

bcXML, an XML Vocabulary for Building and Construction

Frits Tolman Professor ICT in Construction TU-Delft Delft, The Netherlands	Jeff Stephens Project Manager Taylor Woodrow London, United Kingdom	Rasso Steinmann Professor & Senior Consultant Nemetschek AG Munich, Germany
Reinout van Rees PhD student TU-Delft Delft, The Netherlands	Michel Böhms Project Leader TNO Delft, The Netherlands	Alain Zarli Project Leader CSTB Sophia Ant., France

Summary

Electronic information networking in Building and Construction (BC) has been the subject of research for the last two decades and indeed much progress has been made. For example, the exchange of electronic technical drawings, geometry models and building product models is possible today. Also in the eCommerce area much progress has been made, with the Internet dramatically increasing ICT awareness in BC. Several software vendors are marketing interesting Internet based systems that support eProcurement, sometimes even including back office-integration (job costing, accounting).

Despite these positive developments, progress in open, meaningful (BC semantics) communication over the Internet has been limited, and subsequently Internet based project information communication in large projects hardly exists. The reason is that there is still no common multi lingual BC vocabulary that can be used by both humans and computer applications. Such a vocabulary, that contains BC notions like 'beam', 'paint', 'door', 'foundation pile', cannot be implemented with the existing, HTML-based, Internet technology. HTML, the Hyper Text Mark-up Language, is what it says, a mark-up language, not a language to define human and computer understandable content.

With the new Internet language XML, eXtensible Mark-up Language [1], it is possible to define and communicate both content and mark-up. This means that XML supports the development of XML vocabularies as required by BC. The European IST 10303 'eConstruct' Project is doing just this with the development of bcXML (Building Construction XML).

The paper presents the latest results of the project focusing on the aspects related to information networking in Building and Civil Engineering.



Introduction

The European IST 10303 'eConstruct' project (from *eCommerce and eBusiness in the Building and Construction Industry: preparing for the new Internet*) [5] is finding pragmatic answers to the question: "What should an XML vocabulary for Building and Construction look like and what functionality should it support?"

This question has to be answered in a European context and with emphasis, at least initially, on the eCommerce type of communications. The motivation comes from the following facts:

- The Building and Construction (BC) industry has to increase its competitiveness and its ability to function on the European level.
- Currently no open, common electronic BC vocabulary exists that is able to support meaningful human and computer understandable communication over the national borders.
- Open eCommerce in BC, i.e. direct (one to one) electronic buying and selling of components, services and such in an open marketplace is currently not really possible (surely not over the borders).

Of course most consumer-supplier relations are well established and the added value of the Internet for these communications should not be overestimated. However there are many cases where established relations fail, for example if your preferred supplier runs out of stock or otherwise is unable to deliver or if prices rise then an alternative supplier may have to be found.

In an effort to close the gap between consumers and suppliers several initiatives are underway resulting in a proliferation of short-lived closed electronic marketplaces and vertical hubs, each requiring a different format, each taking its share (while adding little value).

Besides eCommerce support the vocabulary should also support the eBusiness type of applications. In our definition eBusiness takes a broader view than eCommerce, taking account of all the related aspects that involve the collaboration of partners (including suppliers) in a project. This means that the vocabulary to be developed should also support communication in the design, construction planning and construction phases, including relevant back-office applications.

Bridging to Other Worlds

Since bcXML is only a vocabulary, i.e. a set of terms and some simple language rules, bcXML will not replace existing formats for electronic communication. Figure 1 shows four groups of application areas with well-established communication protocols or with protocols recently under development. These are the 'islands of communication' that bcXML will help bridge.

With Classification we mean (BC-specific) classification efforts within ISO TC59SC13WG6. Design/Engineering stands for the efforts of ISO-STEP [3] and IAI-IFC [4] to develop communication standards for the exchange of product model data. EDI, from Electronic Data Interchange, is the existing (traditional) world of communications of commercial transactions. Collaboration (ebXML) denotes a new development of commercial and collaboration communications (“eBusiness”) under development by UN/CEFACT and OASIS [2].

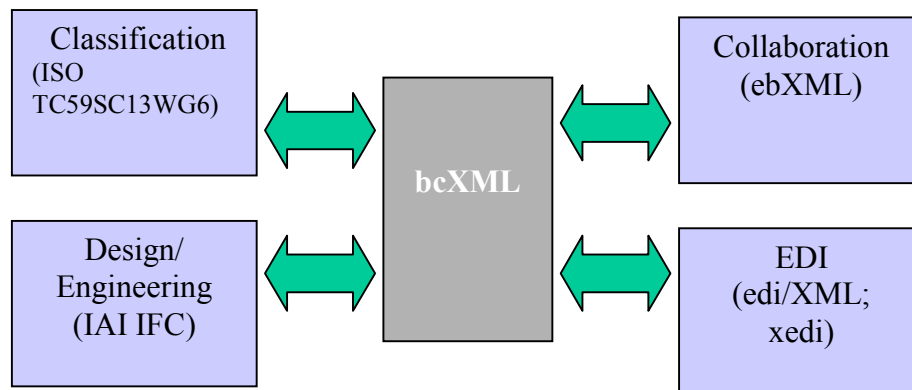


Figure 1. Some of the worlds that bcXML should bridge.

The eConstruct partners agreed that bcXML should, at least, be in some sense compatible with these four worlds. How this has been realized is shown in the meta-schema described below.

The bcXML Meta-Schema

The bcXML meta-schema is split into four subsections. The first subsection, subtitled *Taxonomies*, looks at the requirements that come from the demand and supply side. The second section, subtitled: *Dictionary*, concentrates on the communication of BC meaning inside and over the national borders. The third section, subtitled: *PDT*, focuses on those communication that involves concept that bridge to design/engineering aspects. The fourth section, subtitled: *Collaboration*, concentrates on eBusiness communication aspects involving co-operation and collaboration.

Taxonomies

Electronic information about products and services are still scarce and largely unavailable or not even available at all. This means that eCommerce in BC is not yet playing a role of any importance. However, times are changing fast creating a real need for consumers to quickly find suppliers of products and services. There is also a need for the suppliers to enlarge their market share, often outside the national borders. In the process from paper based communication to electronic communication the current situation is such that most suppliers have electronic catalogues and portals advertising their goods. Moreover eMarkets are popping up everyday. What is not solved is that each electronic catalogue, portal or eMarket use a different taxonomy (different terms for the same goods, different

properties and property descriptions, etc.) and no translation between taxonomies is possible (hence no electronic BC communication at a European scale).

The first problem that eConstruct had to solve was: how do we communicate with this variety of, largely unstructured, taxonomies? The solution proposed is that eConstruct is not going to produce a common (open) taxonomy, but only a common vocabulary, i.e. a set of common terms and some simple definitions that will become available in different languages. The next section discusses the dictionary that eConstruct will develop.

Dictionary

Figure 2 shows how the core of the bcXML meta model contains four groups of unrelated terms: (1) *objects* (subdivided into product, service and resource objects), (2) *properties*, (3) *units* and (4) *associations*. Objects can be related by two main relationships: decomposition (part-of) and specialisation (is-a). These four groups of terms and their simple structure provide the basis of a basic language that extends the general XML functionality with BC meaning.

The simple language described by the meta-schema has a number of advantages over plain XML as it now becomes possible to use these terms as Elements, Sub elements or Attributes in an XML message. Suddenly the computer 'knows' the (or perhaps better 'a') meaning of 'Paint', 'Door', 'Height', 'Width', 'cm' and the sentence:

paint x doors with height y cm and width z cm

For humans the language is extremely basic, but readable. Of course the mark-up features of XML/HTML can present this content much more clearly. For computers the language is also quite readable. If presented in XML format (see below) the browser can 'understand' each word. The great advantage here is that humans and computers share one common language and no further manual information transformations are required for inputting the content in some application program.

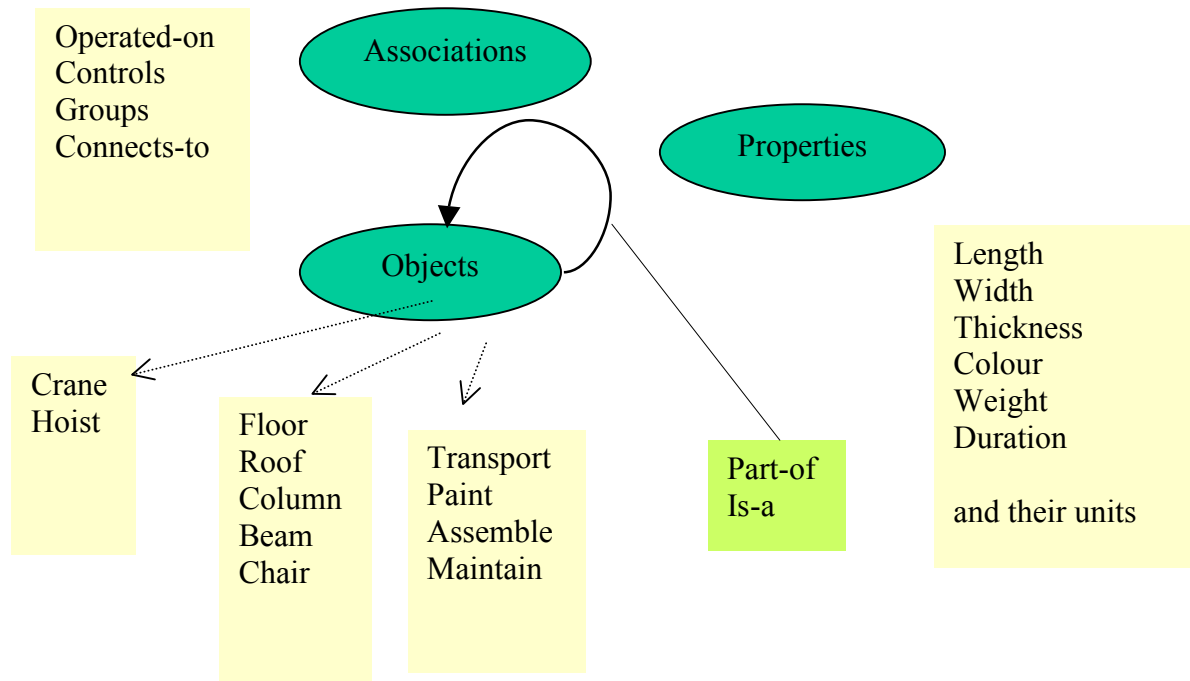


Figure 2 Impression of the bcXML meta-schema. The ellipses denote three groups of terms (examples are shown). Note that decomposition (part-of) and specialisation (is-a) are treated separately. The reason is that XML Schema solves these associations in the language (“sub element” and “extends”)

PDT

The objective is to realize the bridge to design/engineering. eConstruct co-operated with the IAI in the development of a common model that describes objects, properties and units.

Collaboration

One of the most important communications in Building and Civil Engineering is the safe communication between partners in a project. Business partners collaborate by linking their planning and execution business processes. UN/CEFACT is developing protocols to support communications required for collaboration and to guard the safety of the communications. EbXML technology will be suited for eBusiness and allows integration in the execution and planning stages, for example to support scheduling and all the related aspects so that the right product will also arrive at the right place and at the right time.

Formalizing the Meta Model

The bcXML meta-schema has been designed using the Unified Modelling Language (UML) of the Object Management Group (OMG).

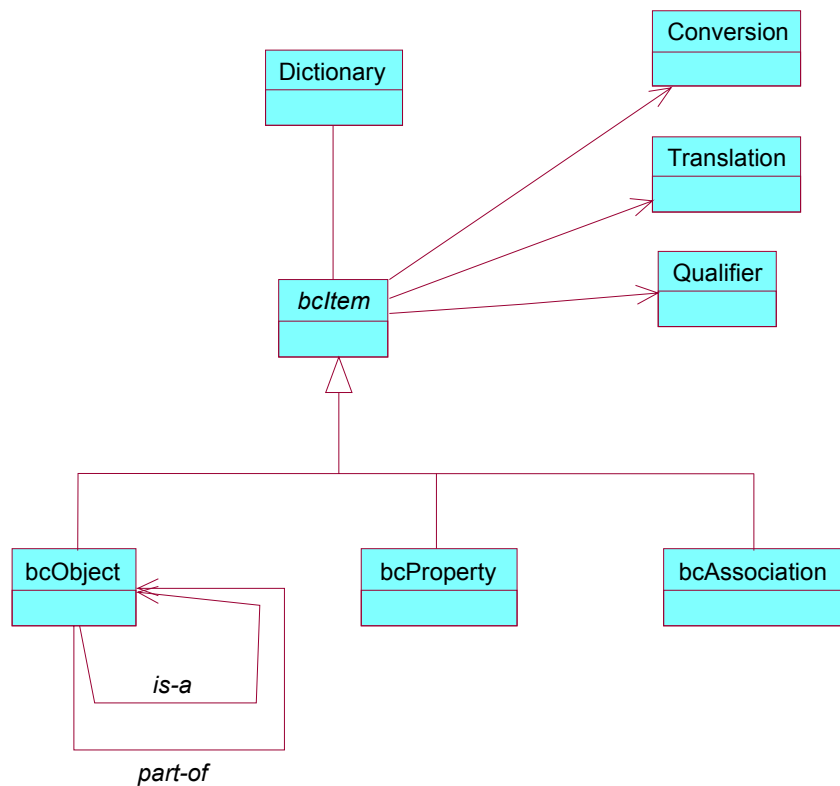


Figure 3. Impression of a UML class diagram that defines Dictionaries that contains bcItems (bcObjects, bcProperties and bcAssociations) that can be (1) organized following different qualifiers, (2) translated into different languages, and (3) converted between different classification schemes.

Different Dictionaries can contain bcItems that are relevant in different application domains. For the Building domain eConstruct will develop one dictionary, called bcDictionary, which will be made generally available.

Example

As an example of what a bcXML communication may look like, consider the XML code of the earlier example presented above. What you see is the XML syntax extended with bcXML meaning.

With this notation the earlier example looks like:

```

<wall id="#w1">
  <parts>
    <door id="#d1" action="paint">
      <properties>
        <height cm="190"/>
        <width cm="80"/>
      </properties>
    </door>
  </parts>
</wall>

```

Though nobody will have to read it, this content description is still readable. This presentation is input for the mark-up language that produces a presentation in the language of choice, and this same presentation is also directly input for a browser, or an application, releasing the human from its manual translation role.

Architecture

In order to understand how bcXML can be used let's consider the simple architecture of figure 4 below.

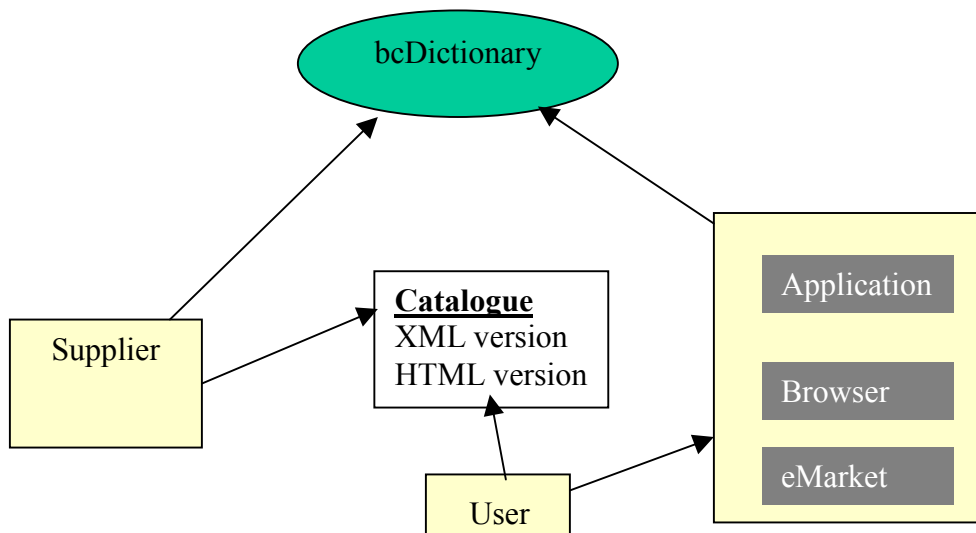


Figure 4. A simple architecture.

Suppliers of products, materials and services define their catalogues using the terms provided by the bcDictionary, transform them into XML and register them for external use. Users can view these catalogues directly in their native language using the (dumb) HTML presentation (the mark-up of the XML content version). Users can also view a translated version or use the XML version through their browser, eMarket, or application. Using the registered XML catalogue and the bcDictionary, the language translation is done on the fly.

Applications

Basically eConstruct will develop three groups of applications as a Proof Of Concept. The first group is dedicated to 'human to application' (H2A) communications, i.e. individuals that want to search the Internet for some particular item and companies that want to sell particular items, as illustrated by figure 4. A set of simple tools will be made available to the public. The second group of applications focuses on Computer Aided Selling (CAS). Here the communication between the CAS system and the various catalogues is done by bcXML. The third group of applications uses bcXML for communication of project information. Here the bcXML communication to the user is done using a browser and some multi media extensions.

Continuation

At the time of writing (December 2000) the first draft version of bcXML is being finalized. The dictionary filling is currently mainly including terms related to precast concrete construction. The reason is that eConstruct uses this domain for testing purposes. In the second year of the project the vocabulary will be extended and translations for different languages will be provided.

Discussion and Conclusions

Information networking in Building and Civil Engineering can greatly benefit from the application of a new XML based Communication Technology, called bcXML. BcXML adds BC meaning to Internet communications. This means that suppliers of Building Construction products and services will better be able to reach their customers and that consumers of BC products and services will more easily find what they need.

Though bcXML will initially focus on simple communications for the procurement of a realistic set of components, materials and services, more powerful versions will be developed in the next eConstruct project stages. Support for interactions between design/engineering, procurement and collaboration interactions in the planning and execution stages will be provided.

All the models and protocols will be tested in the precast concrete domain. The first results will be available in the summer of 2001.

References

- [1] <http://www.XML.org/>
- [2] <http://www.ebXML.org/>
- [3] <http://www.steptools.com/library/standard/>
- [4] http://cig.bre.co.uk/iai_uk/iai/menu1.htm
- [5] <http://www.eConstruct.org/>