $\leftarrow$ Delivery information	1.422	0.381	0.365	3.894	Accepted
H2	Forwarding agent $\leftarrow$ Manufacturing information	0.048	0.196	0.014	3.290	Accepted
H3	Packaging $\leftarrow$ Manufacturing information	0.056	0.245	0.015	3.726	Accepted
H4	Packaging $\leftarrow$ Customer information	0.109	0.428	0.020	5.376	Accepted

The fit indices were chosen using three principles [75–80]. First, the index cannot be easily changed by sample size. Second, the index can indicate the model parsimony. Third, the index cannot be easily changed with many kinds of estimations. The recommended indices depending on these principles are shown in Table 8. These indices fit the recommended threshold values. Hence, the model is acceptable. Although these indices are acceptable, the reliability and validity of the model have to be preferentially verified, as shown in Table 5.

Table 8. Results of goodness of fit.

Model	RMR	GFI	IFI	CFI	RMSEA	CMIN	DF	P	CMIN/DF
Default model	0.053	0.922	0.908	0.907	0.115	96.281	23	0.000	4.186

4.4. Effects of Relationships

Standardized coefficients have the same correlations (value 1.0) in structural equation modeling. There is no effect when a coefficient is 0.0 and there is a strong effect on the causal relationship with a high coefficient. The standardized coefficient is used to examine its relative weight among variables. Total effects are shown in Figure 2 and Table 9.

Figure 2. Results of structural equation modeling.

Table 9. Total effects.

Independent Variables	Dependent Variables	Direct Effect	Indirect Effect	Total Effect
Delivery	Manufacturer	0.196	0.000	0.196
	Customer	0.000	0.000	0.000
	Product	0.000	0.000	0.000
Customer	Manufacturer	0.000	0.075	0.075
	Delivery	0.381	0.000	0.381
	Product	0.000	0.000	0.000
Product	Manufacturer	0.245	0.032	0.277
	Delivery	0.000	0.163	0.163
	Customer	0.428	0.000	0.428

Delivery information has a direct effect (0.196) on manufacturers and no indirect effect (0.000). Customer information has an indirect effect (0.075) on manufacturers and a direct effect (0.381) on forwarding agents. Product information has both a direct effect (0.245) and an indirect effect (0.032) on manufacturers, and its total effect comes to 0.277, as well as an indirect effect (0.163) on forwarding agents and a direct effect (0.428) on customers. Based on the results, delivery information is effective for manufacturers. This appears to be based on the fact that delivery information represents observed variables like consolidation service, traceability, and confirmation of delivery. Customer information is more effective on forwarding agents than on manufacturers, giving forwarding agents the insight to consider customer information (age and gender) in primary delivery service factors. Product information is more effective on customers than on forwarding agents. Even if it is limited to Pr5, Pr6, and Pr7, this result provides deeper insight into manufacturers than forwarding agents [13,14] and customers [57,67]. This is because manufacturers play decisive roles in making product information, more strategic and more effective with by collaborating with packagers, including from Pr1 to Pr9.

5. Discussion and Conclusions

This research aimed to explore the role of packaging as an offline method to share information within the total channel, including supply chains and logistics. The four-hypotheses research framework was tested with 240 sets of data collected from respondents in the food and beverage industry in the Republic of Korea.

5.1. Findings and Implications

Based on the observed role of packaging, we found nine specific variables and the information's perceived effects on stakeholders, their directions, and relative values. This helps future researchers discuss packaging's extended role, the need for information separation, its priority for sharing, and executives' development of a packaging strategy as an offline way to share information. Findings and implication are as follows.

What is packaging's role to share information? Packaging delivers product information and shares it with stakeholders in an offline total channel. When packaging is considered as a generator of product information, it gives diverse participants ways to extend its role and assign additional information. The distinction of information helps packaging play a role in assisting online information sharing as well as the offline flow of goods from manufacturers to end users. This improves stakeholders' competitive edge and answers the next questions directly or indirectly.

Which information is necessary? To answer this, we categorized information to be shared among stakeholders into four latent variables and explained them with 25 observed variables. Only nine observed variables were chosen and used to examine the research framework because the other 16 did not show normality. Manufacturing information was represented with production planning and lead time, delivery information with consolidation service and scheduling, customer information with age and gender, and product information with quality certification, handling of goods, and ecofriendly certification.

Who shares information with whom? To answer this, it was necessary to clarify the direction of the information flow within stakeholders. For this, we introduced packaging as an offline product information generator into the research framework. This allowed us to test relations between manufacturers and packaging, packaging and customers, and manufacturers and forwarding agents. Customer information is more effective for forwarding agents than for manufacturers, and delivery information from forwarding agents is helpful to manufacturers. This gives forwarding agents the insight to consider the customer as the primary service factor. Furthermore, packaging generates more effective information for customers than for forwarding agents. This gives a deeper insight into manufacturers rather than forwarding agents as they play decisive roles in making product information more strategic and more effective with the packers' collaboration.

Finally, to what extent is shared information helpful and effective? To answer this, the research framework was composed of four hypotheses to describe information effects on stakeholders and was tested using structural equation modeling. The effects are perceived by respondents and their values are relative. In terms of total effects, they are enumerated in rank: product information to customers (0.428), customer information to forwarding agents (0.381), product information to manufacturers (0.277), delivery information to manufacturers (0.196), product information to forwarding agents (0.163), and customer information to manufacturers (0.75).

5.2. Limitations and Further Research

The 25 variables were described as sharable information and assessed for normality in statistical analysis. Nine variables were chosen as the other 16 did not show normality. It is conceivable that they might be chosen for further research and, accordingly, the factor score weights of the chosen variables were added, as listed in Appendix B. Standardized coefficients of effects were used to compare them with each other. The comparison of estimated effects could not help but be limited to the use

of standardized coefficients and to the scope of the food and beverage industry in the Republic of Korea. Non-standard coefficients of effects are listed in Appendix C. This enables future researchers to compare these results with their own future results. Both the information priority and its relative effectiveness, with additional comments, could depend on industry scope, country, and relationship levels among stakeholders.

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Appendix A

Table A1. Abridged Questionnaire.

Information (Latent)	Subinformation (Observed)	Definition	Importance				
			1	2	3	4	5
Delivery information	De1	Consolidation service					
	De2	Delivery scheduling					
	De3	Delivery type					
	De4	Transport path					
	De5	Traceability and confirmation of delivery					
Manufacturing information	Ma1	Production planning					
	Ma2	Lead time					
	Ma3	Order processing					
	Ma4	Rate of production					
	Ma5	Defective products					
	Ma6	Production cost					
Product information	Pr1	Origin					
	Pr2	Packaging material					
	Pr3	Manufacturer					
	Pr4	Security indication					
	Pr5	Quality certification					
	Pr6	Handling of goods					
	Pr7	Ecofriendly certification					
	Pr8	Packing unit/size					
	Pr9	Labeling and advertising					
Customer information	Cu1	Age					
	Cu2	Gender					
	Cu3	Residence					
	Cu4	Average income					
	Cu5	Consumption patterns					

Appendix B

Table A2. Factor Score Weights.

	Ma1	Ma2	De1	De5	Cu1	Cu2	Pr5	Pr6	Pr7
Manufacturing	−1.245	5.909	−0.094	−0.378	0.168	0.139	−0.190	−0.092	−0.799
Delivery	−0.010	0.046	0.178	0.719	0.046	0.038	−0.001	0.000	−0.002
Customer	0.012	−0.055	0.031	0.123	2.339	1.934	0.050	0.024	0.210
Product	−0.012	0.057	0.000	−0.001	0.046	0.038	0.210	0.102	0.885

Appendix C

Table A3. Non-standard Total Effects.

Independent Variables	Dependent Variables	Direct Effect	Indirect Effect	Total Effect
Delivery	Manufacturer	0.048	0.000	0.048
	Customer	0.000	0.000	0.000
	Product	0.000	0.000	0.000
Customer	Manufacturer	0.000	0.068	0.068
	Delivery	1.422	0.000	1.422
	Product	0.000	0.000	0.000
Product	Manufacturer	0.056	0.007	0.064
	Delivery	0.000	0.155	0.155
	Customer	0.109	0.000	0.109

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