INFLUENCE OF PRODUCT END OF LIFE MANAGEMENT PRACTICES ON SUPPLY CHAIN PERFORMANCE OF AGRO-BASED PROCESSING INDUSTRIES IN NAKURU COUNTY

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Abstract: **Firms find it difficult to accurately estimate reversal rate of products due to consumer characteristics, regulations and market dynamics. Reverse logistics cannot be avoided since products at the end of a supply chain always have a chance to flow backward due to products recalls and warranties. This is bound to reconfigure the supply chain as on one hand, firms may try to avoid overstocking and overproducing as this may lead to higher recall rates if the market fails to absorb the products. On the other hand, the suppliers need to be maintained by the firm either by contract or through mutual understanding As such; most have not reconfigured their supply chains to accommodate reverse flow of goods. Therefore, the main objective of this study was to establish the influence of product reversal rates of supply chain performance of Agro-based processing industries in Nakuru County. The study adopted descriptive cross sectional survey and targeted 26 agro-based firms in Nakuru County from which a sample of 84 respondents comprising the overall managements, logistics managers, sales managers, stores managers and accounts managers was derived using simple random sampling. Data was collected through questionnaires and analyzed using both descriptive and inferential statistical methods.The findings revealed that product reversal rates significantly influenced to the supply chain performance of agro-based processing industries in the area Further, it was established that product end-of-life management practices as carried out in the agro-based processing industries in the area did not significantly influence the supply chain performance of agro-based processing industries. Finally, the findings revealed that product reversal contingencies were significant to supply chain performance of agro-based processing industries in the area.**

Keywords: **Financial capacity, Preferential Public Procurement opportunities and youth groups.**

I. INTRODUCTION

The processing sector contributes substantially to the overall economic profile of Kenya. The sector accounts for approximately 10% to GDP with the bulk of goods (95%) being basic products such as food, beverages, building materials and basic chemicals- that is, agro-based products. Subsequently, the Kenya Association of Manufacturers (2014) identified agricultural produce processing firms as being the largest contributor in terms of volumes produced and employment in the industrial sector and allied sector in the country. Agricultural companies, thus, have the potential of enhancing economic growth by providing raw materials and market for produce in large quantities and qualities and being catalysts for increased production of farm produce. The Kenyan government has continued supporting the agriculture sector through various policies and programs aimed at enhancing its performance. The agriculture sector development strategy 2010-2020 intended to provide a guide for public and private sectors' efforts in overcoming the outstanding challenges facing the agricultural sector in Kenya is yet to bear fruits (GOK (2010). Besides ensuring food and nutritional

security for all Kenyans, the strategy aimed at generating higher incomes as well as employment, especially in the rural areas. Moreover, it is expected to position the agricultural sector as a key driver in achieving the 10 per cent annual economic growth rate envisaged under the economic pillar of Vision 2030 (ASDS 2010). The strategy complements other strategies put in place by the government to spur growth of the sector. It is therefore necessary that efforts were put in place to enhance performance of the agriculture sector. However, despite the relative progress in the area, the sector faces several challenges mostly emanating from environmental concerns and product marketing. For the most part, the agro-based processing sector is mainly and characterized by poor road network infrastructure and storage conditions, volatile labor resources and weak linkages to other sectors which together mean that the supply chains are generally not highly dependable (Mwatsuma et al., 2013). Only 5% of processed items, such as pharmaceuticals, are in skill-intensive activities (KIPPRA, 2013). In addition, various regulatory institutions are demanding that processing and manufacturing industries comply with several regulatory requirements (KAM, 2014). Most of these regulations deal with safe disposal of products, their containers and processing agents. Marketing conditions are also posing serious challenges as they lower the guarantee that the products will be fully absorbed into the market, therefore, necessitating reversal of products.

1. Statement of the Problem

It is becoming clear in the present business environment that reverse logistics cannot be avoided since products at the end of a supply chain always have a chance to flow backward due to products recalls and warranties. Clearly, the reversal rate of products cannot be accurately estimated due to consumer characteristics, regulations and market dynamics. This is bound to reconfigure the supply chain as on one hand, firms may try to avoid overstocking and overproducing as this may lead to higher recall rates if the market fails to absorb the products. On the other hand, the suppliers need to be maintained by the firm either by contract or through mutual understanding. Moreover, most firms' supply chains are configured in the forward direction with little or no consideration being given to reverse flow of goods. It has been shown that overlooking this aspect of the supply chain could lead to lost opportunity costs in terms of value recovery (Eltayeb et al., 2011) and consumer confidence (Langat, 2012). However, its exact impact on the supply chain performance has not been thoroughly explored. Supply chain performance is critical to the industrial sector as it among other things determines the costs and the rates at which goods will be supplied to the market. Scholars have conducted studies to relate reverse logistics with various components of organizational performance such as; environmental performance, social performance and economic performance (Amemba et al., 2013), however, there are limited studies on the effect of reverse logistics on supply chain management. In addition, most of these firms have focused extensively on the manufacturing sector and the electronic industry with little attention being given to the processing industries most of whose products are agricultural based most of which have short shelf lives and are, therefore, perishable. Therefore, the present study sought to examine the influence of reverse logistics on supply chain performance of agro-based processing industries in Nakuru County.

2. Objective of the Study

To evaluate the influence of product end of life management practices on supply chain performance of agro-based processing industries in Nakuru County

3. Research Hypotheses

In conducting the study the following hypothesis was tested

Ho: There is no significant influence of product end of life management practice on supply chain performance of agro-based processing industries in Nakuru County

II. LITERATURE REVIEW

1. Theoretical Review

Contingency Theory: Contingency theory is a class of behavioral theory that claims that there is no best way to organize a corporation, to lead a company, or to make decisions. Instead, the optimal course of action is contingent (dependent) upon the internal and external situation. Several contingency approaches were developed concurrently in the late 1960s. Historically, contingency theory has sought to formulate broad generalizations about the formal structures that are typically associated with or best fit the use of different technologies. Ireland (1983) indicates that he has used contingency theory to identify managerial actions affecting firm performance. Kelly and Fleming (1986) and Brandon (1987) have attempted to take this further and build models of the procurement system. In this study, the contingency theory draws its relevance from the fact that reverse logistics need adequate contingency planning to absorb the usually indeterminate reverse flows of products. Therefore, the theory is expected to provide insight into the contingency workings of Imported Furniture Distributing Firms.

Theory of Constrains: The second important principle involved in lean manufacturing strategy is minimizing the wastes (Campbell, 2010). According to this principle, wasteful activity which not only does not add to the significant improvement of the company but also creates inefficiency across company's process should be eliminated. Therefore, company can make efficient use of its recourses (such as land, capital and people). This principle does not necessarily mean reduction of the number of employees, processes or activities, rather using resources in appropriate manner; so waste minimization is achieved when used within the corporate regime. For instance, managers can shift employees department in which their skills are used thoroughly. Waste reduction principle can be squared with the theory of constraints (TOC) in the SCM philosophy. This theory is both descriptive and prescriptive in nature and describes the cause of system constraints as well as provides methods to resolve them (Dettmer, 1997). It suggests that with recognizing and eliminating these barriers and inefficiencies, the organization can use the high level of its resources (land, capital and people) in order to improve activities and reduce the wastes. Besides, the system theory of SCM philosophy can cover the waste reduction principle of lean manufacturing as well. It puts emphasis on the interconnected nature of operational activities in the organizations (Ashmos & Huber, 1987).

According to this theory, all organizational activities are connected with each other across organizations, so by improving one operation, all other will be improved respectively. Besides, it describes efficiencies and the role of processes across organization which makes it possible to recognize inefficiencies in order to eradicate them.

2. Empirical Review

End of life (EOL), in the context of manufacturing and product lifecycles, is the final stages of a products existence. The particular concerns of end-of-life depend on the product in question and whether the perspective is that of the manufacturer or the user (Wibowo & Grandhi, 2017). For the manufacturer, EOL concerns involve not only discontinuing production but also continuing to address the market needs that the product addresses which might lead to the development of a new product. For the business using the product, EOL concerns include disposing of the existing product responsibly, transitioning to a different product and ensuring that disruption will be minimal. End-of-life products are products that are in their last stages of existence or in the end of its useful life (Guo & Ya, 2014). The use of recoverable end-of-life products has become a popular option for organizations due to its ability to minimize the environmental impact of industry by; reusing materials, reducing energy use, and reducing the need to put end-of-life goods in dump yards (Lee, Lu & Song, 2014). Since the introduction of green energy initiatives, several countries have adopted green practices for sustainable manufacturing and recover end-of-life products by improving their supply chain processes (Lee et al., 2014). Due to consumers green awareness, strict government and local industry regulations, organizations are compelled to adopt ways to recover end-of-life products for a safer disposal or reuse (Du, Cao, Liu, Li & Chen, 2012). For example, the Australian government enforced National Product Stewardship Scheme in 2011 to demand organizations to manage their end-of-life products (Iakovou, 2009). Therefore, in order for organizations to be competitive, there is a strong need for them to develop a strategy for optimizing the reverse supply chain in order to promote efficient and effective product recovery management (Guo & Ya, 2014; Sabaghi, Mascle & Baptiste, 2016). Reverse supply chain processes usually involve the organizations to receive unused materials, goods and end-of-life products from their customers in reverse order (Xanthopoulos & Iakovou, 2009). This value-generating method promotes sustainable business practice by using some of the recycled parts for refurbishment and repairing goods and proper disposal of damaged parts.To ensure the successful implementation of reverse supply chain management, the process of evaluating the performance of recoverable end-of-life products and selecting the most suitable recoverable end-of-life products for product recovery are crucial for organizations (Meng, Lou, Peng & Prybutok, 2016). Evaluating the performance of the recoverable end-of-life products with respect to a set of specific criteria is, however, challenging. This is due to; multi-dimensional nature of the decision making process, multiple evaluation criteria, and subjective and imprecise assessments. To effectively deal with this problem, an overall performance evaluation of the recoverable end-of-life products is desirable.

III. METHODOLOGY

1. Research Design ,Target Population And Sampling

Bryman and Bell define a research design as the overall blueprint that defines how the research is to be conducted. It is about the strategies that are uses for making of key decisions in the course of the research. Various options are often available to the researcher. They include the descriptive explanatory, the exploratory, cross sectional studies, case study or longitudinal research designs. In order to select the most effective design for a given research, the most important factor to put into consideration is the objective or the purpose of the study.

2. *Research Instruments and data collection and analysis*

This study utilized two types of data: primary data and secondary data. Questionnaires were administered as the main instruments of collecting data from the respondents, that is, primary data. The main advantage of using questionnaires is that the researcher will be able to collect all the completed questionnaires within a short period of time (Kothari, 2004). They also save on time, are confidential, have increased access to populations and eliminate interviewer bias (Fowler, 1993). The questionnaires used in this study contained closed ended questions that were measurable on a Likert scale. They were divided into sections according to the research objectives. Secondary data was obtained through data collection sheets. Using this sheets, data on supply chain inventories and specifically reversed goods was captured. Reliability is the measure of the consistency of the results from the tests of the instruments. It is a measure of the degree to which a research instrument yields consistent results or data after repeated trials. Test-retest of the instruments will be done on the instruments to establish their reliability. The responses from the two administrations were then correlated using the Pearson's moment correlation formula and a correlation coefficient of 0.890 was established. According to Fraenkel and Wallen (2000), as a rule of thumb, a proposed psychometric instrument should only be used if a value of 0.70 or higher is obtained on a substantial sample. The instrument was therefore considered highly reliable for the study. The results confirmed data reliability for the independent variables and therefore they were retained .the questionnaire accepted for the study purposes. The researcher obtained an introduction letter from the school of postgraduate studies of JKUAT that was then presented to management of various youth Group for the data collection exercise. Data analysis was done with the aid of the computer software Statistical Package for Social Scientists (SPSS) version 24. Descriptive statistical measures such as, frequencies, percentages were used to give glimpse of the general trend of the data. Inferential statistics involving the use of correlation analysis were then used to determine the nature of the relationship between variables at a generally accepted conventional significant level of $P \leq 0.05$ (Gall, Borg & Gall, 2003). In addition, multiple regression analysis was employed to determine other characteristics of the variables such as the overall contribution of the independent variable to the dependent variable and also rank the variables according to the order of their importance. Multiple regression analysis was applied to analyze the relationship between dependent variable and independent variable (Sekeran, 2003). The beta (β) coefficients for each independent variable generated from the model were used to test each of the hypotheses under study. The regression model used in the study is shown below:

$Y = \beta_0 + \beta_1 X_1 + + \varepsilon$……………………………………..……………………………………….. (i)

Where;

Y= Supply Chain Performance of Agro-Based Processing Firms, β_0 =constant, $\beta_1 + \beta_3$ = weights crested from the variables (x_1, x_2, x_3) as shown below, X_1 = Product Return Rates, X_2 = Decisions on Product Recovery, X_3 = Product End-of-Life Management mX_3 = Product Reversal Contingencies, ε is the estimated error of the model that has a mean of zero at constant Variance

IV.   RESULTS AND DISCUSSIONS

1. *Response Rate and reliability test*

The high questionnaire response rate (75%) resulted from the method of administration of the instrument, which was in this case self-administered. This was acceptable according to Mugenda and Mugenda (2003). This method also ensured that the respondents' queries concerning clarity were addressed at the point of data collection; however, caution was exercised so as not to introduce bias in the process. Test-retest of the instruments was done on the instruments to establish their reliability. The responses from the two administrations were then correlated using the Pearson's moment correlation formula and a correlation coefficient of 0.890 was established. According to Fraenkel and Wallen (2000), as a rule of thumb, a proposed psychometric instrument should only be used if a value of 0.70 or higher is obtained on a substantial sample. The instrument was therefore considered highly reliable for the study.

2. *Demographic analysis*

that majority (51%) of the respondents were male although the high proportion of females indicated that a significant number of young women who are working in the firms. The results also indicate that majority (36%) of the respondents were aged between 29 – 33 years of age. Concerning the level of education, the results indicate that majority (41%) of the respondents had diplomas as their highest academic qualifications although there was also a considerable number with post graduate qualifications. Majority (44%) of employees of the firms have worked in the firms for more than two years.

3. Product end of life management practices on supply chain performance of agro-based processing industries

The third objective of the study was to evaluate the influence of product end of life management practices on supply chain performance of agro-based processing industries in Nakuru County. A 5 point Likert scale was used to rate responses of this variable and it ranged from; 1 = strongly disagree to 5 = strongly agree. The closer the mean score on each score was to 5, the more the agreement concerning the statement. A score around 2.5 would indicate uncertainty while scores significantly below 2.5 would suggest disagreement regarding the statement posed. The findings are presented in Table 1

Table1: descriptive statistics of Product end of life management practices on supply chain performance

Statement	SA Freq(%)	A Freq(%)	N Freq(%)	D Freq(%)	SD Freq(%)	Mean	Std. Dev
Product shelf lives are an important consideration we make when deciding on how to dispose of it	32(38)	42(50)	6(7)	4(5)	0	4.2	0.805
Most of the retrieved goods are often beyond their shelf lives	6(7)	13(15)	13(15)	29(35)	24(28)	2.38	0.716
We often opt to recycle products retrieved with some considerable time before expiry	22(26)	32(38)	13(16)	9(11)	8(9)	3.62	0.657
Recycling enables us to recover the value of some of the retrieved products	26(31)	29(35)	12(14)	9(11)	8(9)	3.68	0.679
Recycled products enable us to make additional revenues that offsets some operational costs	26(31)	41(49)	14(17)	3(3)	0	4.04	0.831
Our recycled goods fetch good prices in the market	12(14)	31(37)	12(14)	19(23)	10(12)	3.18	0.748
We have developed environmentally friendly waste disposal system in our company	16(19)	38(45)	17(20)	8(10)	5(6)	3.61	0.712
We are careful to abide by the regulations when disposing waste material	43(40)	46(43)	13(12)	4(4)	1(1)	4.19	0.842
Aggregate Score						3.612	0.749

It is evident from the findings in Table 1 that product shelf lives were an important consideration made by the firms when deciding on how to dispose of them (88%). However, most of the retrieved goods were not often beyond their shelf lives (63%) indicating that most firms did not retrieve expired goods. Most firms often opted to recycle products retrieved with some considerable time before expiry (64%). Recycling enables them to recover the value of some of the retrieved products (66%). Recycled products also enabled them to make an additional revenue that offsets some operational costs (80%). The recycled goods were still able to fetch good prices in the market (51%). Other findings indicate that most firms had developed environmentally friendly waste disposal systems (64%) and were careful to abide by the regulations when disposing waste materials (83%). The aggregate mean score (Mean = 3.612) suggests that most of the respondents were in agreement with the statements, hence, it is evident that product end-of-life management practices were being carried out in the agro-based processing industries in the area.

4. Supply chain performance of agro-based processing industries in Nakuru County

Finally, the study sought to determine the status of the supply chain performance of agro-based processing industries in Nakuru County. A 5 point Likert scale was used to rate responses of this variable and it ranged from; 1 = strongly disagree to 5 = strongly agree. The closer the mean score on each score was to 5, the more the agreement concerning the statement. A score around 2.5 would indicate uncertainty while scores significantly below 2.5 would suggest disagreement regarding the statement posed. Table 2 shows results of this examination.

Table 2: descriptive statistics of Supply chain performance of agro-based processing industries in Nakuru County

Statement	SA Freq(%)	A Freq(%)	N Freq(%)	D Freq(%)	SD Freq(%)	Mean	Std. Dev
Our suppliers are often notified in advance when there is variation of orders due to product reversals	9(11)	45(54)	5(6)	17(20)	8(9)	3.6	0.576
We set our supply demands along a margin determined by the estimated product reversal rates	21(25)	35(42)	17(20)	8(10)	3(3)	3.76	0.83
We have configured our supply systems to just in time type to enable us make economic quantity ordering	12(14)	31(37)	12(14)	19(23)	10(12)	3.18	0.748
Our product retrieval and recovery costs are normally within the range of the normal supplies	17(20)	39(46)	14(17)	8(9)	7(8)	3.65	0.799
Through successful product recovery, we are able to raise our profit margins substantially	15(18)	37(44)	14(17)	9(11)	8(10)	3.49	0.925
Through product reversals, we have been able to boost our customer loyalty	32(38)	42(50)	6(7)	4(5)	0	4.2	0.805
Product recovery has improved our supply chain stability	6(7)	13(15)	13(15)	29(35)	24(28)	2.38	0.716
Our company sales volumes have increased due to management of reverse logistics	19(23)	30(36)	9(11)	17(20)	8(10)	3.43	0.96
Aggregate Score						**3.461**	**0.795**

The findings in Table 2 indicate that most of the suppliers to the firm were often notified in advance whenever there was anticipated variation of orders due to product reversals (65%). The firms set their supply demands along margins determined by the estimated product reversal rates (67%). Most firms had configured their supply systems to just in time type to enable them make economic quantity ordering (51%). The firms' product retrieval and recovery costs were normally within the range of the normal supplies (66%) and through successful product recovery, they were able to raise their profit margins substantially (62%). The findings also indicate that through product reversals, most firms had been able to boost their customer loyalty (88%). However, there were doubts on whether product recovery had improved the firms' supply chain stability (63%). Nevertheless, the firms' sales volumes had increased due to management of reverse logistics (59%).

Further, the aggregate score Mean = 3.461 suggests that the supply chain performance of the agro-based processing industries was good for the most part owing to reverse logistics management

5. Correlation Analysis

In this subsection a summary of the correlation analyses is presented. It seeks to first determine the degree of interdependence of the independent variables and also show the degree and strength of their association with the dependent variable separately. These results are summarized in Table 3

Table 3: Summary of Correlations

		Product reversal rates	Product value Recovery	End-of-Life Management	Reversing Contingencies	Supply Chain Performance
End-of-Life Management	Pearson Correlation	-0.001	0.184	1		
	Sig. (2-tailed)	0.994	0.094			

	N	84	84	84	
Supply Chain Performance	Pearson Correlation	.611[**]	.408[*]	0.116	.213	1
	Sig. (2-tailed)	0	0.016	0.006	0.02	
	N	84	84	84	84	84

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

It was important to determine whether product end of life management practices significantly influenced supply chain performance of agro-based processing industries in Nakuru County. The correlation analysis in Table 3 indicates that there was indeed a significant relationship (r = 0.116, p ≤ 0.05) between the variables. The result suggests that there was a weak but significant relationship between product end of life management practices and supply chain performance of agro-based processing industries in the area which was an indication that the firms were not keen on managing their products at the end of their lives. The results are in agreement with Nyarega (2015) who established that most firms did not have end of life management systems for their products, instead the common practice among the processing firms as far as EOL management was concerned was the return of used products and packaging to suppliers for recycling.

6. Regression Analysis

Multivariate regression analysis was used to determine the multiple regression model hypothesized in chapter three held. It was also used to determine how the independent variables influenced the dependent variable collectively. The analysis was also meant to establish the extent to which each independent variable affected the dependent variable in such a collective set up and which were the more significant factors. The results are summarized in Table 4

The study used simple OLS Regression analysis. The independent variable was financial capacity and the dependent variable was Accessibility of the preferential public procurement opportunities. Univaritae regression analysis involved calculation of coefficient of determination (R^2), Analysis of Variances (ANOVA) and regression coefficients

Table 4: Linear Regression Analysis Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.712[a]	.507	.482	2.37043

a. Predictors: (Constant), End-of-Life Management

The regression analysis in Table 4 shows that the relationship between the dependent variable and all the independent variables pooled together had a model correlation coefficient = 0.712. The adjusted r-square ($R^2 = 0.507$) indicates that the model could explain upto 50.7% variations in the supply Chain performance of the agrobased firms in the area.

Table 5: Summary of ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	189.856	4	47.464	8.447	.000[b]
Residual	443.894	79	5.619		
Total	633.750	83			

a. Dependent Variable: Supply Chain Performance

b. Predictors: (Constant), End-of-Life Management Reversing Contingencies

The results of Table 5 indicate that there is a significant difference between means of variables predicting reverse logistics management and the one describing supply chain performance among agro-based firms in Nakuru County ($F_o = 8.447 > F_c = 2.50$; α < 0.05; df = 4, 79; p = 0.000). This finding confirms that the model predicted by Table 4.9 and shows it is indeed significant a result that also agrees with Choi and Zhang (2011) and Wainaina (2014) on the effect of product reversal on manufacturing firms.In order to determine which of the reverse logistics variable was more important when it came to the supply chain performance among agro-based firms in Nakuru County, the beta value was used. The results are given in Table 6 provides a summary of the multiple linear regression analysis correlation coefficients

Table 6: Coefficients^a of the Linear Regression

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.010	4.759		.473	.638
End-of-Life Management	.063	.108	.055	.557	.522

a.   Dependent Variable: Supply Chain Performance

Supply Chain Performance=2.010 + 0.063(End of life management)

It can be deduced from the findings in Table 6 that, the End-of-Life Management was not significant in the model ($\beta = 0.055$, $p = 0.522$).

The study therefore establishes that product end of life management practices, influence supply chain management in agro-based processing firms in Nakuru County.

7. *Hypothesis Tests*

H01: It is evident from the results in Table 6, it is evident that there was no significant association between the variables ($\beta = 0.055$, $p > 0.05$).This meant that we fail to accept the null hypothesis. Therefore, it can be inferred that product end of life management practices as carried out in the firms did not significantly influence supply chain performance of agro-based processing industries in Nakuru County. Similar findings were also arrived at by Xanthopoulos and Iakovou (2009) whose performance evaluation of the end-of-life products in organizations revealed that most did not have independent disposal systems and hence relied on the supplying firm to handle some of the EOL activities.

V.   CONCLUSION

1. *Conclusion*

Regarding this objective, the findings revealed that product shelf lives were an important consideration made by the firms when deciding on how to dispose of them. However, most of the retrieved goods were not often beyond their shelf lives indicating that most firms did not retrieve expired goods. Most firms often opted to recycle products retrieved with some considerable time before expiry. Recycling enables them to recover the value of some of the retrieved products. Recycled products also enabled them to make additional revenue that offsets some operational costs. The recycled goods were still able to fetch good prices in the market. Other findings indicate that most firms had developed environmentally friendly waste disposal systems and were careful to abide by the regulations when disposing waste materials. The regression results, however, revealed that product end of life management practices as carried out in the firms did not significantly influence supply chain performance of agro-based processing industries in Nakuru County.

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