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Application research of brusselator model in enterprise marketing management based on dissipative structure

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ABSTRACT

In recent years, enterprises of dissipative structure have emerged increasingly fierce competition in China and abroad. The enterprises of dissipative structure in China have recognized the current marketing management must be changed from passive to active; and the process control of marketing management needs to be strengthened, achieving marketing management with high-performance. Marketing system should be positioned to build the mechanism of information mining, analyzing and coping with the client needs. Relationship of authority and benefit at all levels should be handled rationally and scientifically. In this way, marketing management framework can coordinate the relation between marketing and services and form organic integration. This research studied and analyzed the current marketing management of enterprises with dissipative structure, and found that applying Brusslator model in enterprise marketing management with dissipative structure can improve the competitiveness of enterprises. The study also clarified the definition of enterprise positive and negative entropy and studied the logical structure of dissipative structure management entropy; established a unified system of positive and negative entropy flow indicators. The study innovatively established Brusselator model of enterprise management entropy and applied it in corporate marketing management based on dissipative structure, selecting the appropriate enterprises to do in-depth research for obtaining basic model data. This study focused on a clear concept of positive and negative entropy of enterprises based on dissipative structure and the establishment of new Brusselator model of enterprise management entropy for derived data, collecting the actual data of related corporation to verify the correctness of the model.

KEYWORDS

Enterprise marketing management; Brusselator model; Dissipative structure; Entropy theory.



INTRODUCTION

With the rapid development of society, economic, technology and information, the environment enterprises are facing is more and more complex, uncertain and difficult to grasp, how to adapt to the external environment is the key to current enterprises. Dissipative structure theory shows that different angles have different distinctions in the expansion of the concept of private capital. Private capital can be defined as all capital from the non-governmental sector in the country; the non-government capital is defined in the standard of ownership, emphasizing the property standard. This is the definition of private capital from the perspective of ownership. Since property standards can be based on ownership, it can also be based on the right to use, which is based on investors. From this perspective, private capital is all capital invested and dominated by national non-governmental sectors. Plan and implementation mechanism of marketing strategies and marketing tactics are needed. The premise of long-term sustainability of microfinance is to integrate the non-governmental private capital and invest into the business investment area. However in China, the integration of private capital is quite difficult, because people generally believe in government financial organizations^[1]. Therefore, China should develop micro-credit and actively create a positive atmosphere for business competition.

LOGICAL STRUCTURE OF CONSTITUTION AND RESEARCH TOWARDS ENTERPRISE MANAGEMENT ENTROPY

Constitution of enterprise management entropy

Entropy theory is called as "management entropy" after applying to the specific field of business management, is called, making it different from other areas. Customer value analysis and prediction: it means analyzing the contribution of the clients to bank profits by data mining; identifying customer group with high value and potential value; analyzing of the natural attributes and behavior attributes of this kind of customer group; and providing decision support for bank to distribute resources, optimize product structure and improve services^[2]. Customer buying preference analysis: it means to find the relation of the customer buying behavior through the excavation of a lot of customer information, provide customers with effective marketing strategies and value-added services according to the preferences and characteristics of customers, and achieve the efficiency and value of personal bank business marketing. Professional customer service: it means to provide all customer groups with specialized, customized, refined service and assessment of service quality and effects through the integration of the above excavation tools and discovery of new service models and methods from multi-angles and multi-levels.

Generation of positive entropy is the inevitable result of running a business. Retail industry is the main application and research area of data mining. Long-term accumulation of retail industry has created a large number of sales data, such as customer purchase records, consumer and service records and goods records. Data mining of retail industry helps dealers identify customers' purchase behavior and buying patterns; therefore it helps improve service quality and increase sales ratio of goods and reduce costs. The involved data mining techniques are: design and construction of the database based on mining techniques; multidimensional analysis on sales, customers, products, time and areas; and analysis on shopping loyalty of customers^[3].

Logic of brusselator model of enterprise management entropy

With increasingly competition, the growth pattern that Chinese commercial banks are too dependent on intermediate business income and interest margin will be unsustainable^[4]. With the continuous development of various types of financial services from Chinese commercial banks and increasing emphasis of each commercial bank on customer relationship management, how to achieve optimal matching between customer base and financial products become more urgent problem to be solved. Association rule mining technology provides effective technical means to discover potential information in the actual business data. This study selects financial customer information and financial products as research object, adopts customer - financial product association model, dig out users' purchase behavior and habits on financial products, and provides decision support information for financial products marketing department, promoting better promotion of financial service Brusselator model to make enterprises become the criterion of dissipative structures. As shown in Figure 1, in order to face the challenges described in the text and meet the needs of bank data sharing and profit-oriented service requirements, in order to compensate for the lack of mining and analysis capabilities of product sales information. The study put forwards the following system design goals: efficient customer classification: using data mining tools, collecting customer segmentation auto generated by customers' natural information, value information and behavior information. Based on the different results of client classification, the bank can effectively grasp the current situation, actively improve customer relationship management, discover and enhance customer value, provide customers with professional, personalized service, as well as provide a basis to establish Brusselator model of enterprise management entropy, making enterprises become the criterion of dissipative structure.

ESTABLISHMENT OF ENTERPRISE MANAGEMENT ENTROPY FLOW INDEX SYSTEM

Hierarchical structure of enterprise management entropy flow index system

In order to achieve enterprise management entropy calculation, the index system of enterprise management entropy must be established. Customer value analysis and prediction: it means analyzing the contribution of the clients to bank profits by data mining; identifying customer group with high value and potential value; analyzing of the natural attributes and

behavior attributes of this kind of customer group; and providing decision support for bank to distribute resources, optimize product structure and improve services. Customer buying preference analysis: it means to find the relation of the customer buying behavior through the excavation of a lot of customer information, provide customers with effective marketing strategies and value-added services according to the preferences and characteristics of customers, and achieve the efficiency and value of personal bank business marketing^[5].

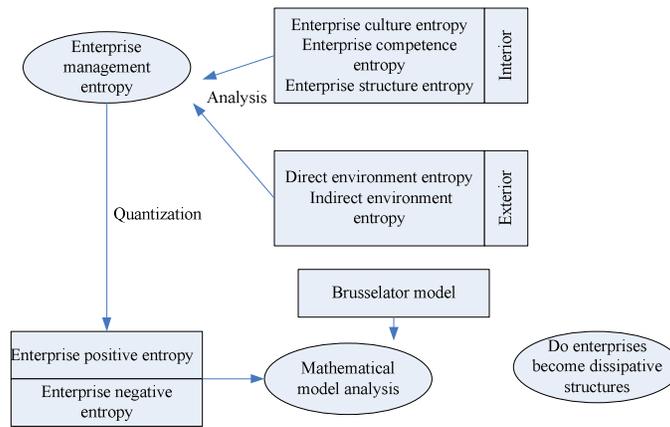


Figure 1 : Logic diagram of research on Brusselator model of enterprise management entropy

Index system of enterprise positive entropy

Enterprise is a complex life system. Retail industry is the main application and research area of data mining. Long-term accumulation of retail industry has created a large number of sales data, such as customer purchase records, consumer and service records and goods records^[6]. Data mining of retail industry helps dealers identify customers’ purchase behavior and buying patterns; therefore it helps improve service quality and increase sales ratio of goods and reduce costs^[7]. The involved data mining techniques are: design and construction of the database based on mining techniques; multidimensional analysis on sales, customers, products, time and areas; and analysis on shopping loyalty of customers. Marketing analysis system adopts traditional c / s (client / server) framework and establishes index system of enterprise positive entropy, as shown in TABLE 1.

TABLE 1 : Index system of enterprise positive entropy

Destination layer	Element layer	Variable layer	Status layer	
Enterprise positive entropy	Enterprise culture entropy	Corporate culture	Combination degree of short-term and long-term interests in enterprises Cooperative effect of brands and products Coordination degree of sensitivity and reaction on market	
		Management culture	Equity degree of enterprise Responsibility, right and benefit of enterprise decisions Work initiative and cultural quality of employees Process scientificity	
		Institutional culture	Scientificity of institutional arrangement Collaboration degree of departments Quality control	
		Enterprise competence entropy	Basic competence	Human resources management Financial control
			Core competence	Research development capacity and industry status Core product profitability Information application level
			Governance structure	Interest rationality of shareholders and enterprises Monitor effectiveness of related interest group towards senior managers
	Enterprise structure entropy	Organization structure	Coordination degree of organization structure and enterprise development Coordination degree of external partnerships	
		Capital structure	Asset-liability Ratio Financing capacity	
		Technical structure	Technical route structure rationality Research input	
			Talent structure	Position and title rationality Knowledge structure rationality

Index system of enterprise negative entropy

In fact classification analysis and cluster analysis techniques are mutually perfect in many aspects, for example: in the early data analysis, the analysts can label, divide species on data based on experience or general rule, then analyze data with the use of classification analysis, achieving general description of each class. Then analysts use these descriptions as a new set of classification to redistrict the collection, obtaining a better effect of the division in the end. Analysts can cycle use these two analysis techniques to obtain satisfactory results, customizing financial solutions for clients of banks. Retail industry is the main application and research area of data mining. Long-term accumulation of retail industry has created a large number of sales data, such as customer purchase records, consumer and service records and goods records.

Data mining technology of retail industry helps dealers identify customers' purchase behavior and buying patterns; therefore it helps improve service quality and increase sales ratio of goods and reduce costs. The involved data mining techniques are: design and construction of the database based on mining techniques; multidimensional analysis on sales, customers, products, time and areas; and analysis on shopping loyalty of customers, as shown in TABLE 2.

TABLE 2 : Index system of enterprise negative entropy

Destination layer	Element layer	Variable layer	Status layer	
Enterprise negative entropy	Direct environment entropy	Industry environment	Industry structure rationality	
			Sustainability of industry life cycle	
			Propulsive force of industry development	
		Competitive environment	Competition normalization	
			Rationality of competition intensity	
		Technical environment	Industry R&D investment level	
			Transformation of industry-university-research cooperation	
			Innovation support	
	Indirect environment entropy		Economic environment	Rationality of financing environment
				Degree of social needs integrity of market mechanism
		Political environment	Policy stability and sustainability	
			Opening up degree Law integrity	
		Cultural environment	Quality level of consumer groups	
		Consumption level of consumer groups		

The index proportion is as follows:

$$P_{Aij} = \frac{x_{Aij}}{\sum_{j=1}^5 x_{Aij}}, (i=1,2,\dots,25) \tag{1}$$

Evaluation index entropy is as follows:

$$e_{Ai} = -\frac{1}{\ln 5} \sum_{j=1}^5 p_{ij} \ln p_{ij}, (i=1,2,\dots,25) \tag{2}$$

Index diversity factor are as follows:

$$g_{Ai} = 1 - e_{Ai} \tag{3}$$

Item I index weight are as follows:

$$\lambda_{Ai} = \frac{g_{Ai}}{\sum_{i=1}^{25} g_{Ai}} \tag{4}$$

Positive entropy is as follows:

$$A = E_A = \sum_{i=1}^{25} \lambda_{A_i} e_{A_i} \quad (5)$$

According to index system of negative entropy (as shown in TABLE 2), indicator ratio is as follows:

$$p_{Bij} = \frac{x_{Bij}}{\sum_{j=1}^5 x_{Bij}}, \quad (i=1,2,\dots,16) \quad (6)$$

BRUSSELATOR MODEL IN ENTERPRISE MARKETING MANAGEMENT BASED ON DISSIPATIVE STRUCTURE

Relation and applicability between Brusselator model and dissipative structure

There are two kinds of entropy within enterprise organizations, positive entropy and negative entropy. Customer value analysis and prediction: it means analyzing the contribution of the clients to bank profits by data mining; identifying customer group with high value and potential value; analyzing of the natural attributes and behavior attributes of this kind of customer group; and providing decision support for bank to distribute resources, optimize product structure and improve services. Customer buying preference analysis: it means to find the relation of the customer buying behavior through the excavation of a lot of customer information, provide customers with effective marketing strategies and value-added services according to the preferences and characteristics of customers, and achieve the efficiency and value of personal bank business marketing. Professional customer service: it means to provide all customer groups with specialized, customized, refined service and assessment of service quality and effects through the integration of the above excavation tools and discovery of new service models and methods from multi-angles and multi-levels.

Fundamental form of brusselator model

Brusselator model suggested by Prigogine is as shown in formula 7 - 10



In formula: A, B(The initial reactant);

D, E-stay the same;

X, Y-time variable concentration.

Brusselator dynamical model equation is as follows:

$$\frac{dX}{dt} = A + X^2Y - BY - X \quad (11)$$

$$\frac{dY}{dt} = BX - X^2Y \quad (12)$$

The only uniform steady-state solution in this equation :

$$X_0 = A, Y_0 = \frac{B}{A} \quad (13)$$

Connotation of brusselator model

Now, "Brussels" model will be escaped. However, China's economic development is still mainly based on government support to promote economic development. Accelerated development of macro economy and the current social consumption in China are disproportionate, causing anxieties of certain people on Chinese economic structure. The disproportionate development can easily cause economic inflation pressures, while China's macroeconomic policy is more focused on monetary tightening, so there have been conflicts between national policies and the development of SMEs. Embodied form of this contradiction is the recovering economy. However, in the background of economic crisis, macroeconomic policies carried out by China are moderate tight monetary policy in the form of economic recovery trend. Therefore the bank loan amount on the national government level is reduced; the high demand of funds and the amount of loan formed a relatively big contradiction. In the background of economic crisis, the majority of SMEs is in trouble, they lack support from government and cannot extricate themselves from the predicament of development. Therefore it is necessary to look for other ways to promote the business operation. At present, the concordant injection of private capital becomes more urgent. It provides funding to enable the normal operation of SMEs to some extent, thus survive the economic crisis. For now, the private capital of credit industry can ease the contradiction between national policies and development of SMEs. Large commercial banks equity structure table is shown in TABLE 3.

The article has already mentioned that the contradiction between national policy and enterprise development can be solved through fund investment, but the source of funds is a major problem. Generally, the funds should come from loan from banks, but under the control of national policy, the loan amount is limited now. So now part of the funds comes from the international fluid capital in some enterprises, the fund injection can bring life to enterprises. However, it is short-term investment and it entered financial market through non-formal channels, once it obtain profits and reach the purpose of short-term returns, they will quickly withdraw funds. Therefore the enterprise will face an awkward position, leaving a very negative impact on the development of enterprises. Due to lack of funds, the enterprise will again introduce international fluid capital. And then repeat the withdrawal of funds, the introduction of capital, so that the business development will lead to a vicious cycle. It will seriously disturb monetary policy in China, resulting in the malicious impact on the national economy. For economic development under the background of economic crisis, this is undoubtedly worse. On the other hand, the integration of private capital can better promote a more stable development of enterprises. And in terms of present situation of China, private capital amount is relatively large. It can effectively solve the financing problems of SMEs; can bring some development prospects for private credit on the basis of solving fund raising problem of enterprise development. It can also avoid vicious circle international hot money brings. While Brusselator model exactly provides mathematical conditions, analytical methods and models for researchers to study relationship between enterprise positive and negative entropy

Enterprises have become the criterion of dissipative structure

According to equations and inferences of Brusselator model, private capital investment can also effectively use nongovernmental private idle funds, and integrate relatively large amounts. If this part of funds can be effectively utilized and then used as credit capital, it can not only promote the development of SMEs, make them rapidly seize the opportunity to grow, get rid of the problems caused by the economic crisis, but also activate the fund to make more people benefits, contributing to the local economy rebounds, as well as helping the local economy break loose from the negative impact of the economic crisis. This approach has seen significant effect in some places, as shown in formula 14.

$$|B| - (1 + A^2) \begin{cases} > 0, & \text{Enterprises become dissipative structures} \\ = 0, & \text{Enterprises are in critical state} \\ < 0, & \text{Enterprises become non-dissipative structures} \end{cases} \quad (14)$$

This part of the funds is idled before invested in the credit industry. The funds after integration can not only promote the development of SMEs, make them rapidly seize the opportunity to grow, get rid of the problems caused by the economic crisis, but also activate the fund to make more people benefits, contributing to the local economy rebounds, as well as helping the local economy break loose from the negative impact of the economic crisis. This approach has seen significant effect in some places. After obtaining enterprise positive and negative entropy, put the results into formula 14 for comparison, then enterprises can be determined whether becoming dissipative structures according to criterion. TABLE 3 shows the fundamental data of enterprise positive entropy. TABLE 4 shows the fundamental data of enterprise negative entropy.

According to the results from TABLE 3 and TABLE 4, it is known that the positive entropy of AAA enterprise is 0.3895, the negative entropy is $0.99251 + A_2 = 1 + (0.3895)^2 = 1.1517$, obtaining the below formula:

$$|B| < 1 + A^2 \quad (15)$$

TABLE 3 : Fundamental data of enterprise positive entropy

	A	B	C	D	E
X_1	3	19	16	8	3
X_2	4	18	16	9	2
X_3	5	16	17	8	3
X_4	4	19	16	7	3
X_5	6	19	13	10	1
X_6	5	20	15	9	0
X_7	8	17	14	10	0
X_8	5	17	15	10	2
X_9	5	19	14	10	1
X_{10}	5	19	13	9	3
X_{11}	5	15	16	11	2
X_{12}	5	20	15	9	0
X_{13}	4	15	19	9	2
X_{14}	4	17	19	7	2
X_{15}	4	21	14	9	1
X_{16}	4	18	19	5	3
X_{17}	7	16	16	8	2
X_{18}	6	15	15	11	2
X_{19}	5	18	14	11	1
X_{20}	5	18	16	9	1
X_{21}	5	17	17	8	2
X_{22}	4	20	15	10	0
X_{23}	5	21	15	8	0
X_{24}	4	20	16	6	3
X_{25}	4	20	15	7	3

TABLE 4 : Fundamental data of enterprise negative entropy

	A	B	C	D	E
X_1	5	17	15	10	2
X_2	5	19	14	10	1
X_3	5	19	13	9	3
X_4	5	21	13	10	0
X_5	4	19	19	7	0
X_6	4	19	13	10	3
X_7	3	20	15	9	2
X_8	4	17	18	10	0
X_9	7	15	16	11	0
X_{10}	1	20	15	9	4
X_{11}	6	15	19	9	0
X_{12}	4	19	18	8	0
X_{13}	8	15	15	11	0
X_{14}	6	18	16	9	0
X_{15}	4	19	14	10	2
X_{16}	6	19	13	9	2

CONCLUSION

The study deeply analyzed the marketing management of enterprises based on dissipative structure, and found that the application of Brusselator model in enterprise marketing management based on dissipative structure can improve the enterprise competitiveness. The research also clarified the definition of enterprise positive and negative entropy; studied the logical structure of management entropy of dissipative structure; established a unified index system of positive and negative entropy. The article innovatively established Brusselator model of enterprise management entropy and effectively applied into enterprise marketing management, selecting the appropriate enterprises to do in-depth research for obtaining basic model data.

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