

THE USE OF ELECTRONIC COMMERCE IN THE MATERIALS PROCUREMENT IN SA CONSTRUCTION INDUSTRY

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ABSTRACT

South Africa is facing the challenge of providing housing and infrastructure to millions of its residents. The improvement of the construction process to enable and improve delivery of such scale is of paramount importance to the industry.

The paper focuses on the use of Internet enabled electronic procurement of building materials.

The CSIR in South Africa is developing a product called eZebuild in collaboration with the construction industry, IT companies and the major banks.

eZebuild consists of a core building product library, tender management and bill of materials systems, integrated with an Internet enabled ordering and payment gateway. eZebuild gives contracting companies access to building materials suppliers via the Internet from a pre-compiled bill of materials.

eZebuild provides materials suppliers, contractors and construction managers an easy to use tool that improves the overall management of materials procurement significantly. It also improve site processes since the procurement of materials can now be pre-scheduled and delivery of materials can occur on a just in time basis reducing site storage requirements and wastage significantly.

Specific items addressed in the paper include:

- *A process analysis of eZebuild and the related changes in the construction management process.*
- *The technologies used to implement eZebuild.*

A brief description of the project including:

- *The merging of these diverse technologies to develop an integrated materials procurement solution or the construction industry; and*
- *Some of the difficulties that are encountered during the implementation of such an integrated system in the construction industry.*

Keywords

Procurement Process, Electronic Commerce, Product Specification Library, Internet, Internet Shopping Mall



1. INTRODUCTION

After several years of severe recession in the South African construction industry, government recently announced that up to R232 billion investments in infrastructure and facility development has been mooted. This implies at least a 20% growth in Gross Domestic Fixed Investment (GDFI) per annum. In addition to this, South Africa is facing a challenge to deliver housing and appropriate services to millions of its residents that has previously been deprived of proper shelter and services.

Furthermore, the industry is suffering from a number of negative factor conditions, such as lack of skills training, low productivity and in particular adversarial relationships between client, contractor, sub-contractor and material supplier. The adversarial relationship even exists inside construction firms between head office and site. These factor conditions are impacting on the overall performance of the industry resulting in ever increasing cost of construction in South Africa.

It is in this context that the CSIR and several industry partners, including IT companies and major banks have embarked on the development of an Internet based electronic materials and labour procurement process for the construction industry. The concept has been named eZebuild.

The main aim of eZebuild is to reduce levels of adversity in the industry by re-engineering the procurement process.

2. CURRENT USE OF INFORMATION TECHNOLOGY IN PROCUREMENT

A series of process analysis undertaken of the South African construction industry has revealed that a great deal of the latest information technology is used in the procurement process. The communication of information between the different systems is however largely still manually integrated.

Process	Information Technology Usage
1) Obtain prices	Level 3: Process primarily manual with use of faxes to transmit information
2) Submit Tender	Level 3: Process manual and likely to stay that way until digital signatures becomes acceptable practise on contracts. In some cases electronic information is submitted in addition to tender documents.
3) Request Material	Level 2 and 3: The use of E-mail has become an accepted practise inside some of the more advance information technology users.
4) Order Material	Level 3: Use of fax is currently the best practise although telephone calls are accepted as long as an order number is provided. The use of structured e-mail or other secure electronic communication should thus be acceptable.
5) Deliver Material	Level 3: For obvious reasons this will remain the same. The delivery note is however also still paper driven.
6) Receiving and checking.	Level 2: Delivery note information is recaptured into spreadsheet.
7) Progress Feedback	Level 2: Current practise is for information to be forwarded by spreadsheet and then imported into cost control systems.
8) Cost Control	Level 1: Information is captured once. Systems fairly well integrated to accounting systems.
9) Invoice	Level 3: Invoices are posted from materials suppliers to contractors.
10) Payment	Level 3: Payment takes place by cheque.

Note on table 1:

Level 1: Full seamless electronic integration of information.

Level 2: Full electronic transfer of information but re-capturing of information takes place at the processing point.

Level 3: Manual transfer and re-capturing of information at the processing point.

Communication is still largely taking place by fax, with limited use of electronic mail in the most technologically advanced companies. This implies limited sharing of information in the procurement process. Figure 1 depicts the existing procurement process in the South African construction industry. Table 1 gives each process and the level of technology integration through the use of information technology.

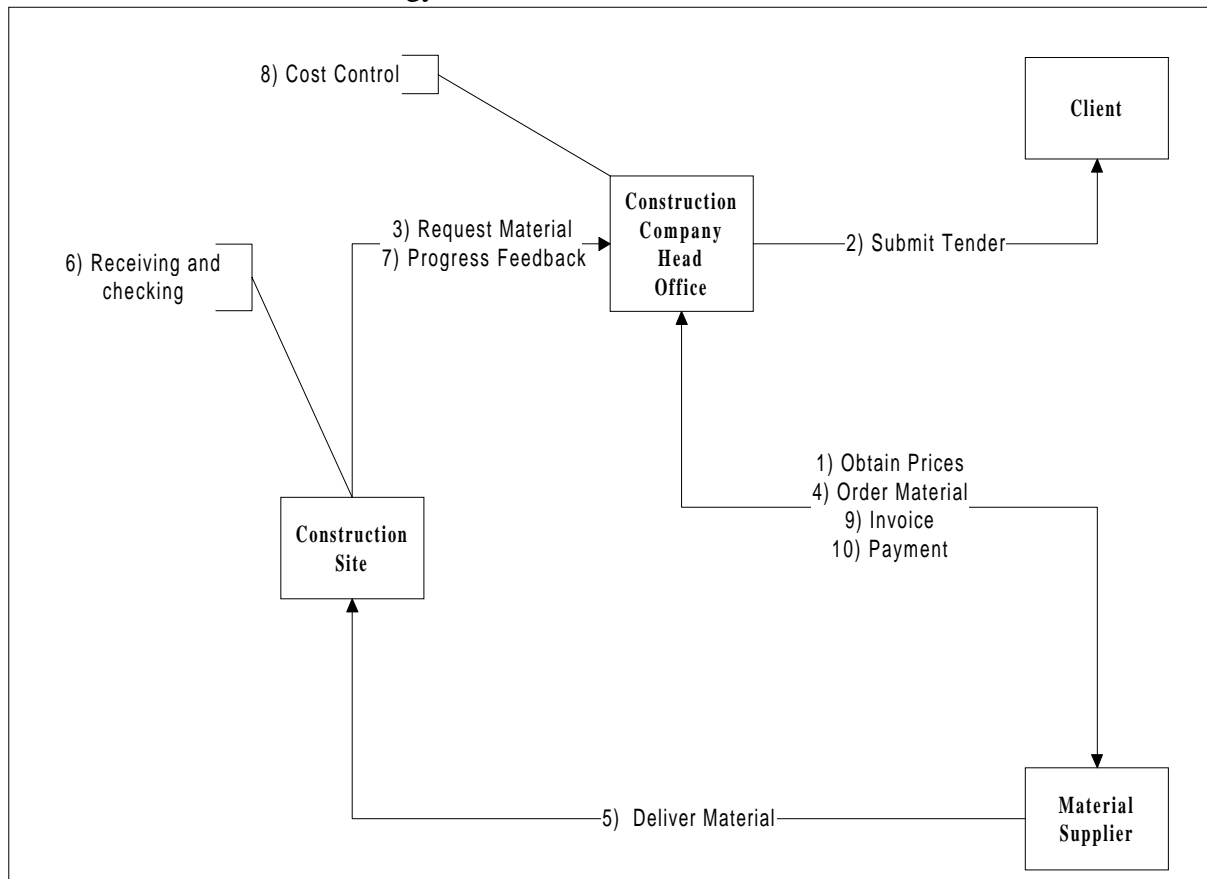


Figure 1: Existing materials procurement process.

3. RE-ENGINEERING THE PROCESS OF PROCUREMENT

In the process of re-engineering the procurement process, the eZebuild project team has drawn extensively on the concepts such as a single integrated project database for a construction project as well as the concept of an industry wide knowledge base. The core information element of the procurement process is the bill of quantities. The bill of quantities includes the product specification for the project. Figure 2 demonstrates the role and importance of the bill of quantities in the procurement process.

4. DESIGNING EZEBUILD

As mentioned earlier, the strategic requirement for eZebuild is to reduce the levels of productivity and adversity in the industry through improved sharing of information. A two phased approach has been adopted towards meeting this requirement.

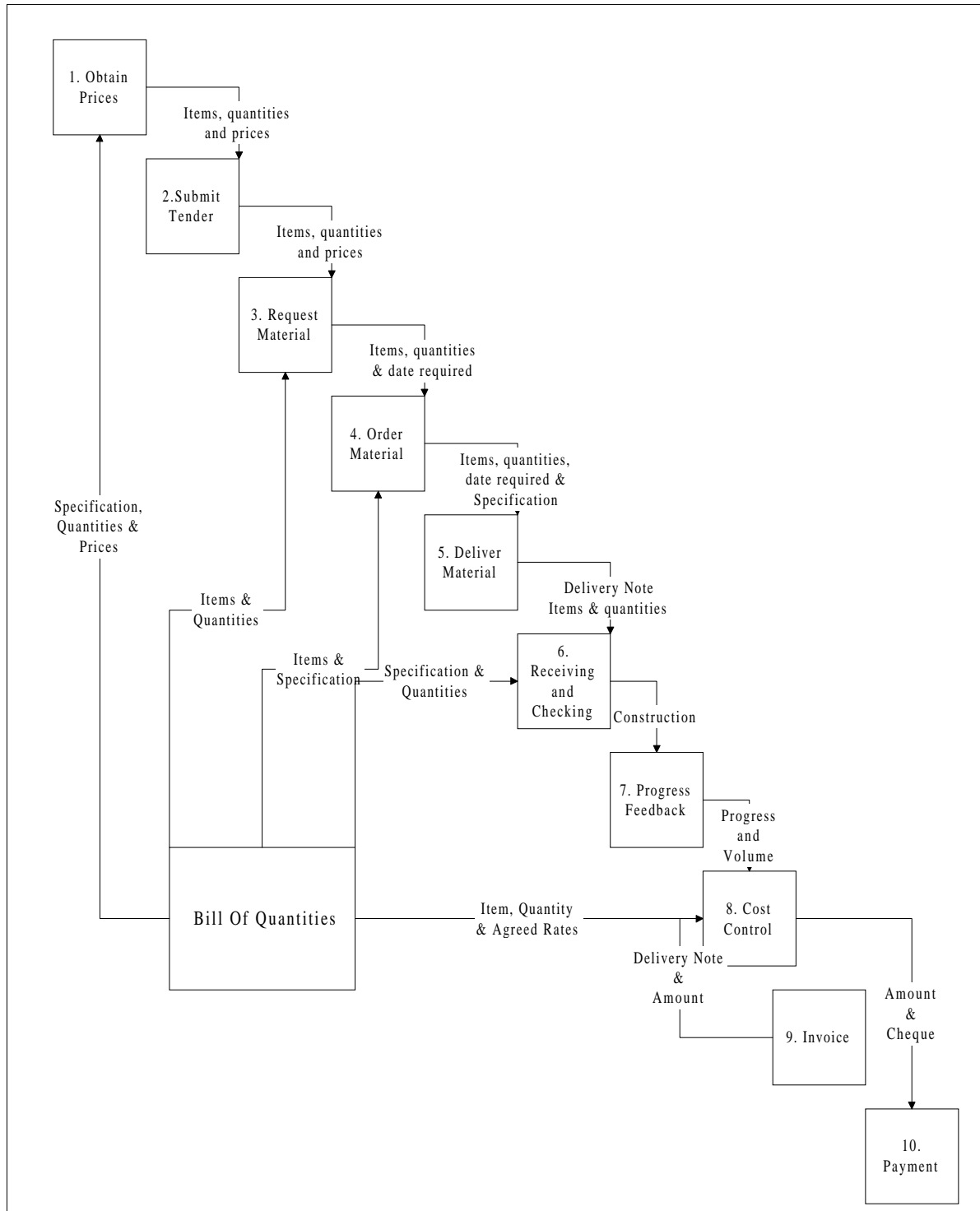


Figure 2 Importance and use of bill of quantities in the procurement process

- Phase 1 requirements include:
 - Develop access to materials and product specifications to which designers, contractors and materials suppliers have direct access. The ideal would be if the manufacturers maintain the product information themselves.
 - Develop access to tender information in such a way that companies can access the information readily.

- Develop a platform for a single bill of quantities with seamless sharing of information by project team members.
- Enable electronic ordering and payment transactions between suppliers and construction companies. Security must be defined to give team members access to relevant information only and protect the information from unauthorised access.
- Phase II requirement is to define a message standard that would allow for seamless electronic integration of processes and systems to eliminate the need for recapturing information.

Based on the above requirements and the conceptual process model the following technical requirements were defined:

Phase I:

- Network communication between the client, head office and construction site as well as material suppliers.
- High speed accesses to a database of building product specifications.
- Security and authentication of all transactions and interfaces to various systems.

Phase II:

- Seamless integration of estimating, ordering, receiving and cost control process of construction companies with the single bill of quantities.
- Seamless integration of the stock control, order management, invoicing and payment processes of the material suppliers.

An analysis of existing processes reveals that the transactions between the various systems and the project database are typically of low volume and relatively small size in comparison for instance to the amount of transactions banking networks handle. In addition to this, access to the database, particularly from the construction site, is on an ad hoc basis, which imply that these systems do not need a real time connection to communicate. Relatively low entry cost, software and hardware requirements make the Internet an ideal carrier to integrate these systems.

Furthermore, technologies such as an Internet shopping mall and an Internet search engine provide proven facilities for order, invoice and payment management as well as authentication and secure communication based on the ISO 8583.

5. EZEBUILD ENABLEMENT

The accessing of building product specification through the Internet is a project that was started by the CSIR in joint venture with an information technology company a number of years ago.

The product specification library consists of approximately 12000 South African manufactured product specifications that have been scanned and indexed. The product specification library is available on the Internet and CD-ROM. Interior decorators, architects, engineers and construction companies use the information in the design and construction process. The product library is currently maintained through a bureau service, however developments are in process to develop a database driven version of the product specification library.

This allows manufacturers and product developers to access and maintain product information. The intention is that the library will be migrated to relational database. The relational database

will in turn be used to publish information to the Internet. Figure 3 demonstrates the proposed use of a data warehousing methodology to maintain and update the product specification library.

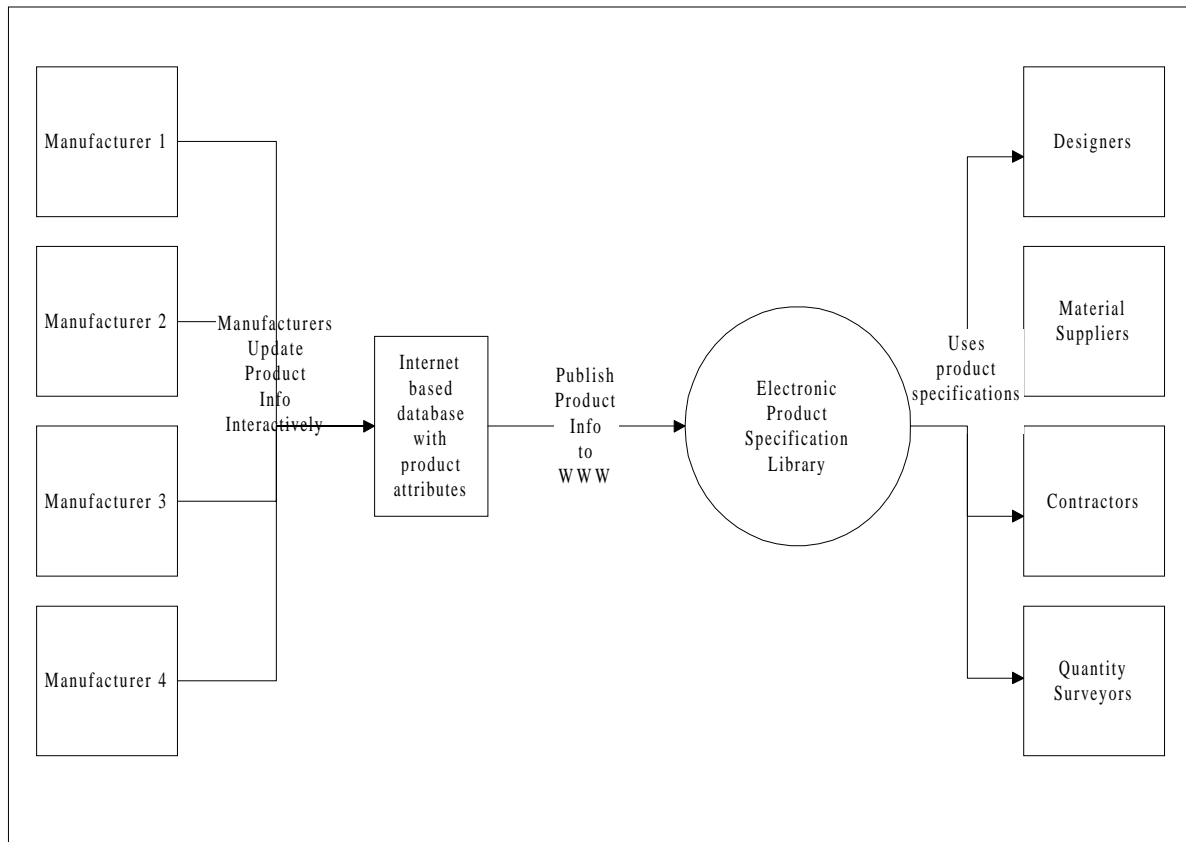


Figure 3: Product specification library

The concept of an Internet enabled project server is by now fairly well known and can almost be considered as state of the art. The project server allows the participants in the construction process to share information such as drawings, minutes of meetings and site instructions. In addition to this, the project server can also be used to enable the management of the procurement process. Figure 4 below depicts the enablement of the project server to accommodate electronic commerce.

In order to enable electronic commerce, the project server needs to be enabled with an electronic shopping mall. An electronic shopping mall guarantees secure, authenticated electronic business transactions between parties. If the shopping mall is linked to a payment gateway, payment and transfer of funds can also be enabled.

Secure transaction processing according to ISO 8583 requires that the project server be registered with the local digital certification authority. In the case of South Africa it is SACA (South African Certification Authority). The certification authority issues a digital certificate for the project server. The digital certificate consists of software that encrypts all data and transactions.

The digital certificate also manages access control to the project server by the authentication of a user during the log on procedure to the server.

In addition to this, user security profiles in the database ensure that users only have access to

information in the database that they are entitled to.

Users are enabled with a web browser to access the project server.

Project Database			
Supplier Table	Product Item & Quantities Table	Quotation Data Table	Progress Feedback Data Table
Electronic Shopping Mall			
Order Management	Transaction Processing	Payment Management	Transaction Record History
Digital Certificate			
Secure communications and transactions protocols based on ISO 8385	Low level authentication of user and merchants	Interface to electronic Payment Gateway	
Hardware and System Software			

Figure 4: Enablement of project server for electronic commerce

6. OPERATION OF EZEBUILD DURING PHASE I

When a construction company decides to tender on a project, it can request the client to download the tender document to the contractors project server. The bill of quantities, which forms part of the tender document can be entered into the database on the project server. Figure 5 below depicts the proposed eZebuild process.

The items table in the database must contain at least the following information:

- Specification of item
- Quantity
- Planned delivery date
- Estimated time between order and delivery

Costing staff can use structured E-mail to request prices from suppliers, and eventually directly from manufacturers. The supplier can enter the information into a separate table consisting of the following information at least:

- Supplier Number
- Item Number

- Quoted price
- Discount applicable
- Payment method

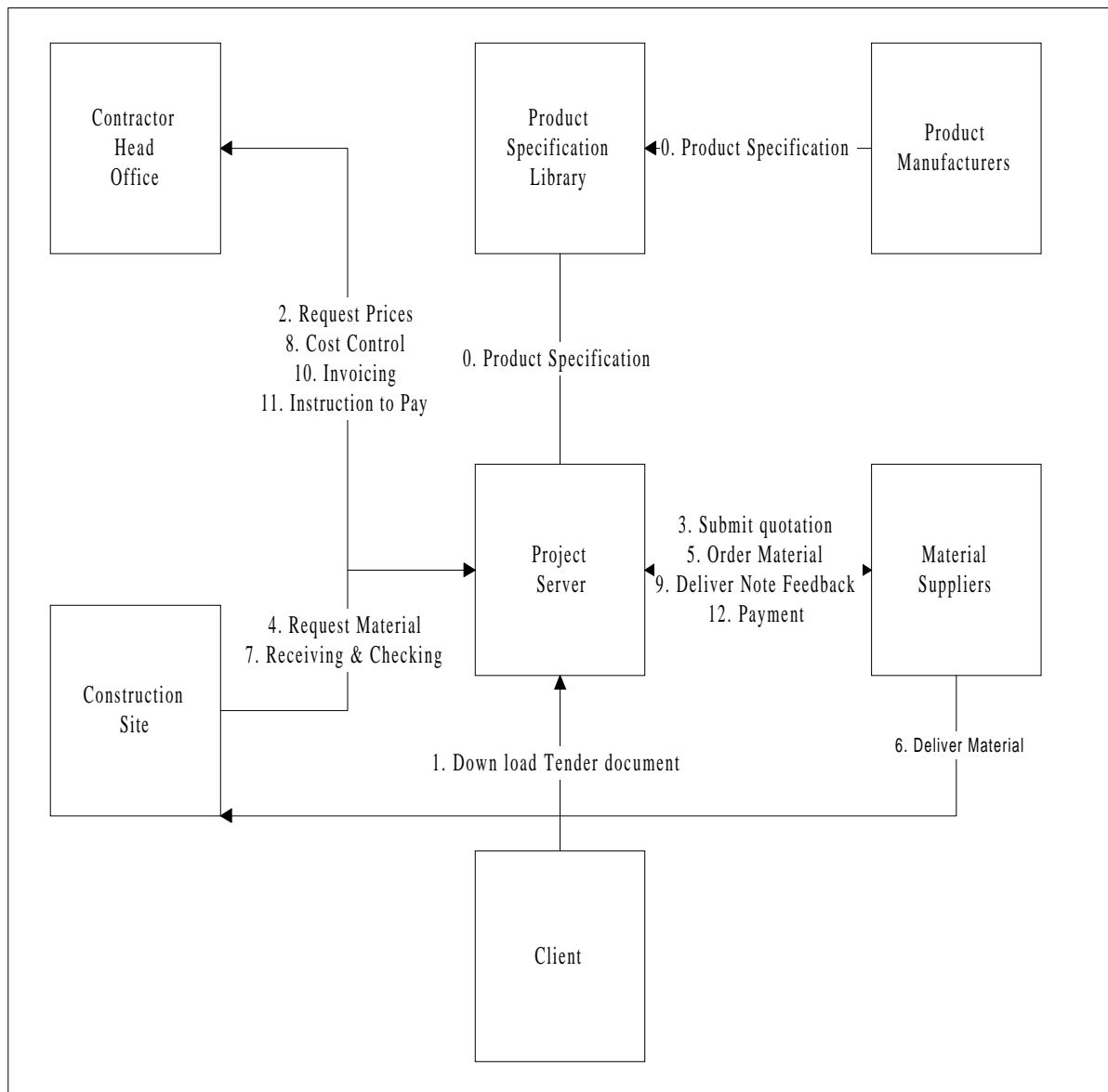


Figure 5: Proposed process model

On commencement of the project the contractor populates the bill of quantities with the preferred supplier information. A preliminary delivery schedule is attached to each item and suppliers are requested to add an approximated delivery time.

The construction site requests delivery of items from the electronic shopping mall through an Internet browser. The electronic shopping mall generates an electronic order. The order is forwarded to the supplier by means of a structured E-mail who then delivers the material on site.

Acceptance of materials delivered on site is fed back into the project server against items ordered. This immediately makes the information available for cost control purposes at head office.

The supplier confirms delivery of items on the construction site by feeding the information back to the electronic shopping mall. The electronic shopping mall generates an invoice. The invoice is forwarded to head office by means of a structured e-mail.

Head office downloads information from the electronic shopping mall into the accounting system.

Payment can be effected by instructing the electronic shopping mall to transfer funds from the contractors bank account to that of the supplier.

7. IN CONCLUSION

It can be concluded that eZebuild hold great benefits for both improved productivity and improved communications in the construction industry. Some of these benefits include:

- Shared accessible information throughout the procurement process.
- The need for separate buyers disappears due to the fact that a continuous flow of information from the site to the supplier is created.
- Improved and direct access to the ordering system provides improved capabilities for just in time procurement. This allows for reduced levels of materials on site and thus reduced wastage.
- Using eZebuild contributes to increased use of information technology in the construction process and significant improvement of the process through sharing of information.

Some of the problems experienced with the development of eZebuild are given below.

- The largest initial concern was the banking systems. However, although banks have mammoth legacy systems, the concepts of interoperability and message exchange are well established in the banking environment. This provided significant out of industry learning for the project team particular in the area of secure electronic transactions. However, the learning took time and delayed the process.
- The available electronic shopping malls operate on the principle of immediate payment. The construction industry required that the shopping mall operate on a principle of delayed payment. The electronic shopping mall software had to be customised to cater for this need.
- Connectivity of remote construction sites, as well as Internet bandwidth is proving to be one of the largest problems.
- Resistance to change and the acceptance of new operating procedures is proving to be one of the largest problems.

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