STANDARDS AND DIFFERENTIATION: SQUARING THE CIRCLE

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ABSTRACT: Intercommunication between diverse computer systems demands the use of standards. Initial standards were concerned with the physical and electrical including the structure of the messages sent by one system to another. The most recent developments have addressed high level semantic issues which are the primary concern of the users. The trend therefore has been one from lower, syntactic, system concerns to higher, semantic, application issues. Whereas the development of the ISO Open Standards Intercommunication standard has been universally accepted the creation of higher level standards has not been so simple. This paper addresses some of those issues. In particular, it draws on the lessons learnt in the production and evaluation of a multi-media product selector that has been built to support the construction industry. A primary concern that has been highlighted by this product is the need to provide novel query mechanisms which can cope with a diversity of data structures. This demand for differentiation is directly at odds with the standardised capabilities of current distributed data structures.

KEYWORDS: Standards, differentiation, X500, product, selectors

PRODUCT SELECTORS IN THE CONSTRUCTION

An integral element of most construction projects is the selection of components and products which will go towards the completion of the project. The selection process however is complex, the selectors must balance a diverse number of demands. Typically such demands include the need to conform to any specification, cost constraints, time constraints and a variety of organisational demands. The most obvious demand is the need for conformance to specification, this will not only require conformance to technical constraints but also aesthetic demands. To satisfy the first requires the supply of technical data pertaining to a product, however to satisfy the demand for visual acceptability requires the use of pictures and images showing the product in use. This visual aspect of construction products naturally requires the provision of such images and product catalogues frequently embody such images. In a computer environment the requirement for a multimedia system is obvious. Cost data is not as simple as it might seem. Few suppliers care to quote a given price for a particular product. Discounts can be offered depending on volume, customer or lead time; indeed prices are negotiable on virtually any aspect of product supply. Suppliers prefer to operate an enquiry system for their products which can facilitate negotiation. Temporal aspects of product supply again occur in a large variety of forms; lead times for delivery and the period allowed for payment are just two examples. Finally organisational demands are concerned with constraints inherent within an organisation that will either faciltate or restrict the selection and use of a particular product. The decision-making process is inherently complex given the obvious and explicitly stated constraints.

However, the process is further complicated by the desire of suppliers to differentiate their products and services from those of their competitors. This differentiation is one of the primary mechanisms for attaining competitive advantage (Porter, 1980, 1985). Yet in the absence of previous exposure a product selector will have little understanding of the nature of differentiation and what benefits it can bring. Furthermore the nature of differentiation mitigates against its inclusion in any standardised data structures.

With the huge number of products available for use in the construction industry it can be a difficult process merely to identify all the possible sources of supply. It is an expensive task for product manufacturers and suppliers to disseminate data on their products and much of that data can be highly volatile, a key example is availabilty and delivery lead times. To optimise product selection the data requires high level uniformity which allows a conceptual unification of the search space. The creation of such uniformity is, however, directly at odds with the desire to allow a high degree of variablity necessary to reflect differentiation.

This paper considers this problem in the light of experiences in building and evaluating a large scale, distributed, multimedia product selector for the construction industry. This system was built using the X500 Directory Services standard and allowed distributed enquiries for products.

MEDIA PRODUCT SELECTOR: MMPS

MMPS is a distributed database system holding product data together with bibliographic information. It is a shared product database system which is accessible by organisations with network capabilities within the construction industry. The database is composed of entries; each entry contains information about one object, and typically one object represents one product. Thus one entry might hold data about a specific brick product. Objects of the same type are grouped into an object class, or alternatively specific objects represent a specialisation of an object class. Thus the object class brick might have specific product objects, heat resistant brick and frost resistant brick. Where an object class represents a generalisation of a product type, this object class is called a product category in the MMPS system. However, objects are not restricted to holding only data on specific products, they might also hold data on product suppliers. In fact the MMPS system handles three types of data stored in a hierarchical structure of entries. At the top level supplier details such as company name, address, telephone number, fax, electronic mail address, etc. are held. Below this, at the second level MMPS holds product category data, typical product categories (or object classes) are door, window, tile, brick and blocks. The lowest level holds the data on product products. Thus in the brick product category each entry will contain details on the product name, material, sizes, weight, colour, compressive strength etc.

In addition to these structured data types MMPS also has the important facility for handling unstructured data types, in particular it incorporates bit map images. This is an important component in any product selector for the construction industry since selection is not only made on the basis of technical and financial criteria but also on the visual impact of a product.

The system utilises the X.500 Directory System capabilities to store and manage the product database. The database consists of data stored in several organisations. Users perceive the system to be logically centralised, but physically it is a distributed database with its data fragmented over several geographically remote sites. Each organisation that holds product data has a Directory System Agent (DSA) to manage the data local to that site and perform the distributed operations. The combination of all the distributed data constitutes the Directory Information Base (DIB). Each user is represented in accessing the system by a Directory User Agent (DUA), which is considered to be an application process. The system enables users to search through the database, select a product, and view its details. The users of the system can read and modify the information, or part of it, subject to having the proper access rights.

This system will serve as a powerful tool for introducing electronic marketing into the construction industry. It will contribute to the improvement of productivity and the reduction the overall costs. In the future this system may also be integrated with other communication technologies such as electronic mail systems for negotiation purposes,
and to Electronic Data Interchange for computer-to-computer transfer of data such as invoicing, billing and electronic funds transfer.

IMPLEMENTATION DETAILS AND DATA STRUCTURES

The Directory System is an international standard for a global, logically centralised but physically distributed, electronic network directory. It has the capability of handling large volumes of data, it can store a wide variety of information, it is accessible to both people and applications, it offers extensive services to its users, and finally it provides naming conventions to find specific addresses.

The prototype MMPS has been developed using QUIPU an implementation of the 1988 standard for the X.500 Directory System. The Directory System consists of one or more DSAs, which are OSI application processes. The information belonging to the DIB is shared between these application processes. The DSAs co-operate to perform operations, with each DSA holding a fraction of the total directory information. Co-operation may take several forms and requires navigation through the distributed system. If a DSA cannot satisfy a request using its own information, it will pass the question to other DSAs.

The Directory User Agent (DUA) is the user interface of the system. It provides users with various services such as interrogation and modification to the product database. It assists the user in formulating requests, submits the completed requests to the database system and organises the answers received from it into a format meaningful to the user. In addition to data management the Directory System is also responsible for enforcing service qualifications such as service controls, security parameters, and filtering capabilities.

The DIB information is held in the form of entries. An entry may be treated as a record of a product, or information on an object. The entries of the DIB are arranged in the from of a rooted tree known as the Directory Information Tree (DIT). This arrangement of the entries reflects the natural hierarchical relationships between the objects. The hierarchical structure adopted by the Directory is a logical structure only. The Directory standard does not specify how the actual physical information is to be stored. The product data of MMPS itself is stored in a separate database controlled by a database management system. This database may be relational, hierarchical, or based on a flat files. The Directory accesses this database management system for product data by mapping its own hierarchical view of the information onto the actual underlying database structure. The manner in which data is stored in the X.500's DIB is very important, since the search strategy for a specific data item will strongly depend on it. The better the data is structured the faster the data is retrieved, and the less storage area is wasted.

Considering the MMPS system itself the data stored is of course concerned with construction products, and the suppliers and distributors of those products. The data structure of the MMPS system is designed as part of the Directory Information Tree (DIT). A virtual root has been created at the organisations level in the DIT. This root represents the ceiling for the MMPS data so that all the entries of both suppliers and products are stored under it. The virtual root also limits the movement of the when browsing and helps the system search function to limit its search to specific levels to reduce the search time.

Directly under the virtual root are the suppliers' entries. The attributes of this entry, hold all the information about the suppliers of the construction products. When a product is found the DSA will already hold the reference to the supplier's information.

Under the supplier level comes the product category level. The attributes of these entries hold all the information about the products that are held by the suppliers. Typical product categories include windows, doors, roof tiles and slates, bricks, blocks etc.

Under the product category level is the product level. These entries are normally leaf entries and contain the data of each specific product. It should be noted that each product, when found during a search, inherits all of the supplier's information. Whilst this is usually the bottom level this is not necessarily the case; further subdivisions are possible with further levels added as required.

COMPETITIVE ADVANTAGE AND PRODUCT DIFFERENTIATION

In his three books on Competitive Strategy and Advantage Michael Porter (1980, 1985, 1990) has analysed those factors which make one company more competitive than another. His approach is broader than the traditional economic model of supply and demand which states that consumers will consume more if prices are lowered. He points out that the behaviour of both the supply and demand side of markets is more complex than the theory can account for. He characterises competitive advantage in three different ways. First there is indeed the traditional approach of cost leadership; a company will succeed over others if its products and services are cheaper than those of its competitiors. This presupposes that the products and services are indeed interchangeable, while this is true in the small area of commodity goods it does not hold for the vast majority of trading activity. Moreover, as Porter points out there can only be one lowest cost supplier. In traditional economic theory one would expect all the other suppliers to go out of business. Thus Porter describes two further approaches to obtaining a competitive advantage. First, there is the idea of differentiation. In this approach companies attempt to make themselves different from their competitiors, using some basis other than price. They may offer quicker delivery, local support, higher quality, better after sales service, guarantees and warranties, or even something as intangible as a brand name or image. It would appear as if this differentiation approach actually dominates the various attempts by companies to compete; we shall return to differentiation below. The final approach to competitive advantage relies upon the use of focus to satisfy a particular, and restricted need. In many cases companies attempt to supply something which is unique, or address narrow niche markets.

STANDARDISING DIVERSITY

In evaluating the MMPS system described above the designers encountered a particular problem associated with creating product catalogues and selectors. The problem arises because of the tension between standardisation and diversity.

The demand for standardisation arises from the technical need to integrate systems. The need for such standards is well-understood; the basic idea is that is two disparate systems wish to communicate then they must both conform to some common interface standard. In the absence of such a mutually agreed standard they remain isolated. The standards are commonly expressed in the form of protocols, which are themselves sets of rules. While the drive for standardisation has come from the needs of users the manifestation of those standards has essentially been machine based. In short, the most successful and well developed standards are technical in nature.

In constructing a software system that embraces an entire industry rather than an individual company or small subset of an industry there is a demand to maintain the diversity that stems from differentiation. This becomes particularly acute in the provision of a product catalogue. While it is relatively easy to identify certain characteristics which are shared by all products within a particular product type the problem arises when organisations wish to characterise their products using unusual, and possibly, unique attributes.

While system level standards and communication standards are now well established the use of standards to meet specific industry needs is still in its infancy. In evaluating the multimedia product selector system the builders of that system learnt some lessons concerning the nature of standards needed to satisfy industry. While machine level standards are primarily syntactic in nature (they are concerned with message formats, wrappers etc rather than what they messages actually contain) the application standards must be semantic. This poses many problems.

For a product such as a brick it might appear as if this were a pure commodity. Yet in designing MMPS for bricks it was found that many companies differentiate themselves using certain attributes. Delivery lead-time was such a characteristic; hand-crafted bricks was another. Large scale discounts were common in pricing the bricks and these discount structures varied from company to company; indeed they varied from customer to customer even for the same company. All of these caused problems in designing MMPS. Simplistically it might seem that the inclusion of every possible attribute could solve the problem; unfortunately this is not so. Many suppliers do not wish to specify certain data. The appearance of blank fields is however unacceptable to their marketing requirements.

REQUIREMENTS IN FUTURE SYSTEMS

The key lesson is that the specification of semantic standards must be at a sufficiently high level of abstraction to allow a diversity of formats which can thereby cope with differentiation. The problem for the customers arises however in formulating queries which can extract meaningful information. Simple queries simply do not work. Essentially they must be able to ask for things that they may not know exist.

Nevertheless, the point is still valid and some means of disseminating structure data (or metadata) to the users of a catalogue and product selector must be provided. The best means for this remains a topic for future work.

As a final point, it should be pointed out that the problems encountered in this work bear a remarkable similarity to those being encountered in building query systems for object oriented databases. Since the object oriented approach is built around the idea of extensible data type systems any query system must have the ability to handle queries on types which may not have existed during the design of the query language. Equally, with user-defined abstract data types lying at the heart of such a database the problem arises of informing the users of the database about the structure (or metadata) of the database. Given that this problem remains unsolved it is not surprising that our particular problem remains outstanding.

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