A Standardizing Architecture Model for B2B Electronic Commerce

Hongbiao Li
School of Information Engineering
Northeast Dianli University
Jilin China
foxysc@163.com

Honggang Li
Medium Technology and Propagation Department
Northeast Dianli University
Jilin China
lihonggang126@126.com

Abstract— **Electronic commerce (EC) can be defined as to use information technology for improving business relations between trading partners. The objectives of this work are to develop the reference model for IDEF0 based B2B electronic commerce and to implement a prototype system for its fundamental issues such as business process, information standards, and information system integration. The research scope is to develop standards for related business processes and their information exchange, to develop XML EDI as the standard exchange method, and to implement a prototype system.**

Keywords— ***IDEF0; MRP; EDI; Model; Standard document; Electronic commerce; Outsourcing process***

I. INTRODUCTION

Electronic commerce (EC) can be defined as 'to use information technology for improving business relations between trading partners. The most important factors to achieve B2B integration are standardization and digitalization. Especially regarding standardization, there are several issues according to various hardware, software, documents and trading customs in typical companies. The objectives of this work are to develop the reference model for IDEF0 based B2B electronic commerce and to implement a prototype system for its fundamental issues such as business process, information standards, and information system integration. The target industry in the work is electronics assembly supply chain and the target business is its outsourcing process. The research scope is to develop standards for related business processes and their information exchange, to develop XML EDI as the standard exchange method, and to implement a prototype system.

II. ARCHITECTURE MODEL FOR B2B ELECTRONIC COMMERCE

A. B2B architecture model

For more efficient B2B electronic commerce, intra-enterprise resources also have to be integrated for mutual access and usage the information systems can give fundamental base for information sharing and business process improvement. Further things are required to make it true. First, it is necessary to make standards of EC not only for intra-enterprise but also for B2B. The standards include information, format, and business processes. Second, multi-media and information technologies are essential for business interface and information sharing. Third, there must be open mind to share their business information to increase overall performance.

Let us consider the example of integration through EC in electronic assembly supply chain. A supplier can make online access to product engineering information which contractor provided. A contractor can also trigger the supplier's production and procurement process and monitor its progresses in real time. This means that each company takes role as a department in an enterprise and they can share required information with seamless business process linkage.

B2B integration is more essential as EC becomes more popular. This integration needs to be agile to adapt to changing environment. In the near future, functionally specialized companies that meet the requirement could organize and part by projects and they will make virtual corporations.

Fig.1 depicts the model of B2B business processes, documents, and related intra-enterprise processes. The model is developed based on the entire trading process characterized by contractor and supplier in the electronic assembly industry. The starting point of the model is contractor's database that is entered by sales department. The end point is payment checking. The following sections are detail explanation about corresponding business process.

B. Outsourcing process

A model to represent detailed outsourcing process among B2B trade is developed. In our model the process started from outsourcing requirement that was caused by product development, insufficient inventory, or other reasons. This process is constituted with requirement for quotation, selection, contract, receiving, inspection, and finally payment. Following are short explanation for major processes.

• Requirements for outsourcing: This is the starting point of B2B trade. These requirements come from production planning, scheduling, material resource planning (MRP), and capacity requirement planning (CRP). Production department decides the items and quantities based on various information.

• Acquiring related information: When there is requirement for outsourcing, a company acquires information about needed products. New suppliers can send their catalog or the company can distribute its acquisition plan to possible suppliers.

• Pre-selection: The company selects the suppliers and sends them require for quotation (RFQ). Decisions are made

978-1-4244-4639-1/09/$25.00 ©2009 IEEE

using acquired information such as contractors, factory status, and managers by primary review and interview. Product catalog is also required for further investigation of product specifications.

• Request for quotations: The company makes request for quotations (RFQs) after the analysis of product catalogues. In the catalogue analysis, specifications, quality, color, etc are used as criteria.

• Selection of supplier and shipment of product data package: The company selects suppliers by re-established criteria from received quotations. Then they make product data package (PDP) for suppliers review. PDP contains detail information of products such as drawings, bill of materials, specifications, and information needed for parts assembly. PDP is sent to the selected suppliers and the suppliers can send their opinion for engineering change.

• Contract: After negotiation of contract conditions such as unit price, quality, delivery conditions etc, contract details are fixed. The contract becomes the restricting framework for the following processes.

• Release order and expedite: After contract, the company releases order according to contract and regularly checks the progress. If there is delay, they expedite or try to make alternatives. The checking frequency is dependent on importance of the items.

• Goods receipts and inspection: Receipt department usually does this process. They prepare goods receipts with shipping notifications by suppliers. The supplier invoice is verified using item name, quantity, unit price, and delivery date with outsourcing order. After the goods receipts, inspection process checks the quantity, quality, and delivery date. If there is a delivery delay or product fault, they can give penalty to suppliers by contract.

• Payment: The results of goods receipt and inspection are posted to accounting department. Accounting department pays to suppliers after verification of outsourcing order, invoice, and received goods.

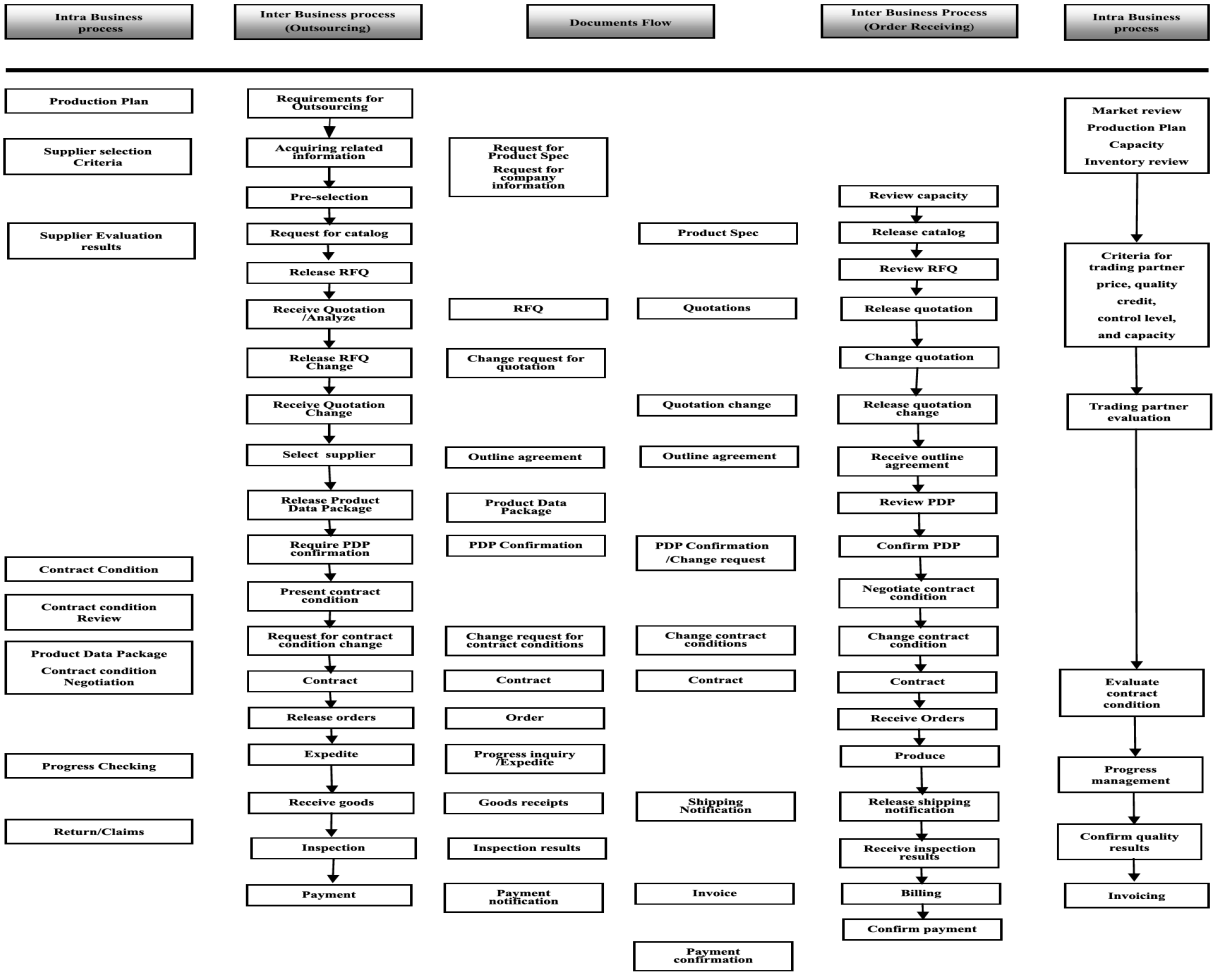

Figure 1. Reference architecture of B2B electronic commerce.

C. Order receiving process

In this study we assume that suppliers open information in public about their company and products. Our model begins at the process of production capacity review after they receive trade suggestion such as inquiry or request for quotation.

• Production capacity review: When a supplier receives RFQ, they investigate their refined production capacity. Sales department checks master production scheduling (MPS), bill of materials, and inventory records. Based on these information, sales department finds out feasible production capacity and the possibility of new production order release, and order quantity modification.

• Release quotation: Inquiry and quotation serve as guides to crucial presales processes. RFQ contains drawings, product specification, quantity, quality specification, and due date. Suppliers refer it when they prepare quotation. Quotations contain price condition, production condition, and delivery condition. Price condition represents unit price, billing, and processing/material costs. Production condition can include borrowing of materials or fixtures.

• Product data package review and confirm: The suppliers have to review PDP precisely before final confirm of contract. They compare their production skill and capability with product specification. They send engineering change request if needed. After the engineering review and change are finished, both sides confirm PDP.

• Contract: The contract specifies that customer will order a certain quantity of product from the supplier during a specified period. Contract usually contains all negotiation results such as price, duration, production, and delivery conditions.

• Receive orders: After the contract, the suppliers receive order according to the contract and stars production. If there are any changes of schedule or engineering, they notify to customers and discuss with them. The received orders are sent to production department to make production plan and check inventory.

• Shipping notification and delivery: After production is finished, the suppliers release shipping notification. If it is delayed than the due date of contract, they discuss with the contractor. They ship and deliver the product to the predefined destination with the predefined method by the contract.

• Billing: Order receiving processes conclude with billing. The supplier receives inspection results about quantity, quality, and delivery date. They make invoice with comparison of issue document and delivery document. Billing methods, such as separate invoice, collective invoice, and split invoice, are determined by the contract.

III. FUNCTIONAL MODEL FOR B2B ELECTRONIC COMMERCE

For framework of B2B EC, it is needed to identify related business processes and to define the required information and interface between enterprises. The B2B business processes are developed with IDEF0.

A. Outsourcing process

Table I shows the structure of outsourcing processes. Corresponding explanations are as follows.

TABLE I. STRUCTURE OF OUTSOURCING PROCESSES

A0: Outsourcing
A1: Set up the selection criteria
A11: Market survey and analysis
A12: Decide outsourcing items
A13: Decide exception for outsourcing
A14: Decide supplier selection criteria
A2: Select supplier
A21: Request for quotation
A22: Review the quotations
A23: Investigate the supplier
A24: Select supplier
A3: Contract
A31: Release product data package
A32: Review the prototype
A33: Negotiate the contract options
A34: Negotiate price
A35: Contract
A4: Manage progress
A41: Order management
A42: Progress management
A43: Goods receipt and inspection
A44: Payment

1) Set up the selection criteria

Production planning such as scheduling, MRP, and CRP, can initiate the screening process of outsourcing items. For the selected items engineering requirements and constraints are considered and these can be turned out to conditions for supplier selection. In market survey, company investigates the state-of-the-art technology and product, price, and trade conditions for required items. The outsourcing item list is finally determined after the comparison of the market survey results and item management information in the company. The exceptions and restrictions of outsourcing are determined by law restriction like patents, customer special request, specified manufacturer, and/or security. These restrictions may prevent the company from outsourcing and they have to in-house produce or specially manage that outsourcing. The selection criteria are defined based on the market survey for the selected outsourcing items.

2) Select supplier

The company can send RFQ to pre-selected suppliers or entitle the notice for bid. When the company receives the quotations, they keep them securely and select negotiable suppliers. They will receive company introductory document that contains company name, history, capital, built-up date, trade information, product information, and product capacity. After review of that document, they may visit the suppliers and investigate the management status, current production status, quality assurance activity, and shop status. This activity also includes interview with executives. They compare and select suppliers that they need with the results from review and investigation. They also determine the trade level of the supplier. This can be used as the level of progress management.

3) Contract

The company negotiates with selected suppliers. They discuss with suppliers about the details of the contract, such as quality assurance, trade options, delivery, and price. The final contract is made after settlement. At the early stage of contract processes the company releases PDP that contains the detailed production information. The selected supplier has to review that and request the engineering change if necessary. Then the supplier sends the prototype made by PDP. The company confirms PDP after checking the engineering change request and the prototype. To set up detailed contract options, they discuss about quality assurance, claim procedure, packaging, delivery, and ordering policy. They also negotiate pricing policy including payment conditions and methods. After all the things are settled down they exchange contract documents.

4) Manage progress

The order is fulfilled as in the contract. These activities contain order management, progress management, and payment. Order management starts from the receiving of request for outsourcing and screens them, and releases order to the contracted suppliers. Production or inventory department requests progress information. The progress management inquires the production progress to the supplier by predetermined interval or the request from other departments. If there is some delay they expedite or make alternatives. When they receive shipping notification, inventory management department prepares the goods receipts. The supplier's invoice is verified with received goods and order information. Inspection process checks the quantity, quality, and delivery date. Inspection results can be used as supplier evaluation. Inventory data are updated and goods receipts information are sent to production department. The results of goods receipts are also posted to accounting department to prepare payment according to payment methods of contract.

B. Order receiving process

Table II shows the structure of order receiving processes. Corresponding explanations are as follows.

1) Process quotation

A supplier regularly gathers the market information to prepare order receiving. To get market information they survey market trend by searching industry status. When they receive inquiry or RFQ, they review suggestion and reply for that. They may use market information, such as trade and technology development status of other companies in the same industry, as references to set up the trade directions and conditions. When the suppliers receive inquiries or RFQ, they have to reply after checking for engineering feasibility, available-to-promise (ATP), and profitability. This activity is closely related with engineering, production, and finance department. The quotation is released to the customer. This can include some modification from original RFQ and customers can also request change options.

TABLE II. STRUCTURE OF ORDER RECEIVING PROCESSES

A0: Order receiving
A1: Process quotation
A11: Market survey
A12: Receive request for quotation
A13: Send quotation
A2: Contract
A21: Receive product data package
A22: Send the prototype
A23: Negotiate the contract options
A24: Negotiate price
A25: Contract
A3: Manage progress
A31: Order receiving management
A32: Production planning
A33: Progress management
A34: Shipping management
A35: Invoicing

2) Manage progress

After the contract, the supplier receives orders according to the contract and starts production. When the order is received, the supplier reply orders confirmation. The received orders are sent to production department to make production plan and check inventory. BOM management extracts product structure and calculates required quantities by part explosion. Inventory management checks available quantities for making net requirement. Received orders are regarded as fixed in MPS calculation. MRP makes production plan with MPS, BOM, and inventory information. CRP can adjust the production schedule considering production capacity by production line or work shop. The supplier may regularly send progress reports or reply for progress inquiry from the customer. They ship the products according the contract and orders and release shipping notification. The shipping information also posts to finance department. The finance department prepares billing and they fix the invoice when they receive inspection results from the customer. Information model for B2B electronic commerce.

IV. INFORMATION MODEL FOR B2B ELECTRONIC COMMERCE

Current standard EDI documents contain unnecessary items and require data repetitions when we adopt those to outsourcing process. The reason is that EDI is developed for general usage and trade. We analyze traditional documents that are used in outsourcing process of electronics assembly industry. With this approach, standard documents are extracted and their information contents are identified. We implemented RFQ and quotation with XML using pseudo standards.

A. Standard documents

When analyzing business processes of B2B EC, we also investigate the traditional documents exchanged between enterprises. The documents are gathered from real electronics assembly companies. These documents are compared with the extracted documents and their contents for outsourcing processes. In this research, EDI document structure and contents for RFQ and quotation is developed. EDI structure of quotation is designed to give the sequence information when EDI system would translate and reverse-translate data transmission items.

Fig.2 depicts the EDI document structure of RFQ. Also, the segment specification is specified according to the designed EDI document structure. Segment specification defines data element, composite data element, and code element that can fill the segment. Referring UN/EDIFACT syntax rules and message design guidelines we develop EDI document structure

for RFQ of outsourcing processes. The EDI document for RFQ consists with message header, beginning of message, date/time/period, free text, reference, name/address, contact information, communication information, currencies, item line, additional product ID, item description, measurements, quantity, and message trailer.

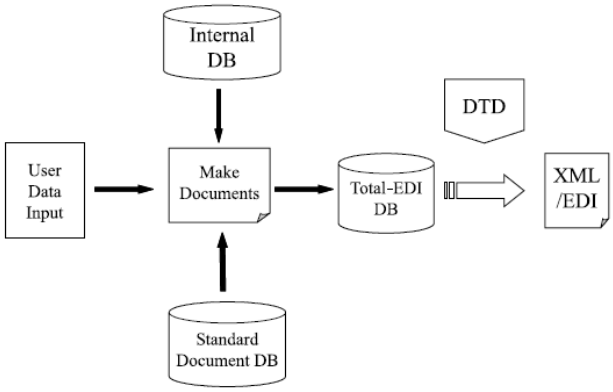

Figure 2. Concept of XML–EDI translation.

B. Design for XML-EDI

In this work, XML is adopted for the efficient production and exchange of documents on the internet. The types of documents used in ordinary enterprises are numerous various and there are many differences between B2B and intra-enterprise purposes. Suppliers have to follow the customer's own requests by custom of outsourcing, which often causes re-entry and manual operations in documentation. In order to solve this problem, we defined the standard documents and develop standard exchange method based on XML. The documents along with processes are directly linked with internal database of enterprise. When the user selects the document, the document format is retrieved from format database. The pre-entered data are filled automatically through integration of internal and format database. Thus, it is possible to eliminate the repetitive entry and to input the only additional information. Each segment of produced documents are saved in document database. Saved segments are translated with XML by predefined DTD for each document. Fig.3 describes the concept of XML-EDI translation.

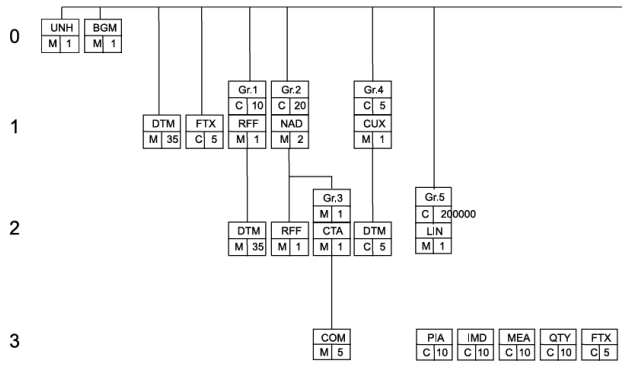

Figure 3. EDI document structure of RFQ.

The company that received the XML EDI documents can retrieve them using DTD and XSL. DTD defines document format and XSL does document presentation. XML documents can be presented with ordinary web browsers.

Traditional EDI systems require a dedicated program to translate and de-translate related information. The SGML based EDI systems also require special browsers to retrieve the documents. Our system, however, XML based EDI systems do not require special programs or browsers. This can be done by DTD and XLS that define format and representation of the documents.

V. CONCLUSION

Recently global supply chain management and its outsourcing are widely spread. It becomes more important to make virtual enterprise environment. It makes true the efficient exchange and sharing of business and technology knowledge.

The objectives of this research are to develop the architecture model for IDEF0 based B2B electronic commerce. For modeling B2B EC with IDEF0, It is found that standards for information and exchange method are essential elements to implement the B2B EC. We analyze the traditional documents for outsourcing and EDI documents to define standard information. We define standard documents and its items according to the developed model. For standard exchange method, we adopt web and XML. The web is to offer the unified interface environment for small sized companies that involved in this industry. We used XML to give platform independent representation of documents. XML would eliminate the need of special translate programs. We developed DTD and XSL for RFQ and quotation as examples. As a result, a set of model is presented for B2B EC. They are architecture model, standard documents, and standard exchange system.

REFERENCES

[1] Sheppard, E. (2002). ‘‘The Spaces and Times of Globalization: Place, Scale, Networks, and Positionality.’’ Economic Geography 78(3), 307–30.

[2] Bernus, P., Nemes, L., Williams, T.J., 1996. Architectures for Enterprise Integration. Chapman and Hall, London.

[3] Bin, W., Yunlung, C., 2000. A framework for strategically-driven evaluation of enterprise information systems. Int. J. Prod. Res. 38 (17), 4071–4084.

[4] Sheppard, E. (2002). ‘‘The Spaces and Times of Globalization: Place, Scale, Networks, and Positionality.’’ Economic Geography 78(3), 307–30.

[5] Doumeingts, G., Vallespir, B., Chen, D., 1995. Methodologies for designing CIM systems: a survey. Comput. Indus. 25, 263–280.

[6] Turowski, K. (2002). ‘‘Agent-Based e-Commerce in Case of Mass Customization.’’ International Journal of Production Economics 75, 69–81.

[7] Wheeler, J. O., Y. Aoyama, and B. Warf. (2000). ‘‘Introduction: City Space, Industrial Space, and Cyberspace.’’ In Cities in the Telecommunication Age: Fractured Geographies, 3–17, edited by J. O. Wheeler, Y. Aoyama, and B. Warf. New York: Routledge.

[8] IDEF-0, integrated-computer-aided manufacturing definition, activity model, integration definition for function modeling, NIST FIPS pub 183, 31 December 1993