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Study of Multi-source Fusion B2C Business Process Reengineering of the Petri net Model

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Abstract

In order to fuse a multi-source B2C E-commerce system, this paper implements a new multi-source fusion B2C mode business system application development, which can provide customers with efficient and reliable comparison and cross-platform business system of choose and buy goods. By analyzing the Multi-source fusion B2C E-commerce system demand of business process reengineering and Petri net theory, the B2C electronic commerce system of multi-source fusion structure is proposed, graphical workflow modeling methods is adopted, the multi-source fusion of B2C business process reengineering Petri model is established, with the help of CPNtool simulation system and the establishment of correlation matrix analysis of the model. The experimental simulation analysis and output of experimental reports indicate that the business processes are properly designed, no deadlocks node exist at runtime, accessibility meets which provides the reference model for the development of multi-source fusion of B2C electronic commerce system.

Keywords: *electronic commerce, petri net model, B2C, business process reengineering*

1. Introduction

With the continuous development of computer technology and network, more and more enterprises in order to realize the management and marketing, the form of electronic commerce is started to use. Enterprise to consumer business model has become the main patterns for e-business. B2C (Business to Customer) E-commerce mode refers to marketing on consumer groups using the Internet for all the trade activities, which will realize the information flow, cash flow, business flow and part of the logistics completely connection online. At present, each big as successful B2C E-commerce enterprises, respectively built independent business systems, which have their own advantages and disadvantages, and can satisfy the users on the same system of commodity price and demand of choose and buy goods, but it is lack of a set of integrated commodities price comparison and buying of multi-source fusion of B2C E-commerce system. Multi-source fusion B2C platform will be the success of B2C E-commerce platform through which fuses multi-source fusion algorithm. A unified system of B2C E-commerce is integrated, and business process is reengineered to provide customers with efficient and reliable comparison and selection function. Multi-source fusion B2C electronic commerce system can provide a unified business platform for users, improve the efficiency of the user network shopping, and realize truly one-stop service.

Petri net is combinations of model presented by a graphical representation, with the advantages of intuitive, easy-to-understand and easy-to-use, and it has its own knack in description and analysis. Meanwhile, Petri net is strictly defined as mathematical object. It could not only be used for static structural analysis, but also for the dynamic behavior analysis by means of mathematical analysis methods and techniques, and has the flexible modeling ability and system performance analysis skill. Therefore, the use of Petri net workflow model makes it more convenient and intuitive than the traditional flowchart [1, 2]. It can also through the construction of input, output, and the correlation matrix of the necessary verification to realize the proposed model. The system modeling plays a crucial role in system development, through the establishment of the B2C business process reengineering model of multi-source fusion, Multi-source fusion B2C E-commerce system could be accessed and analyzed in pre-

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development to ensure the quality of the system, to effectively improve the reliability and the feasibility of the system and to reduce the cost of system development.

2. Petri Net Summary

Petri net, the combinations of model presented by a graphical representation, is invented in 1960 by CA Petri. It is used to describe distributed system, and it can describe the structure of the system and perform simulation. It is widely used in software design, workflow management, data analysis, workflow patterns, parallel programming, protocol verification, and other fields, and also be used for concurrent processing of multiple event description and analysis of dynamic systems. Photography represents the conditions in the systems, resources, and information or the like can be statically expressed. Changes represent the event of changes in the system, contain dynamic expressions such as the state changes, the changes in conditions of the flow of information, and resource consumption and production. At the same time, Petri net contains execution control mechanism, describes the dynamic behavior of the system through the change of excitation and tokens mobile [3-5]. The description of the system structure is called the network (net).

The basic definition is:

Triple $N=(P,T,F)$ is called a directed net [3] in which,

(1) $P\cap T=\phi$;

(2) $P\cup T\neq\phi$;

(3) $F\subseteq P\times T\cup T\times P$

("×" is Cartesian product);

(4) $dom(F)\cup cod(F)=P\cup T$ in which,

$dom(F)=\{x\mid\exists y:(x,y)\in F\}$

$dom(F)=\{x\mid\exists x:(x,y)\in F\}$

This model sextuple $\sum=(P,T,F,K,W,M)$ is called library/transition system [3, 5], there into, $P=(P_1,P_2,\cdots P_j)$ presents finite set of place; $T=(T_1,T_2,\cdots T_i)$ presents finite set of transition.

F is input function, which define the weight set of directed arc from P to T.

1) (P,T,F) is a net, $W:F\rightarrow\{1,2,3\cdots\}$ is called weighted function

$K:P\rightarrow\{1,2,3\cdots\}$ is called capacity function

$M:P\rightarrow\{0,1,2\cdots\}$ is a tag of $\sum$,

Satisfies $\forall_p\in p:M(p)\geq K(p,t)$

2) $\sum$ satisfies transition occurrence rules

a) *For* $t\in T$, $M[t>$ *condition*

$\forall_p\in t$: $M(p)\geq W(p,t)$

$\forall_p\in t-t$: $M(P)+W(t,p)\leq K(p)$

$\forall_p\in t\cap t$: $M(P)+W(t,p)-W(p,t)\leq K(p)$

b) *If* $M[t>M'$, *then* $\forall_p\in P$

$M(p)-W(p,t)$, *if* $s\in{}^{\cdot}t-t^{\cdot}$

$M(p)+W(p,t)$, *if* $s\in t^{\cdot}-{}^{\cdot}t$

$M(P)+W(t,p)-W(p,t)$, *if* $t\in{}^{\cdot}t\cap t^{\cdot}$

$M(s)$, *others*

3. Multi-source Fusion of B2C Business Architecture

Based on the multi-source information fusion theory, a multi-source information fusion of B2C business architecture is built, the individual business platform for the integration of multi-

source integrated on a unified business platform. The system structure of Multi-source fusion B2C E-commerce is as shown in Figure 1.

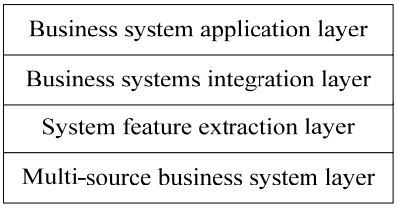

Figure 1. Multi-source Fusion of B2C Business Architecture

In this architecture, multiple source business system layer includes the enterprise's business systems (e.g., dangdang, jingdong mall Su Ningyi purchase, gome mall, new egg, etc.), and mature systems feature extraction layer. Use the information fusion method to extract the multi-source business system layer in all the characteristics of the system, provide support for the fusion layer; Business system integration layer should mainly according to the system feature extraction extract all the characteristics of the system, optimize the multiple business system integration; Business system application layer provides a multi-source fusion of business platform, to provide users across the business in the unified platform system, the function of the choose and buy goods [2, 6, 7].

4. Multi-source Fusion B2C Business Process Reengineering Model

4.1. Establish the Multi-source Fusion B2C Business Process Reengineering Petri Net Model

The B2C business process reengineering of multi-source fusion model is established based on Petri net theory and multi-source fusion of B2C business architecture, and it mainly includes two steps as follows.

4.1.1. Structured Modeling

The analysis of multi-source fusion of business reengineering process is achieved by the top-down, constantly iterative approaches, multi-source fusion B2C business process reengineering of the Petri net model is built, and the multi-source fusion B2C E-commerce system library and the table of change meaning are listed. In the modeling process, multi-source fusion of B2C E-commerce system business process has been simulated through the B2C business process optimization and reengineering. Then, Multi-source fusion B2C business process reengineering of the Petri net model has been simulated by the use of simulation tools WinTTPN [8, 9].

4.1.2. Analysis and Validation of Model.

By the use of multi-source fusion B2C business process reengineering of the Petri net model, in the previous step, obtain input, output, and the associated matrix of the system model, and necessarily verify the transition firing sequence and arrival probability for the system state, current state or requested state, conservation conditions, accessibility and rationality to make the necessary validation.

Through the above theory, the B2C E-commerce system of multi-source fusion front and backend resources integration and business process optimization and reengineering, price comparison and cross-platform of valid and reliable function of choose and buy goods, firstly establish each node which determines multi-source fusion of B2C business process reengineering model, and show a Petri net modeling library and the table of basic meaning and transition. Multi-source fusion B2C business process reengineering of the Petri net model library and meaning change are as shown in Table 1 and Table 2 respectively.

Table 1. Place Meaning Table

Place	Meaning	Place	Meaning
P1	user	P6	Shopping cart
P2	B2C E-commerce system	P7	Payment module
P3	Price comparison module	P8	merchants
P4	Commodity information	P9	Logistics module
P5	Inventory sufficient merchants	P10	Evaluation module

Table 2. Transition Meaning Table

Transition	Meaning	Transition	Meaning
T1	Register Login	T7	Online payment
T2	Search products	T8	Order confirmation
T3	Commodity price comparison	T9	Logistics distribution
T4	Check Stock	T10	Goods receipt
T5	Select businesses	T11	Goods evaluation
T6	Submit orders	T12	After-sales service

Multi-source integration the B2C business process reengineering Petri net model is as shown in Figure 2.

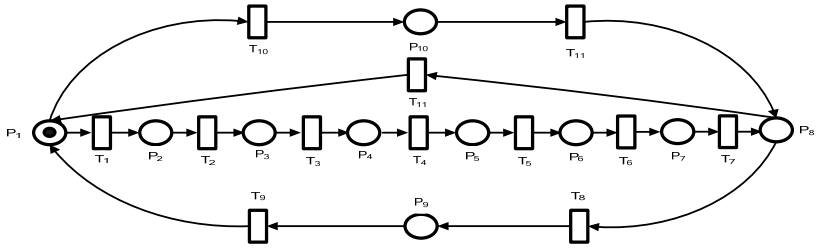

Figure 2. Multi-source Fusion B2C Business Process Reengineering of the Petri Net Model Diagram

4.2. Petri Model Analysis

In order to analyze research of conservation and accessibility multi-source fusion of B2C business process reengineering Petri net model by the use of the matrix equation, first create a matrix equation, use two matrix equations A^- and A^+ to show flow relationship in the Petri net. Matrix A^- input matrix shows the relationship with the input position, the output matrix A^+ represents the relationship with the output position, and the associated matrix $A = A^+ - A^-$ [3, 4, 10].

4.2.1. Petri Net Conservation Condition Analysis

If and only if there is a positive right vector W , $A \cdot W = 0$.

4.2.2. Petri Net Accessibility Analysis

Suppose a mark M' is available from M , then there is a transfer of ignition sequence $\cdot M$ make identification from M' to M , $M' = M + X \cdot A$

According to the rules above, based on the Multi-source fusion B2C business process reengineering of the Petri net model built above, it can find out the input matrix A^- , output matrix A^+ and associated matrix A , respectively is:

$$A^{+}[j,i]=W(t_j,p_i)=\begin{bmatrix}0&1&0&0&0&0&0&0&0&0\\0&0&1&0&0&0&0&0&0&0\\0&0&0&1&0&0&0&0&0&0\\0&0&0&0&1&0&0&0&0&0\\0&0&0&0&0&1&0&0&0&0\\0&0&0&0&0&0&1&0&0&0\\0&0&0&0&0&0&0&1&0&0\\0&0&0&0&0&0&0&0&1&0\\1&0&0&0&0&0&0&0&0&0\\0&0&0&0&0&0&0&0&0&1\\0&0&0&0&0&0&0&1&0&0\\1&0&0&0&0&0&0&0&0&0\end{bmatrix}$$

$$A^{-}[i,j]=W(p_i,t_j)=\begin{bmatrix}1&0&0&0&0&0&0&0&0&0\\0&1&0&0&0&0&0&0&0&0\\0&0&1&0&0&0&0&0&0&0\\0&0&0&1&0&0&0&0&0&0\\0&0&0&0&1&0&0&0&0&0\\0&0&0&0&0&1&0&0&0&0\\0&0&0&0&0&0&1&0&0&0\\0&0&0&0&0&0&0&1&0&0\\0&0&0&0&0&0&0&0&1&0\\1&0&0&0&0&0&0&0&0&0\\0&0&0&0&0&0&0&0&0&1\\0&0&0&0&0&0&0&1&0&0\end{bmatrix}$$

$$A=A^{+}-A^{-}=\begin{bmatrix}-1&1&0&0&0&0&0&0&0&0\\0&-1&1&0&0&0&0&0&0&0\\0&0&-1&1&0&0&0&0&0&0\\0&0&0&-1&1&0&0&0&0&0\\0&0&0&0&-1&1&0&0&0&0\\0&0&0&0&0&-1&1&0&0&0\\0&0&0&0&0&0&-1&1&0&0\\0&0&0&0&0&0&0&-1&1&0\\1&0&0&0&0&0&0&0&-1&0\\-1&0&0&0&0&0&0&0&0&1\\0&0&0&0&0&0&0&1&0&-1\\1&0&0&0&0&0&0&-1&0&0\end{bmatrix}$$

Analysis of the network implementation: based on static characteristics Petri net system in a given network, and then define the conditions and consequences of shift, the dynamic network operation can be described. But if the dynamic execution is conducted, it must make sure that M_0 must have ignition of transfer of concession, the distribution of token is taken in the network, so that the net turn to a new state, when there is no transfer of concession, stop the implementation process [11, 12].

The Petri net starting identification is $M_0=(1,0,0,0,0,0,0,0,0,0)$

First to determine Petri net is ready to ignite.

$T_1: {}^{\cdot}T_1=\{P_1\}$

$M(P_1)=1=W(P_1,T_1)=1$

$T_1^{'} = \{P_2\}$

$M(P_2) + W(T_1, P_2) = 0 + 1 = 1 = K(P_2)$

So T_1 has concession.

T_{10}: $T_{10} = \{P_1\}$

$M(P_1) = 1 = W(P_1, T_{10}) = 1$

$T_{10}^{'} = \{P_{10}\}$

$M(P_{10}) + W(T_{10}, P_{10}) = 0 + 1 = 1 = K(P_{10})$

So T_{10} has concession.

T_2: $T_2 = \{P_2\}$

$M(P_2) = 0 < W(P_2, T_2) = 1$

So T_2 has no concession, the reason is lack of resources.

In the same way, $T_3, T_4, T_5, T_6, T_7, T_8, T_9, T_{11}, T_{12}$ have no concession, the reason is lack of resources.

Through the judgment, T_1 and T_{10} have concession, then Calculated separately ignition of identification $M^{'}$.

T_1:

$$M_1^{'} = M_0 + F_1[\cdot] \cdot A = (1,0,0,0,0,0,0,0,0,0) +$$
$$(1,0,0,0,0,0,0,0,0,0,0) \cdot A$$
$$= (1,0,0,0,0,0,0,0,0,0) + (-1,1,0,0,0,0,0,0,0,0)$$
$$= (0,1,0,0,0,0,0,0,0,0)$$

T_{10}:

$$M_2^{'} = M_0 + F_2[\cdot] \cdot A = (1,0,0,0,0,0,0,0,0,0) +$$
$$(0,0,0,0,0,0,0,0,0,1,0,0) \cdot A$$
$$= (1,0,0,0,0,0,0,0,0,0) + (-1,0,0,0,0,0,0,0,0,1)$$
$$= (0,0,0,0,0,0,0,0,0,1)$$

New state $M_1^{'}$ user login successful B2C system, multi-source fusion P_2 receive access token. New state $M_2^{'}$ users complete cross-platform commodity evaluation, P_{10} tokens. With the help of incidence matrix and reachable analysis, state after changes meets the expected goals, which prove the Multi-source fusion B2C business process reengineering of the Petri net model is effective.

According to correlation matrix analysis and the established to figure known multi-source fusion of B2C business process reengineering Petri net model satisfies the requirement of workflow accessibility, it can satisfy the multi-source fusion of B2C business process reengineering needs, and provide efficient and reliable comparison and new mode of cross-platform functionality of choose and buy goods.

4.2.3. Experiment Simulation

Petri net system simulation tools can be applied in order to improve the efficiency and intuitive of the verification of the system Petri net. CPNTools complete system model is implemented. Input the established Multi-source fusion B2C business process reengineering of the Petri net model to CPNTools tools for simulation analysis, the output system simulation lab report is shown in Figure 3.

Figure 3 CPNTools simulation output report shows that the established multi-source fusion B2C business process reengineering of the Petri net model of business process design is reasonable, the system is operating normally, there is no deadlock node.

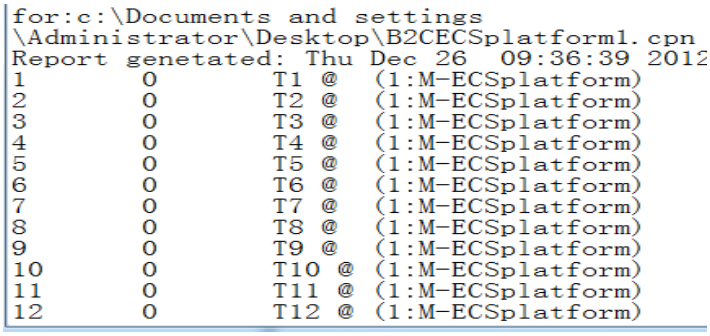

Figure 3. CPNTools Simulation Output Report

5. Conclusion

Based on multi-source fusion theory, this paper put forward a new multi-source fusion of B2C E-commerce mode. The Petri net modeling method of system and system simulation software CPNTools are adopted, multi-source fusion B2C business process reengineering of the Petri net model is established. Through the associated matrix and accessibility analysis, state after changes meets the expected goals, which proves the Petri net model is effective and reachable. By observation of the system model simulation process, rational analysis, and the analysis of simulation experiments report, no deadlock nodes exist in the process of system operation, and business process design is reasonable. The model optimization and reengineering the B2C business process of multi-source fusion, fusion of multi-source of B2C E-commerce system development before the evaluation and analysis, to ensure the quality of the system, but also can effectively improve the reliability and feasibility of the system, to reduce the cost of system development.

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