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Logistics Data Exchange for the EDI Customs Clearance System based on XML

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Abstract: Because of the disconnection between the Logistics services trading platform and the EDI customs clearance system, the logistics clearance data needed to be gathered manually, and the efficiency of customs clearance was rather low. In view of this problem, a logistics data exchange method based on the XML technology was proposed, which firstly achieved the batch extraction and conversion of the logistics clearance data that came from the Logistics services trading platform. Then, the data was transferred to the customs broker. Finally, the data was parsed by deserialization and submitted to the EDI customs clearance system automatically. The logistics data exchange method achieved the connection between the logistics services trading platform and the EDI customs clearance system, and raised the efficiency of customs clearance.

Keywords: the logistics clearance data, exchange of data, the EDI customs clearance system

1. INTRODUCTION

With the development of logistics informatization [1], the logistics service trading platform plays an increasingly important role in the port logistics to promote the prosperity of port import and export trade [2]. However, the goods customs clearance efficiency may become the obstacle to the development of port logistics [3]. According to the current policy, the EDI customs clearance systems, which has not realized the data connection with logistics professional service trading platform to receive logistics customs data , is only used for the customs clearance enterprises with the customs certificate. And the data are discrete to be extracted difficulty in the trading platform with layered structure [4]. Because of the structural difference between the trading platform and customs clearance system and the absolute security needs, there is a limitation in the data exchanging and transferring [5] relate to the clearance's logistics data can only be collected by the manual way, which leads to the high error rate, long clearance cycle and other issues [6].

To solve these questions, this paper researched how to extract and transfer logistics clearance data in heterogeneous systems. Therefore, the data exchange method based on XML [7] was put forward to achieve logistics customs clearance data batch extraction from the business trading platform, transformation and security transmittal to the customs clearance enterprise. At the same time, through the way of anti-serialization[8,9], the logistics data of customs enterprises were automatically submitted to the customs EDI clearance system, which realizes the seamless connection between the logistics service trading platform and the EDI customs clearance system to improve the efficiency of customs clearance.

2. RESEARCH OF DATA EXCHANGE METHOD

Data sources of data exchange method come from the logistics service trading platform. The platform includes all kinds of logistics services, such as transportation, commodities trading, warehousing, customs clearance and others, each of that has a corresponding transaction process. Because every user may play multiple roles in the platform, the different service transaction processes can be in series, which causes considerable intricacy and high discreteness in server data store process and low efficiency during extracting

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customs data directly from the server. Therefore, this paper chose SgmlReader [10] in the C # to parse trading related presentation layer, converting its structure into format specification. At the same time, the SgmlReader would read the node values in the structures to achieve batch extraction of data and automatically transfer data to the customs clearance enterprise after these data had been transformed into XML as a collection [11,12]. Finally, the XML document would be converted to SQL data and submitted to customs clearance system.

2.1 The extraction method of logistics customs clearance data

There are a wide range of logistics services transaction processes in the platform of logistics service trade. The trading processes which are different services can be connected in series, resulting in an uncertain data storage position and low extracting efficiency. E.g. the platform customers may experience the trading process which includes commodity, transportation and customs clearance, and they will find that some customs data may be stored in other processes when they import a batch of goods. Therefore, it is not able to complete querying all customs clearance data only through the customs clearance process, and it make inquiries task more onerous and difficult through traversing all the logistics data of transaction processes in the data layer. On the method of data query, M. Mansoori put forward the viewpoint of data set resource [13]. In order to achieve the batch extraction of platform logistics customs data, this paper created the following data models to improve the efficiency of data extraction.

What may be connected in series with the clearance process are commodity trading process and transport process. This paper introduced a concept of object data set and numerical data set:

Object data set: elements are the object names, such as clearance port, the mode of transportation, transportation, etc.

Numerical data set: elements are the values of object, such as Guangxi Dongxing, river and sea transport, shipping, etc. Object data set and numerical data values both are ordered set, and there are corresponding relationships among their elements.

This paper defined the object data set, numerical data set, customs clearance object data sets and customs clearance numerical data of commodities trading process as *S*, *Si*, *R*, *Ri*, defined the object data set, numerical data set, customs clearance object data sets and customs clearance numerical data of transport transaction process as *Q*、*Qi*、*P*、*Pi* ,defined the object data set, numerical data set, customs clearance of customs clearance transaction process as *A*、*Ai*、*C*、*Ci* . defined the target object data set and the target numerical data set as *B*、*Bi* . Known that the contract number is *xi*, and the number of bill of lading is *yi*, this paper created object data set *Z* as elements of the all objects on customs clearance. The data extraction model (figure 1), which is the extraction of *B* and *Bi* from the platform transaction process.

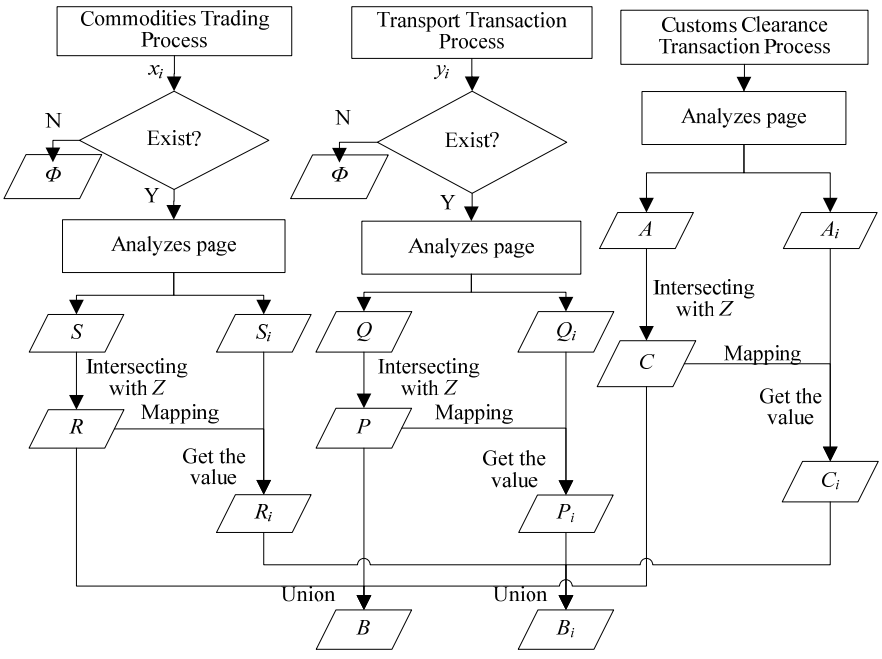


Figure 1. The data extraction model

(1) To determine whether commodities trading process exists on the platform through the known conditions xi, if any, use the class SgmlReader to analyze page of the commodities trading process and extract the object data set S and the numerical data set Si . S and Si can respectively be expressed as:

$$S = \{s_e : e \in [1, m]\} \quad (1)$$

$$S_i = \{s_{ie} : e \in [1, m]\} \quad (2)$$

The elements' positions of two data sets are corresponding, and elements of Si are the values of the elements of S. Otherwise, make it directly as an empty set.

(2) Getting the customs information object data set R which contained in the commodity transaction process from the intersection between the object data sets S and customs clearance data set Z, i.e. $R = S \bigcap Z$, which can be illustrated as:

$$R = \{R_e : e \in [1, m]\} \quad (3)$$

(3) Querying the value of the R elements by the mapping relationship between S and Si, getting the customs information numerical data set Ri which contained in the commodity transaction process, is represented as:

$$R_{\mathrm{i}} = \{R_{ie} : e \in [1, m]\} \quad (4)$$

(4) Querying the transport transaction process through the dataset Ri from last step and the known condition yi, then getting the dataset Q of customs information object and the dataset Qi of customs information numerical value.

$$Q = \{Q_e : e \in [1, m]\} \quad (5)$$

$$Q_{\mathrm{i}} = \{Q_{ie} : e \in [1, m]\} \quad (6)$$

(5) Since the existence of customs transactions, the object dataset C and the numerical dataset Ci of the customs information included in the customs transactions can be acquired directly according to the method above, the dataset represented as:

$$C = \{C_e : e \in [1, m]\} \quad (7)$$

$$C_{\mathrm{i}} = \{C_{ie} : e \in [1, m]\} \quad (8)$$

(6)The dataset B of goal structure was acquired through the union set of R、P and C, i.e. $B = R \bigcup P \bigcup C$, it can be expressed as:

$$B = \{B_e : e \in [1, m]\} \quad (9)$$

And the dataset Bi of target object was acquired through the union set of Ri, Pi and Ci, i.e. $B_i = R_i \bigcup P_i \bigcup C_i$, it can be expressed as:

$$B_{\mathrm{i}} = \{B_{ie} : e \in [1, m]\} \quad (10)$$

The elements of B represented the objects of the customs clearance, while the elements of Bi represented

the values of objects belonging to the customs clearance.

2.2 The method of conversing data from logistic customs

Since the uncertainty and the insecurity of data on the platform of logistics service transacted, the EDI customs clearance system refuses to accept the dataset extracted from the platform of logistics service transacted, which in one hand leads to the declare of customs clearance must be collected artificially, in the other hand causes a higher error rate and a longer cycle of clearance, obviously, impeding the cargo passed smoothly. In fact, the EDI customs clearance systems is only available to the logistic enterprises which owing the aptitudes of clearance. Therefore, the data must be stored in database S of clearance enterprises, then submitted them to the EDI customs clearance system for the clearance of cargos.

However, since the dataset B and Bi stored in the servicer belonged to the platform of logistics service trading, there is no connection between database S and the servicer belonged to the platform. It is hard to extract and store the data B and Bi in database S. Considering to solve this problem, this paper introduced a method of converting data between the logistic enterprises and the clearance company. Firstly, convert the dataset into XML documents through XML serialization. Secondly, transmit the XML document into clearance enterprises via the encrypted HTTPS protocol [14], and store the extractive data of logistics customs in the database S after achieving XML deserialization through the data converting tools of the clearance enterprise. Finally submit the data into the EDI customs clearance system. Among them, the serialization is the process which converting the state information of an object state information into a procedure that can be stored or transmitted. So the XML serialization means that endowing the extractive data to the corresponding nodes of XML after converting the public fields and properties of the XML into a procedure that can be stored, finally, generating the XML document [15]. On the contrary, XML deserialization corresponds to XML serialization that can convert the flow of XML into data flow. With the combination of the serialization and deserialization of XML, it can be easy to achieve target of storing and transmitting the data between heterogeneous systems.

3. THE IMPLEMENTATION OF THE DATA EXCHANGE METHOD

The data exchange method of the logistics customs contains the creation of data extraction model, the exchange and the transmission of data, which is able to be implemented through programming with C# language.

3.1 Business process of the data exchange method

In the business process of the data exchange method (Figure 2):

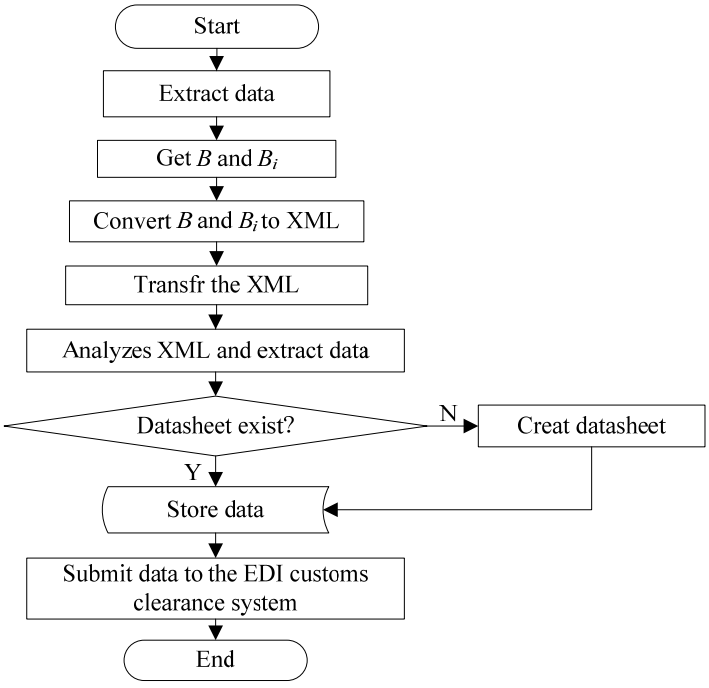


Figure 2. Business process of the data exchange method

The generated XML is transferred to the clearance enterprise via the encrypted HTTPS protocol and resolved by data conversion tool of the clearance corporate. Data conversion tool is simple and independent software which is packaged by the C# Forms application and used after downloading and installing. And its core functions are deserializing XML, extracting and submitting logistics data to database. Before submitting the data to the EDI customs clearance system, the

tool judges that whether destination datasheet exists in the database, if not, create datasheet and submit data; on the contrary, submit data directly.

3.2 The implementation of converting data set to XML

The data was extracted from the data set B and Bi by the mapping relationship and saved to the grid virtual table MyTable after B and Bi were obtained from the platform of logistics service trading. Then, a new XML document containing the root node of the "Order" was created and the document needed to be loaded and serialized. Finally, some sub nodes, which were named of each item in the customs clearance, were added to XML document and assigned by the data in the MyTable. The key codes of XML serialization and node assignment are shown in Table 1. The resulting XML of the data conversion is showed in figure 3, the right of which is the unrolled commodity information and the supplement to the left.

Table 1. The key codes of XML serialization and node assignment

```
XmlDocument xmlDoc = new XmlDocument();
xmlDoc.Load(System.Web.HttpContext.Current.Server.MapPath("../hhy/" + CustomsForm)); //Load the XML document
XmlNode root = xmlDoc.SelectSingleNode("Order");// Find node<Order>
XmlElement xe1 = xmlDoc.CreateElement("CustomsForm");//Create node<CustomsForm>
xe1.SetAttribute("Demander ", MyRow[2].ToString());//Set the demander attribute of the node
xe1.SetAttribute("Servicer ", MyRow[6].ToString());//Set the servicer attribute of the node
XmlElement xesub1 = xmlDoc.CreateElement("Import port ");// Define the name of the child nodes as "import port"
xesub1.InnerText = MyRow[10].ToString();//Assignment to the child node
xe1.AppendChild(xesub1);//Add to<CustomsForm>
……
```

3.3 The transmission of XML

Use encrypted HTTPS protocol to achieve the automatic transmission of the generated XML documents from the logistics service trading platform to the clearance enterprises.

3.4 The parsing of XML and storing of logistics data

After the received XML documents were deserialized by the data conversion software tool, the parsed customs data was stored into the database, which prepared for submitting to EDI customs clearance system. The core codes of deserialization are shown in Table 2.

Table 2. The core codes of deserialization

```
OpenFileDialog ofd = new OpenFileDialog();//OpenFileDialog
ofd.ShowDialog();
string loadFullName = ofd.FileName.ToString();//Get the name of file
XmlDocument xmlDoc = new XmlDocument();
xmlDoc.Load(loadFullName); // Load the XML document
XmlNode root = xmlDoc.SelectSingleNode("//CustomsForm");
XmlNode Port1 = xmlDoc.SelectSingleNode("//Import port ");// Access for the node whose name is "import port"
string Port = Port1.InnerText.ToString();//Pass the value of the node to variable "Port" and be ready to store in the database
.....
```

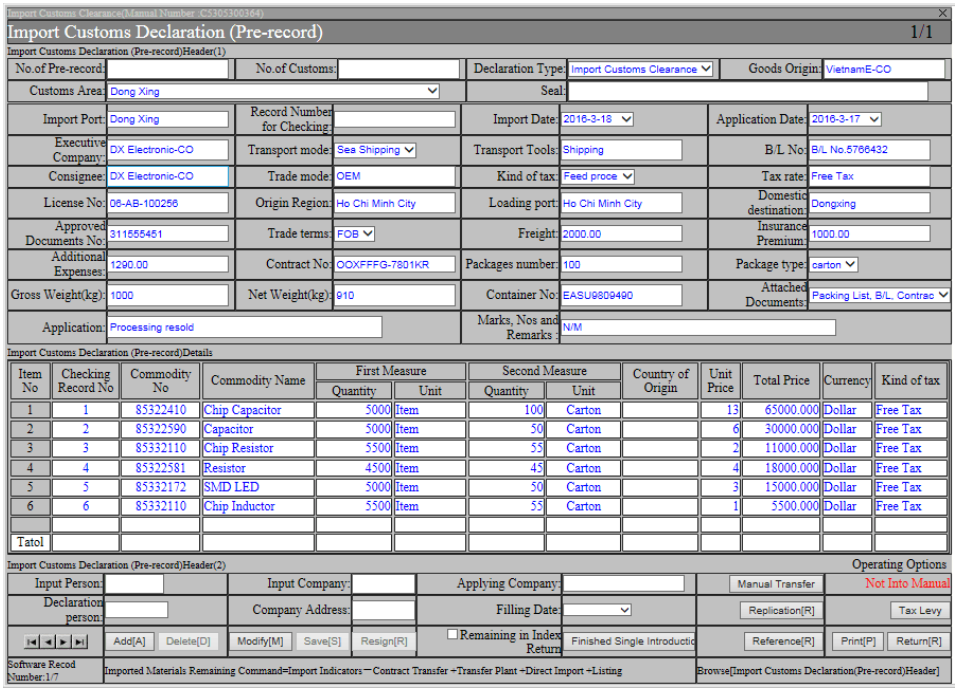
```
<?xml version="1.0" encoding="UTF-8"?>
<Order>
  - <CustomsForm Server="GXYHLogistics" Demander="DX Electronic-CO">
      <Import port>Dongxing</ Import port>
      <Transport mode>Sea Shipping</Transport mode>
      < Executive company>DXE-CO </Executive company>
      <Goods origin>VietnamE-CO </Goods origin>
      < Transport Tools>Shipping</ Transport Tools>
      <B/L No>B/L No.5766432</B/L No.>
      <Trade mode>OEM</ Trade mode >
      < Kind of tax>Feed process</ Kind of tax>
      < Tax rate>Free Tax </ Tax rate>
      <License No>06-AB-100256</License No.>
      < Origin Region>Ho Chi Minh City </ Origin Region>
      < Loading port>Ho Chi Minh City </ Loading port>
      < Domestic destination>Dongxing</ Domestic destination>
      < Approved Documents No>311555451</ Approved Documents No.>
      < Trade terms>FOB</ Trade terms>
      < Freight>2000.00</ Freight>
      < Insurance Premium >1000.00</ Insurance Premium >
      < Additional Expenses >1290.00</ Additional Expenses >
      < Contract No>OOXFFFG-7801KR</ Contract No.>
      < Packages number>100</ Packages number >
      < Package type >carton </ Package type >
      <Gross Weight(kg)>1000</ Gross Weight(kg)>
      < Net Weight(kg)>910</ Net Weight(kg)>
      < Container No>EASU9809490</ Container No.>
      < Application>Processing resold</ Application>
      < Attached Documents >Packing List, B/L, Contract</ Attached Documents >
      < Marks, Nos and Remarks >N/M</ Marks, Nos and Remarks >
      <Declaration type >Import </ Declaration type >
      < Customs area >Dongxing</ Customs area >
      < Import Date>2016-03-18</ Import Date >
      < Application Date >2016-03-17</ Application Date >
      < Consignee > DX Electronic-CO </ Consignee >
      + < Commodity Name>=" Chip Capacitor">
      + < Commodity Name>="Capacitor">
      + < Commodity Name>=" Chip Resistor">
      + < Commodity Name>=" Resistor">
      + < Commodity Name>=" SMD LED">
      + < Commodity Name>=" Chip Inductor">
    </CustomsForm>
</Order>
```

```
- < Commodity Name>=" Chip Capacitor">
    < Item No > 1</ Tax>
    < Checking Record No > 1</ Checking Record No >
    < Commodity No > 85322410</ Commodity No >
    < Commodity Name > Chip Capacitor </ Commodity Name >
    < First Measure Quantity > 5000</ First Measure Quantity >
    < First Measure Unit > Item </ First Measure Unit >
    < Second Measure Quantity > 100</ Second Measure Quantity >
    < Second Measure Unit > Carton </ Second Measure Unit >
    < Unit Price > 13</ Unit Price >
    < Total Price >65000.000</ Total Price >
    < Currency > Dollar </ Currency >
    < Kind of tax> Free Tax </ Kind of tax>
  </ Commodity Name>
- < Commodity Name>=" Capacitor">
    < Item No > 2</ Tax>
    < Checking Record No > 2</ Checking Record No >
    < Commodity No > 85322590</ Commodity No >
    < Commodity Name > Capacitor </ Commodity Name >
    < First Measure Quantity > 5000</ First Measure Quantity >
    < First Measure Unit > Item </ First Measure Unit >
    < Second Measure Quantity > 50</ Second Measure Quantity >
    < Second Measure Unit > Carton </ Second Measure Unit >
    < Unit Price > 6</ Unit Price >
    < Total Price >30000.000</ Total Price >
    < Currency > Dollar </ Currency >
    < Kind of tax> Free Tax </ Kind of tax>
  </ Commodity Name>
- < Commodity Name>=" Chip Resistor">
    < Item No > 3</ Tax>
    < Checking Record No >3</ Checking Record No >
    < Commodity No > 85332110</ Commodity No >
    < Commodity Name > Chip Resistor </ Commodity Name >
    < First Measure Quantity > 5500</ First Measure Quantity >
    < First Measure Unit > Item </ First Measure Unit >
    < Second Measure Quantity > 55</ Second Measure Quantity >
    < Second Measure Unit > Carton </ Second Measure Unit >
    < Unit Price > 2</ Unit Price >
    < Total Price >11000.000</ Total Price >
    < Currency > Dollar </ Currency >
    < Kind of tax> Free Tax </ Kind of tax>
  </ Commodity Name>
  + < Commodity Name>=" Resistor">
  + < Commodity Name>=" SMD LED">
  + < Commodity Name>=" Chip Inductor">
  </CustomsForm>
</Order>
```


Figure 3. The resulting XML

3.5 The Submission of Logistics Data

Extracted data in the database was submitted to the EDI customs clearance system (Figure 4), then the results was transmitted to the custom server after verification.



Import Customs Clearance(Manual Number :CS305300364) 1/1

Import Customs Declaration (Pre-record)

Import Customs Declaration (Pre-record)Header(1)

No.of Pre-record:		No.of Customs:		Declaration Type:	Import Customs Clearance	Goods Origin:	VietnamE-CO
Customs Area:	Dong Xing			Seal:			
Import Port:	Dong Xing	Record Number for Checking:		Import Date:	2016-3-18	Application Date:	2016-3-17
Executive Company:	DX Electronic-CO	Transport mode:	Sea Shipping	Transport Tools:	Shipping	B/L No:	B/L No.5766432
Consignee:	DX Electronic-CO	Trade mode:	OEM	Kind of tax:	Feed proce	Tax rate:	Free Tax
License No:	06-AB-100256	Origin Region:	Ho Chi Minh City	Loading port:	Ho Chi Minh City	Domestic destination:	Dongxing
Approved Documents No:	311555451	Trade terms:	FOB	Freight:	2000.00	Insurance Premium:	1000.00
Additional Expenses:	1290.00	Contract No:	OOXFFFG-7801KR	Packages number:	100	Package type:	carton
Gross Weight(kg):	1000	Net Weight(kg):	910	Container No:	EASU9809490	Attached Documents:	Packing List, B/L, Contrac
Application:	Processing resold			Marks, Nos and Remarks:	N/M		

Import Customs Declaration (Pre-record)Details

Item No	Checking Record No	Commodity No	Commodity Name	First Measure		Second Measure		Country of Origin	Unit Price	Total Price	Currency	Kind of tax
				Quantity	Unit	Quantity	Unit					
1	1	85322410	Chip Capacitor	5000	Item	100	Carton		13	65000.000	Dollar	Free Tax
2	2	85322590	Capacitor	5000	Item	50	Carton		6	30000.000	Dollar	Free Tax
3	3	85332110	Chip Resistor	5500	Item	55	Carton		2	11000.000	Dollar	Free Tax
4	4	85322581	Resistor	4500	Item	45	Carton		4	18000.000	Dollar	Free Tax
5	5	85332172	SMD LED	5000	Item	50	Carton		3	15000.000	Dollar	Free Tax
6	6	85332110	Chip Inductor	5500	Item	55	Carton		1	5500.000	Dollar	Free Tax
Tatol												

Import Customs Declaration (Pre-record)Header(2) Operating Options

Input Person:		Input Company:		Applying Company:	Manual Transfer / Not Into Manual
Declaration person:		Company Address:		Filling Date:	Replication[R] / Tax Levy
Add[A]	Delete[D]	Modify[M]	Save[S]	Resign[R]	Remaining in Index / Finished Single Introductio / Reference[R] / Print[P] / Return[R]

Software Recod Number:1/7 | Imported Materials Remaining Command=Import Indicators—Contract Transfer +Transfer Plant +Direct Import +Listing | Browse[Import Customs Declaration(Pre-record)Header]

Figure 4. The submission of logistics data

4. CONCLUSIONS

This paper discussed the research and implementation of data exchange methods of logistics and customs. In data processing, the data model was created to carry out the batch extraction of logistics data in the logistics service trading platform, which overcomes the difficulty of data extraction and improves the efficiency of data extraction; meanwhile, the exchange of data between heterogeneous systems is realized by using the serialization and deserialization of XML. At present, the application of data exchange between the logistics service trading platform and the customs EDI clearance system is insufficient, but with the rapid development of the import and export trade and logistics service trading platform, the design and application of data exchange method will be further improved.

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