

# Design and Application of Logistics Robot based on RPA

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**Abstract:** In the logistics management process, tedious and repetitive tasks are very common, which is inseparable from a large number of manual data entry and processing of a large number of orders to complete the daily logistics workflow. The work of entering data and processing orders takes a lot of time and high repetition. The application of RPA robot (Robotic Process Automation) is particularly important, which can reduce a lot of labor cost and time cost, improve accuracy, and is of great significance for logistics management. This paper designs a RPA robot framework for logistics management, which is directly used in the development tool Uibot Creator. Developers carry out the second development on the basis of this framework, which can simplify the development process, improve the efficiency of development, save project preparation time, and improve the efficiency of logistics operation and management. The core functions of the framework include logistics web portal framework, logistics information capture, input, logistics documents, mail automation and other frameworks. Finally, the designed Robotic Process Automation framework is applied to the logistics management process to verify the effect of the optimization.

**Keywords:** Robotic Process Automation, Logistics management, Development framework design, Application.

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## 1. Research background

The analysis of the World Economic Forum shows that with the digital transformation of the transportation industry, the value of logistics enterprises will exceed 10 trillion RMB, and the social benefits will reach 16 trillion RMB. In the process of digital transformation of logistics enterprises, how to simplify the logistics management process and speed up the core business, how to reduce costs and further improve service quality will determine the future of logistics enterprises. At this time, RPA (Robotic Process Automation) technology has the opportunity to exert its talents. RPA software tools simulate the processes repeated by logistics managers every day to improve the efficiency of logistics operation and management, such as simulating the process of simulating operators to enter a large number of data manually and deal with a large number of orders.

The business process digital transformation of logistics enterprises is in a period of rapid development, at this time the basis of the transformation and development comes from various factors of the technical dimension, and the Robotic Process Automation technology will be an important part of the digital transformation of logistics operation and management. Cheng Ping etc. [2-8] used robotic process automation technology to optimize the financial management process, such as fixed assets management process, accounts receivable management process, tax management process and so on. RPA robot was designed for the process to improve the management efficiency. Tian Gaoliang studied the application of financial robot based on RPA technology. Quan Wenju applies RPA financial robot to electric power enterprises, and explores the significance of RPA in improving the management level of electric power enterprises. He Hong etc applied RPA to insurance companies, which reduced the repetitive work of financial managers. Liu Qingying analyzed the influence of RPA robot on the financial management of enterprises. Lu Ying applies intelligent finance to financial management in the field of real estate. Jiang Mingyu designed a template framework for developers based on RPA technology, and completed the automatic generation of An enterprise accounting reports

based on the framework, which greatly improved the development efficiency of the process.

Yu Yanling analyzed the influence of digital transformation on enterprise logistics marketing mode, and Yu Lei put forward the intelligent management mode of logistics and commodities with intelligent LOT network. Zhang Daochen analyzed the problems existing in the operation of logistics parks in China. The research of the above scholars shows the importance of the digital transformation of logistics enterprises, and the logistics management process needs to be further optimized. Robotic Process Automation technology will solve a large number of problems in logistics management process and improve the efficiency of logistics management.

## 2. Business pain points in the process of logistics management

Logistics operation and management process is inseparable from a large number of manual data entry and processing of a large number of orders to complete the daily logistics workflow, data entry and order processing work takes a lot of time and high repetition. It mainly involves inventory management, order management, logistics information management, transportation management and other businesses. at present, these services require a large number of repeated manual operations, which are easy to cause data errors and untimely updates. at the same time, there are complex customer relationships in logistics enterprise management that need to be dealt with.

### 2.1. Inventory management

#### 2.1.1. Purchase and storage process

For organizations with multiple suppliers and engaged in a large number of production activities, it is very important to purchase all kinds of materials, and hundreds of activities may occur every day. Before the arrival of the wave of intelligence in the industrial manufacturing industry, corporate organizations could only manually update the materials they needed every day and submit orders to suppliers. This kind of operation is not only time-consuming and laborious, tedious

and tiring, but also destroys the enthusiasm of employees because of the boring work.

### **2.1.2. Inventory management process**

Before the RPA robot participates, the staff responsible for inventory and order processing need to log in to the business system, check the inventory levels of different warehouses one by one, and deliver the inventory list after screening the goods. Then, after updating the warehouse, the staff need to fill out the invoice one by one, confirm the inspection one by one, and finally send the order to the logistics supplier system. Manual execution cannot monitor inventory in real time, find missing materials and send orders in time, which will lead to untimely delivery of orders, and then affect the industrial supply chain and increase the risk of sales loss.

## **2.2. Order management**

With the increasing number of orders, the status of logistics orders needs to be updated in real time every day. Operators need to sort out the unprocessed order numbers in advance, summarize them into the Excel table, then manually log in to the relevant logistics system, and copy these order numbers to the corresponding area of the system page. Operators manually handle hundreds of order numbers every day, which is a huge workload.

For booking documents, the field is more than 50, and it takes more than five minutes for the operator to enter an order, and it needs to be checked repeatedly. Coupled with the different sources of booking manifests, the format cannot be unified, which makes it difficult to import in bulk. The workload is so heavy that it takes more time to complete the booking data entry process during the peak season, and employees have to work overtime.

## **2.3. Delivery and sorting**

Party A's supply chain management personnel need to manually query the relevant information in the ERP system according to the established conditions, grab the goods list information that has been stored and ready for transportation, and generate the waybill, which contains the recipient, address, mode of transportation and other information, and finally send the order to the logistics supplier's OMS or TMS system. This process has a lot of manual operations, a large amount of data, high repeatability and error-prone.

## **2.4. Logistics information management**

### **2.4.1. Logistics staff**

Logistics operators need to log in to the logistics information query system every day, follow up and monitor the status according to the logistics status information, download and input the data at the end of the signed status, and follow up and continue to track the unsigned status. For the need to manually check and track the abnormal logistics information, you need to download the status category manually, in addition, you need to enter the information completion system after the data download. Manual review is a waste of time.

Logistics automatic return personnel need to log in to the logistics return system every day, upload the finished data through the excel form, manually check the abnormal form information, and do a good job of data collation for normal information, but because the abnormal form does not report an error reminder, it needs to be checked manually, and the cost of manual review is high.

Logistics customs declaration personnel need to log in to

the to-do and done task list of the customs declaration management platform system every day, submit and view the logistics declaration information, match and verify the information of multiple approval stages, download the information that meets the customs declaration requirements through the background system, and open the Excel form, fill in the relevant information such as the return receipt and processing time of the customs declaration and audit, and calculate the time spent in all stages. Finally, it is checked and checked manually by sending e-mail.

### **2.4.2. Logistics management personnel**

After sending the goods, the supply chain management personnel of Party A need to manually log in to the system or website provided by the logistics supplier and obtain the logistics status information from the logistics supplier through the logistics order number. Update the information through various logistics information platforms, so that customers can track the current logistics information in a timely manner. In this process, the workload of logistics management personnel is huge and repetitive.

## **2.5. Transport management**

In the process of transportation, motor vehicle violations are inevitable, which requires logistics and warehousing companies to query and deal with the relevant work. There are a large number of repetitive operations in this process, which require a lot of labor costs and time costs, and the operation is not timely enough, it will produce a large number of late fees, resulting in greater losses. When the transport goods are dangerous goods, the relevant management personnel need to fill in a large number of application forms before the transportation of dangerous goods, and need to log into the road transport safety supervision system constantly to apply, the application process is repetitive and tedious, large and error-prone.

## **2.6. Financial problems in logistics management**

Whether we are sending express logistics or receiving express logistics, we will often face the need to issue invoices, while we have to send express delivery and deal with invoices the whole thing is very messy.

## **2.7. Logistics bidding**

The managers of logistics suppliers need to log in regularly to the bidding system or website provided by Party A to further calculate the bidding information of the project, and then manually upload the relevant bidding documents and manually calculate the quotation. This workflow has a large workload, high repeatability, is prone to errors, and requires a short time to complete, so it is difficult to submit relevant information in time.

# **3. The design of logistics management robot based on RPA**

The above problems in the logistics management process can be solved and optimized through RPA (Robotic Process Automation). RPA refers to the use of software with AI (artificial intelligence) and ML (machine learning) functions to deal with some repetitive and heavy workload tasks that need to be performed manually. In this paper, a RPA robot framework for logistics management is designed to solve the above problems. Developers carry out the second

development on the basis of this framework, which can simplify the development process, improve the efficiency of development, save project preparation time, and improve the efficiency of logistics operation and management.

This article will use UiBot Creator, a common development tool of RPA in China. The core module of the framework includes execution process module, initialization module, data processing module and exception handling module. The execution process block contains various core functions of the logistics management process, and each module has a reserved interface to facilitate developers to use the framework directly. The development main framework is shown in figure 1:

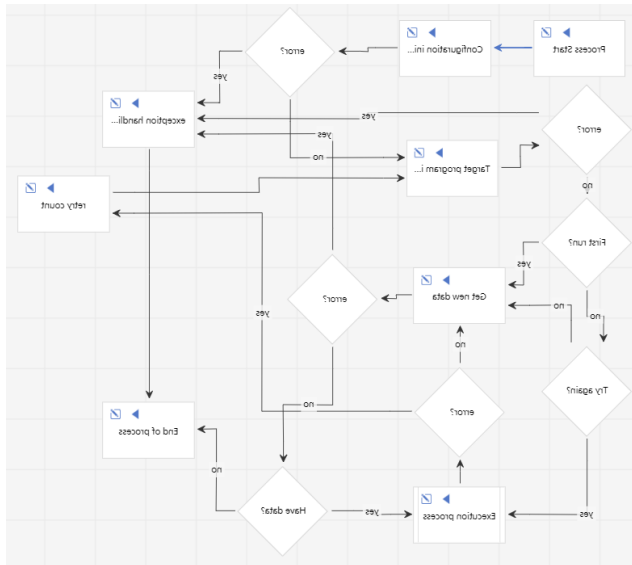


Figure .1 Development Agent Framework

In this framework, initialization, target program initialization, first run judgment and retry judgment are configured as initialization function modules, exception handling and retry counting process blocks are exception handling function modules, obtaining new data and judging whether there is a data flow block as data processing function module, execution process block as sub-process, which contains the main functions needed by logistics management process. Contains logistics web portal framework, logistics information capture, input, logistics documents, mail automation and other frameworks, the specific process is as follows:

### 3.1. Initialization module

The initialization module mainly includes configuration initialization and object program initialization.

#### 3.1.1. Configuration initialization

Variable Name	Value
<code>g_bRetryStatus</code>	False
<code>g_dicTransactionItem</code>	Null
<code>g_dicConfigData</code>	{}
<code>g_iCount</code>	0
<code>g_iRetryNumber</code>	0
<code>g_bFirstRun</code>	True

Figure .2 Initial values of global variables

The configuration initialization process block is used to initialize the parameters, set the log level, set and read the configuration file. The parameters are mainly global variables `g_iCount` (initial value of retry count), `g_iRetryNumber`

(number of retries), `g_bRetryStatus` (initial value of transaction item retry state), `g_dicTransactionItem` (transaction item data), `g_bFirstRun` (identification of the first run). The initial value is shown in figure 2. The relevant data of the logistics management process will be put into the `g_dicTransactionItem` and configuration files, such as inventory information, order information, logistics status, financial information, logistics indicators and so on.

#### 3.1.2. Object program initialization

The initialization of the target program is to initialize the environment before the process runs, read the related fields from the flow chart variable `g_dicConfigData`, deal with them, check whether the target program of the RPA process has been installed and other necessary preconditions, judge whether the robot environment meets the requirements, close the browser, close the logistics system, close the software, and so on. After the initialization of the target program, it will determine whether to run it for the first time, and if it runs for the first time, it will carry out data processing, otherwise it will choose to run the main program directly or get new data according to the limit of the number of retries.

### 3.2. Exception handling module

When there is an exception in the process block such as configuration initialization, target program initialization and data processing, the exception handling process block will be carried out to complete the process of writing error log, sending e-mail to notify relevant personnel, screenshot and other processes; when there is an exception in the execution process block, it will enter the retry counting process block to complete the data update, screenshot, timing and other processes of `g_bRetryStatus` and other variables. The main code is as follows:

```
Log.Error("an exception occurred in the process, processing!")
Dim SystemException = Null
SystemException = $BlockInput //system variable
Log.Error(SystemException)
```

### 3.3. Data processing module

Get the data and assign it to the flowchart variable `g_dicTransactionItem` for global use. The subflow needs to be used after input. The data can be obtained by consuming a data queue message specified in UiBot Commander, reading a specific row in the specified Excel table, reading the specified field data in the specified database, reading an email in the specified mailbox, and obtaining the returned data through webAPI. Or choose other methods of data acquisition according to the needs of logistics managers. It must contain the following code:

`g_bFirstRun = False` //enter this process block, and the initial running status needs to be updated to False. This command cannot be deleted.

`g_dicTransactionItem = Null` //initialization is required before getting the data of a new transaction. This command cannot be deleted.

### 3.4. Logistics web Portal Framework

This framework is mainly aimed at the acquisition and input of logistics information in the logistics web portal, using RPA and python plug-ins to complete this process. This process automates the browser with the selenium feature of python, and the following python packages need to be imported:

```

from selenium import webdriver
from selenium.webdriver.support.ui import
WebDriverWait
from selenium.webdriver.support import
expected_conditions as EC
from selenium.webdriver.common.by import By
from selenium.webdriver.chrome.options import Options
After importing the python package, you can automatically
log in to the browser and go to the designated logistics portal
for related operations. You can use a headless browser to
automatically run the process in the background, and the
browser will not be displayed in the windows page. This
cannot be done by RPA. The core code of python is as follows:
def python_selenium(content):
    #headless browser configuration
    chrome_options = Options ()
    chrome_options.add_argument('--headless')
    chrome_options.add_argument('--disable-gpu')
    # instantiate a browser object (the driver passed into the
browser)
    bro =
webdriver.Chrome(executable_path='./chromedriver',
options=chrome_options)
    # Let the browser find a request corresponding to the
specified url
    bro.get('https://*****.com/')
    # locate the relevant buttons in the browser
    ele = WebDriverWait(bro,
60).until(EC.presence_of_element_located(*****))
    # enter the logistics information to be queried in the input
box
    ele.send_keys(content)
    # wait a while for the relevant content to appear
    sleep (2)
    # obtain logistics information
    new = bro. find_element_by_class_name('textpanel-target-
textblock').text
    # close the browser
    bro.quit()
    return new

```

Import the python\_selenium function into Uibot through the above Python plug-in. When you do not need to run the browser in the background, you can also directly use the RPA framework to operate the logistics web portal website. The specific process is shown in figure 3:

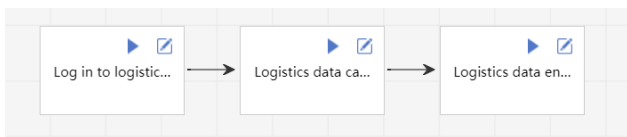


Figure .3 Logistics web portal flow

### 3.4.1. Log in to the logistics Web portal process

This process is divided into three steps: logging in to the website, closing the pop-up window, logging in to the account, logging in the URL address of the website in the login process, and maximizing the browser window. There is an interface at the properties of the browser window to facilitate developers to perform secondary development according to the actual needs to complete the corresponding operations. The core code of the login process is as follows:

```

Dim hWeb = ""
hWeb=WebBrowser.Create("chrome","about:
blank",30000, {"bContinueOnError":

```

```

False,"iDelayAfter":300,"iDelayBefore":200,"sBrowserPath
":"","sStartArgs":""})
Window.Show({"wnd":{"cls":"Chrome_WidgetWin_1",
"app":"chrome"}},"max")

```

The process of closing the pop-up window has a relevant interface set at the pop-up window properties. Developers can configure relevant parameters according to the specific conditions of the website and set the closure of multiple windows to prevent the pop-up window interface from affecting the next relevant operations. the login process mainly includes judging whether you have logged in to the logistics administrator account and automatically clicking the login button to enter the account login interface if not logged in. Enter the specified account and password (g\_dictGlobal ["usName"] and g\_dictGlobal ["usPassword"]) set in the initialization process in the account password input box, and click Log in to complete the account login operation. This process has relevant interfaces in the account password input box, login button and other locations, and the developer configures it according to the interface elements of the input box of the login interface.

### 3.4.2. Logistics data capture process

This process is carried out on the basis of opening the logistics website and logging in, and grabs the relevant logistics data according to the demand, including in and out information, logistics order information, logistics status information and so on. The capture time can also be run regularly according to the needs of logistics managers, and the time interval can also be set to ensure timely update of logistics information. The main command used is data capture. As shown in figure 4, after clicking the data crawling command, the page shown in figure 5 will appear. Click to select the target and select two targets at the same level, and you can crawl the data of the relevant tables and web pages. But this method is only applicable to the data with tables or rules, so this process framework also provides other relevant commands to meet the needs of crawling data. These commands require developers to do more secondary development according to the characteristics of the web page. The main commands that need to be used are getting the element text, getting the child elements, traversing the array and so on. There is an interface in the element location, and the final data will be stored in the variable arrRet.

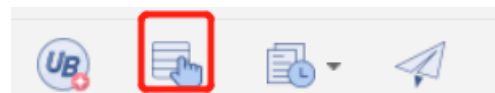


Figure .4 Location of data crawling command



Figure .5 Data crawl command page

### 3.4.3. Logistics data entry process

This process is carried out on the basis of opening the logistics website and logging in, inputting relevant logistics data according to demand, including in and out of warehouse information, logistics order information, logistics status information and so on. The entry time can also be entered regularly according to the needs of logistics managers, and the entry interval can also be set to ensure the timely updating of logistics information. The main commands used are input text in the target, setting element check, setting element selection, obtaining child elements, traversing sub-elements

input in turn, etc., and there is an interface in the element location.

### 3.5. Logistics information capture framework

This framework aims at grasping logistics information in relevant documents, systems and databases, and grabbing relevant logistics data according to demand, including logistics system background information, in-and-out information, logistics order information, logistics status information and other data. The operation of grabbing information can be grabbed again when the logistics information is updated to ensure the timely update of the logistics information. This framework includes opening files, systems, logistics information capture, logistics information processing and other processes, as shown in figure 6:

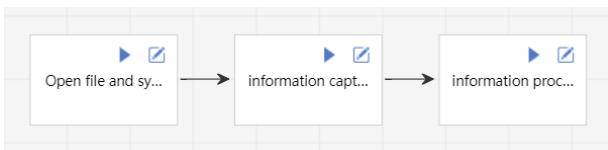


Figure .6 Logistics information capture process

The process of opening files and systems is mainly to prepare for the process of grabbing logistics information, opening Excel files, databases and systems containing logistics information. The main commands in this process include selecting files dialog box, obtaining file list, opening files in turn, opening corresponding system software, and so on.

At the end of the process of opening the file and the system, the logistics information in the file or system will be grabbed, and the operation of reading cells, rows, columns and areas will be carried out for the Excel table, and the same operation as the browser will be carried out for the system, obtaining the target sub-elements, traversing the sub-element array, obtaining the target element text, etc., for the database, the SQL statement can be executed directly to fetch the logistics information of the database. The framework has interfaces in the cell, row, column, area and element location of the Excel, which requires developers to choose the corresponding location according to the requirements.

After completing the logistics data capture process, the captured data needs to be processed and stored. This framework stores the captured information in Excel, and developers can change it according to their actual needs. The main commands involved in the data processing process are building data table, data slicing, data deduplication, data sorting, data table merging, array processing, etc., as shown in figure 7:

```

Dim objExcelWorkBook = ""
Dim arrRet = ""
Dim objDatatable = ""
objDatatable = DataTable.BuildDataTable([],[])
objDatatable = DataTable.SliceDataTable(objDatatable,[],[])
objDatatable = DataTable.DropDuplicatesDataTable(objDatatable,[],"first")
objDatatable = DataTable.SortDataTable(objDatatable,"",True)
objDatatable = DataTable.MergeDataTable(leftTable,rightTable,"inner","",False)
arrRet = Unshift([], "")
  
```

Figure .7 Data processing commands

After completing the data processing, the processed logistics data is stored in the Excel table. The main commands involved are creating Excel table, writing regions, cells, rows and columns, creating worksheets, saving and closing Excel, and so on. Developers can deal with Excel tables according to their actual needs.

### 3.6. Logistics information input framework

This framework mainly includes two processes: opening the Excel file or system that needs to be entered and inputting information, and inputting relevant logistics information according to demand, including data such as in-and-out information, logistics order information, logistics status information, etc., the entry time can also be entered regularly according to the needs of logistics managers, and the input interval can also be set to ensure timely updating of logistics information. The main commands used are operated with the browser, including entering text in the target, setting element check, setting element selection, obtaining sub-elements, entering sub-elements in turn, etc., and setting an interface in the element location.

### 3.7. Mail Automation Framework

This framework mainly includes real-time monitoring, completion notification, error notification and other processes. When the whole RPA process is running, email is sent after the corresponding operation is completed, and logistics managers are notified. After the relevant logistics information is updated, the relevant personnel can also be informed by e-mail. When the whole process ends, or when the process reports an error, the operator of the process can also be informed by email. The main commands involved in this framework are getting the current time, getting the element text, judging the text change, sending mail, trying to execute, sending error mail and so on.

### 3.8. Logistics document framework

This framework mainly processes some documents through the Mage AI function of UiBot. The document recognition types include text recognition, form recognition, general multi-bill recognition (commonly used), card recognition and so on. Before the start of the process, select the Mage AI function shown in figure 8. Then there will be a pop-up window shown in figure 9. after selecting the corresponding recognition type according to the type of logistics document, enter the selection of image source. And according to the actual needs to select the type of documents for further processing.

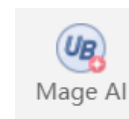


Figure .8 Mage AI



Figure .9 Mage AI configuration page

## 4. The application of RPA robot in logistics management process.

Based on the above RPA robot framework, the related processes of logistics management are optimized and applied to inventory management, order management, shipping and sorting, logistics information management, transportation management, financial problems in logistics management, logistics bidding and so on. The framework mentioned above can be used in these processes, including initialization module, exception handling module and data processing module. Then use other related functional frameworks according to the

requirements.

## 4.1. Automation of inventory management

### 4.1.1. Purchase and storage process

In this process, the RPA robot can monitor the inventory level in real time and notify the team before the inventory level becomes low, so that the team can order products in advance and generate real-time reports to optimize inventory demand. After participating in the inventory management robot, it can automatically log in to the business system, monitor the inventory level and generate a report, and then grab the delivery list. RPA robots can synchronize information with systems such as the company's CRM. Based on the generated report information, the inventory management robot can send mail to communicate with the supplier to place an order. The purchasing manager approves the request according to the email notification, and the RPA robot can automatically send the order to the logistics supplier system. This process needs to use the framework of logistics web portal framework, logistics information capture framework, mail automation framework. First of all, you need to use the login logistics portal website or system process in the logistics web portal framework, the user needs to add the URL address of the website or the location of the logistics system in the configuration file, and the secondary developer needs to configure elements such as the input box of the login interface at the interface of the framework, as shown in figure 10. You can directly select the login button where you click the target, or configure the element of html in the properties.

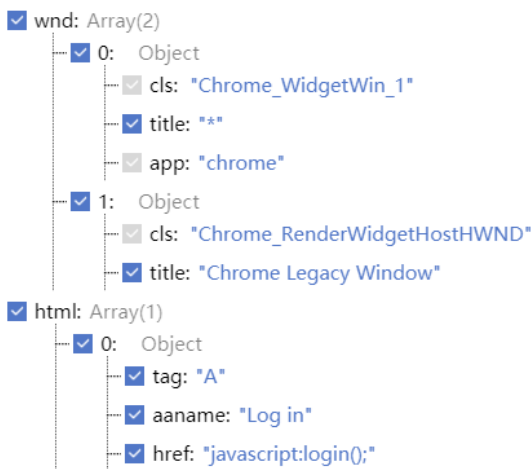


Figure .10 Login to the logistics system configuration page

After automatically logging in to the website or system, automatically click to enter the inventory page, as shown in figure 11, to grab the inventory information. The information capture process needs to use the framework of logistics information capture, and directly use the data capture function, such as the function page shown in figure 12, to grab the inventory in the table, according to the actual situation of logistics enterprises, grab inventory information regularly, and store the data in the inventory level report after capture.

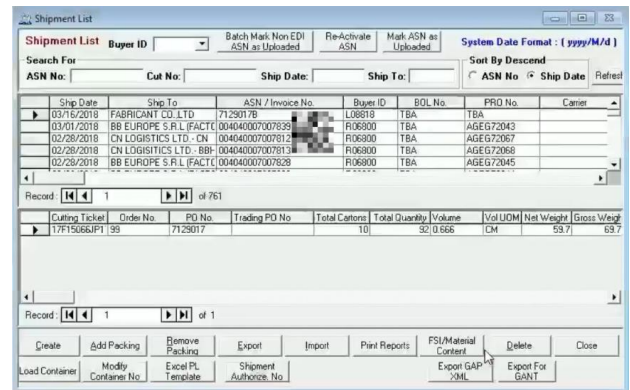


Figure .11 Inventory Management Page

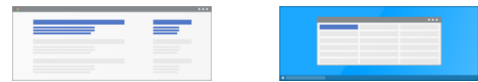


Figure .12 Data capture page

Based on the report information of inventory level, the mail automation framework is used to notify suppliers and purchasing managers to place orders, in which developers are required to configure mailbox SMTP server, port, account number, password, sender, recipient, title, body, attachment, etc. as shown in figure 13, the recipient can be the relevant personnel of the supplier or the purchasing manager, and the generated inventory level report can be added to the email attachment.

The RPA robot based on the framework designed in this paper can replace the manual way to update the materials needed every day in the purchase and storage process. The RPA robot can update the inventory online all day, 24 hours a day, generate a report to remind the stock when it is out of stock or higher than the upper limit, and automatically fill in the invoice. In this way, the enterprise's inventory management can be in the best state at all times. RPA robot can effectively reduce the risk of sales loss caused by inventory or raw material shortage, ensure that enterprises maintain the best inventory level, and effectively manage the supply of all kinds of products in times of peak and low demand.

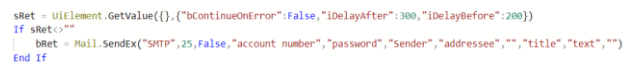


Figure .13 Mailbox configuration page

### 4.1.2. Inventory management process

In this process, the RPA robot can automatically log in to the business system, check the inventory levels of different warehouses one by one, and automatically screen the goods and deliver the inventory list. After updating the warehouse, the RPA robot can automatically fill out the invoice, confirm the inspection one by one, and finally automatically send the order to the logistics supplier system.

The frameworks that need to be used in this process are logistics web portal framework, logistics information capture framework, logistics information input framework and mail automation framework. The development step of this process is roughly similar to the purchasing process, which is also automatically logged into the system to capture inventory data. The difference is that after capturing inventory data, you need to use the framework of logistics information input. Fill the relevant logistics information into the system shown in figure 14 and confirm it. The secondary developer needs to

configure the attributes of the system input location in the location shown in figure 15. You can select the input target at the search target that gets the location of the child element, or configure it in the target location in the right attribute. Finally, the process uses the mail automation framework to automatically send mail to the vendor.



Figure .14 Storage system page

```

Keyboard.InputText({}, information, True, 20, 10000, {"bContinueOnError": False, "idelayAfter": 300, "idelayBefore": 200})
#icon("res://default.png")
UIElement.SetCheck({}, True, {"bContinueOnError": False, "idelayAfter": 300, "idelayBefore": 200})
#icon("res://default.png")
UIElement.SetSelect({}, [], "text", {"bContinueOnError": False, "idelayAfter": 300, "idelayBefore": 200})
#icon("res://default.png")
arrElement = UIElement.GetChildren({}, {"bContinueOnError": False, "idelayAfter": 300, "idelayBefore": 200})
for each value in arrElement
    #icon("res://default.png")
    Keyboard.InputText(value, information, True, 20, 10000, {"bContinueOnError": False, "idelayAfter": 300, "idelayBefore": 200})
next
    
```

Figure .15 Input information configuration

The secondary development of RPA robot based on the framework designed in this paper can solve the problem that manual execution cannot monitor inventory in real time. RPA robot can find the missing materials and send orders in time, provide product-based lifecycle management services, provide partners with order management and other services, and form a scene ecological data closed loop. To achieve process standardization, reduce the occurrence of verification matching errors and other problems, through the digital staff to greatly improve the efficiency of verification, through the docking of internal and external systems, without the need for integration cost and time. Through the price collection and feedback in different periods, it can provide a strong basis for future production, design and sales.

## 4.2. Automation of order management

### 4.2.1. Waybill automation

We can use the RPA robot to handle a large number of online couriers or pickups, so that we can better publish this information to couriers in each area. Then, according to the data in the company database, automatically enter customer information, process payment, send e-mail to confirm and place orders, automate the process, and deal with abnormal parts in batches. The RPA robot automatically sends the information of the goods in the order system every day, and then obtains all kinds of information of the goods (such as parameters, transportation requirements, consignee information, etc.) from different systems, and finally uses the specified format to automatically make the logistics delivery list.

With the increasing number of orders, the status of logistics orders needs to be updated in real time every day. The RPA robot can monitor the status of the waybill in real time, and automatically update the relevant order transfer details in the system, automatically summarize them into the Excel table, and automatically transfer them to the logistics system. The RPA robot can work with intelligent routing systems based on artificial intelligence, coordinate multiple logistics partners, such as road transportation, shipping and air transportation, and automatically assign delivery companies and methods according to the specific place of delivery of the product. The RPA robot can send email to customers in time when there is a delay in logistics, and enhance the customer experience

through real-time updating of orders.

This process mainly uses the logistics information capture framework, mail automation framework, logistics bill framework and so on. Next, we will give a simple application case. First of all, the RPA robot will automatically log in to the logistics system, and use the logistics information capture framework to grab and identify the order information in the system. When a new order appears, it will automatically query the relevant information of the order in the system, as shown in figure 16. the query process will automatically enter the order information captured before the query input box, and automatically download the SKU file after querying the corresponding order.

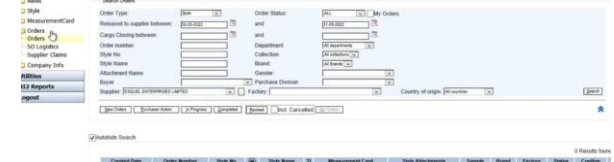


Figure .16 order information query



Figure .17 SKU file download

After downloading the SKU file, the RPA robot will automatically log in to the ASN system, upload the SKU according to the order and generate the freight list. As shown in figure 18, the logistics document framework will be used to identify the SKU file and other documents, and the identified information will be sorted out automatically. At the end of all processes, the mail automation framework is invoked to notify the user by mail.

ASN No.	Ship Date	Ship To	ASN / Invoice No.	Buyer ID	BOL No.	PRD No.	Carrier
	03/16/2018	FABRICANT CO. LTD	7129017B	L08818	TBA	TBA	
	03/01/2018	BB EUROPE S.R.L. (FACT)	004040007007839	R06800	TBA	AGEG72043	
	02/28/2018	CN LOGISTICS LTD - CN	004040007007812	R06800	TBA	AGEG72067	
	02/28/2018	CN LOGISTICS LTD - BBH	004040007007813	R06800	TBA	AGEG72068	
	02/28/2018	BB EUROPE S.R.L. (FACT)	004040007007828	R06800	TBA	AGEG72045	

Figure .18 Download of SKU file

### 4.2.2. Automatic entry of manifest

When the freight forwarder or shipping company or airline receives the customer's booking power or related documents, the customer service operator needs to enter the booking information into his own booking system. PA robot can use computer artificial intelligence technology to automatically scan and process the data of booking documents in various formats, and then input them automatically. When an abnormal situation occurs, the relevant personnel will be notified by email for manual inspection and review, and the manual input workload of this process will be greatly reduced. The specific process is shown in figure 19, this process mainly uses the logistics document framework to identify the power of attorney and read the information, the mail automation framework automatically sends mail to the business person, and the logistics information capture

framework reads the data of FMS.



Figure .19 Automatic process for manifest entry

### 4.3. Automation of delivery and sorting

In the stage of shipping process, the RPA robot can regularly query the upcoming goods in the ERP system according to the number of the logistics order and automatically generate the shipping order, obtain the information of the goods to be shipped in the ERP system and the list of goods to be shipped in the goods delivery plan in a fixed time period, and generate the logistics order, including the detailed transportation mode, recipient and address and so on. Then the RPA robot will automatically log in to the logistics supplier system and automatically generate logistics orders. Logistics operators reduce repetitive work, convert to paying attention to abnormal situations and adjusting waybill, at the same time, improve the accuracy and efficiency of the whole process, let logistics information be updated, and enhance customer experience.

In the delivery planning and tracking process, the RPA robot can automatically execute the pick-up request process, check the process, report the internal logistics system and the status of shipment between portals, automatic shipping and other processes. According to the mail received, the RPA robot can extract the shipping details, record them in the scheduling system, and automatically upload information such as car time in the web portals of customers and operators.

The logistics information capture framework and the logistics information input framework are used in the delivery and sorting process. The RPA robot regularly acquires the shipping list information in the logistics system according to the logistics order number, and will use the logistics information capture framework to change the attributes of the logistics list location in the system for information capture. To input the captured information into the waybill, this step needs to use the logistics information entry framework to input the receiving address, recipient, transportation mode and other information into the corresponding location of the waybill, in which each location requires the developer to redevelop. configure the specific location and its attributes, and finally automatically transmit the waybill of the input information to the logistics supplier's system. The operation process is shown in figure 20, and the development process is shown in figure 21, which mainly includes three parts: data capture, data processing and data input.

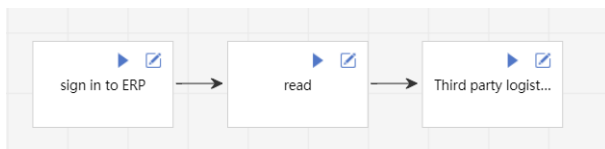


Figure .20 Automatic process for manifest entry

```

arrayData = UIElement.DataScrap(["html":[{"id":"rfe1","tag":"tbody"}],{"app":"chrome","cls":"Chrome_widgetsIn",
arrElement = UIElement.getChildren(["and":[{"app":"app","cls":"OpusApp","title":""}],{"cls":"OpusApp"}],{"cls":"OpusApp"}])
for each value in arrElement
  sRet = UIElement.GetValue(value,{"bContinueOnError":False,"IdelayAfter":300,"IdelayBefore":200})
  arrRet = push(arrRet,sRet)
next
arrRet = split(arrRet,"\\")
@icon["@src:default.png"]
keyboard.InputText({},arrRet["destination"],True,20,10000,{"bContinueOnError":False,"IdelayAfter":300,"IdelayBefore":
@icon["@src:default.png"]
keyboard.InputText({},arrRet["addressee"],True,20,10000,{"bContinueOnError":False,"IdelayAfter":300,"IdelayBefore":
@icon["@src:default.png"]
keyboard.InputText({},arrRet["address"],True,20,10000,{"bContinueOnError":False,"IdelayAfter":300,"IdelayBefore":
@icon["@src:default.png"]
keyboard.InputText({},arrRet["type of shipping"],True,20,10000,{"bContinueOnError":False,"IdelayAfter":300,"IdelayBefore":
  
```

Figure .21 Development process

### 4.4. Automation of logistics information management

The RPA robot can replace the related work of the logistics operator. The RPA robot automatically logs into the logistics information query system every day, monitors the status according to the logistics status information, downloads the data at the end of the signed status, needs to follow up and continue to track the unsigned status, automatically checks and tracks the abnormal logistics information, and automatically downloads the status categories. After the data is downloaded, the RPA robot automatically inputs the information completion system.

The RPA robot can replace the related work of the logistics automatic return personnel. The RPA robot automatically logs into the logistics return system every day, uploads the finished data through the excel form, automatically checks the abnormal form information, collates the normal information, and automatically checks the abnormal form instead of manual review.

The RPA robot can replace the related work of the logistics customs declaration personnel. The RPA robot automatically logs into the to-do and done task list of the customs declaration management platform system every day, submits and views the logistics customs declaration information, automatically matches and verifies the information of multiple approval stages, automatically downloads the information that meets the customs declaration requirements through the background system, and automatically inputs the customs declaration audit receipt processing time information into the EXCEL form. Calculate the time spent in the whole process, and then automatically send an email to the relevant personnel for review, or send it directly to the RPA robot for review.

RPA robot can help supply chain managers automatically log in to the website or system provided by logistics suppliers after the goods are delivered, automatically query and update the logistics status according to the number of logistics orders, and input the latest information into the designated system, so that customers can know the current logistics status in time.

The general steps of the above process are shown in the figure. First, the logistics web portal framework is used to automatically log in to the supplier's TMS system, then the logistics information capture framework is directly used to capture the information shown in the figure, and the mail automation framework is used to automatically send the information needed by the customer to the customer mailbox. Finally, the relevant information is automatically entered into the customer system through the logistics information entry framework. Complete the main process of logistics information management.

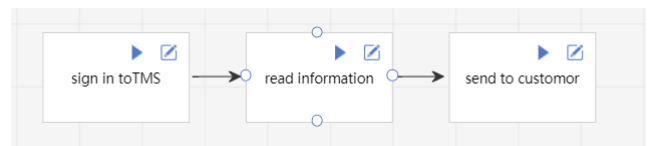


Figure .22 Development process

Order No.	Order Date	Order Status	Order Type	Order Category	Order Sub-Category	Order Item	Order Item Description	Order Item Unit	Order Item Quantity	Order Item Price	Order Item Total	Order Item Tax	Order Item Discount	Order Item Net Total	Order Item Net Total Tax
1	2023-10-27	Completed	Standard	Standard	Standard	1	Standard Item 1	Standard	100	1000	100000	10000	0	90000	91000
2	2023-10-27	Completed	Standard	Standard	Standard	2	Standard Item 2	Standard	200	2000	40000	2000	0	38000	39000
3	2023-10-27	Completed	Standard	Standard	Standard	3	Standard Item 3	Standard	300	3000	90000	3000	0	87000	89000
4	2023-10-27	Completed	Standard	Standard	Standard	4	Standard Item 4	Standard	400	4000	160000	4000	0	156000	160000

Figure .23 Development process

## 4.5. Automation of transport management

The management process of transportation information is the same as the logistics information management process in the previous section, which is directly for secondary development. For the transportation of dangerous goods, the RPA robot can automatically declare before the transportation of the goods, automatically log in to the road transport safety supervision system, fill in the scheduling, consignment and other information in batches according to the information in the waybill application form, and generate declaration forms. The RPA robot completes the declaration process accurately and quickly, which can save a lot of time cost and labor cost.

The dangerous goods transportation process mainly uses the logistics information input framework, in addition to the command to input text in the target, it also needs to use the commands such as setting element selection and setting element check shown in figure 24. In the secondary development, you only need to configure the selected element attributes to complete the transportation of dangerous goods waybill, as shown in figure 25. After filling in, the RPA robot will complete the relevant declaration process in the system and automate the whole transportation management process.

```
Keyboard.InputText({}, Dangerous goods information, True, 20, 10000, {"bContinueOnError": True, "icon": "@res:default.png"})
UiElement.SetCheck({}, True, {"bContinueOnError": False, "iDelayAfter": 300, "iDelayBefore": 300, "icon": "@res:default.png"})
UiElement.SetSelect({}, [], "text", {"bContinueOnError": False, "iDelayAfter": 300, "iDelayBefore": 300, "icon": "@res:default.png"})
arrElement = UiElement.GetChildren({}, {"bContinueOnError": False, "iDelayAfter": 300})
For Each value In arrElement
    #icon("@res:default.png")
    Keyboard.InputText(value, Dangerous goods information, True, 20, 10000, {"bContinueOnError": True, "icon": "@res:default.png"})
Next
```

Figure .24 Secondary development configuration

Figure .25 Automatically fill in the relevant information

## 4.6. Automation of financial issues in logistics management

RPA robot can integrate data from logistics system, waybill payment system and other systems, and automate the process from order to cash for major 3PL operators. Solve the problems such as untimely time, inaccurate data, multi-system information congestion and so on. PA robot can automatically obtain financial data in transportation, and at

the same time use artificial intelligence, OCR and other technologies to scan invoices, instead of a large number of manual inputs, to achieve invoice automation in the logistics process.

This process mainly uses the Mage AI module and OCR module in the logistics document framework, such as configuring the relevant commands shown in figure 26 in the framework to complete the relevant operations related to the invoice, in which the last line of command can carry out specific selection and configuration; you can choose different invoice types, you can choose to extract different information.

```
value = LocalOCR.ImageOCR("", "SceneText", 10000)
#icon("@res:default.png")
value = LocalOCR.ScreenOCR({}, {"height": 0, "width": 0, "x": 0, "y": 0}, "SceneText", 10000, {"value": Mage.PDFOCRInvoice({}, "", "", False, [[1, 2]], 10000, 30000)})
sRet = Mage.ExtractInvoiceInfo(value, "vat_special_invoice", "vat_invoice_drawer")
```

Figure .26 Relevant commands for invoice identification

## 4.7. Automation of logistics bidding

RPA will log in to the bidding system or website provided by Party An on a regular basis, further check the bidding information of the project according to the set business logic, and then automatically upload the relevant bidding documents and automatically calculate the quotation. Solve the heavy workload, high repeatability, prone to errors, the time required to complete is very short, it is difficult to submit relevant information in time, the specific process is shown in figure 27.

In this process, the logistics information capture framework is mainly used to capture the bidding information of logistics projects in the customer bidding system, and the logistics information input framework is used for automatic bidding. finally, the mail automation framework is used to automatically send mail to customers and responsible persons' mailboxes.

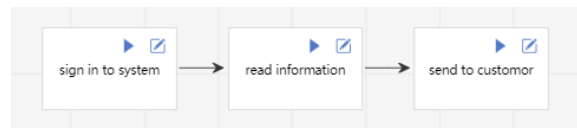


Figure .27 Automation process of logistics bidding

## 5. Conclusion

Based on the business pain points in the logistics management process, this paper designs a RPA robot framework for logistics management. Developers carry out the second development on the basis of this framework, which can simplify the development process, improve the efficiency of development, save project preparation time, and improve the efficiency of logistics operation and management. The core module of the framework includes execution process module, initialization module, data processing module and exception handling module. The execution process block contains various functions of logistics management process, including logistics web portal framework, logistics information capture, input, logistics documents, mail automation and other frameworks. Finally, the designed Robotic Process Automation framework is applied to the logistics management process to verify the effect of the optimization. It is used in inventory management, order management, delivery and sorting, logistics information management, transportation management, financial problems in logistics management, logistics bidding and other processes.

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