# Non-Neutral Comparison of the Part 28 Early Bindings

## 1 Background and context

This paper compares three early bindings for XML.

The Containment Early Binding uses XML containment to describe STEP data. This binding is intended to be used to communicate complete information about a single EXPRESS defined data instance between an EXPRESS processing system and a XML enabled client.

The Strongly Typed Early Binding describes a complete instance of a STEP schema without loss of information. This binding is intended to give the most readable description possible to an EXPRESS defined data set without loosing any critical data semantics.

The Object Serialization Early Binding can also describe a complete instance of a STEP schema without loss of information. However like Part 21, in most circumstances this binding is intended to be used by application programs, not people.

The three bindings are applied to an example data set that was originally developed to illustrate the Containment Early Binding. The goal of the paper is to convince the reader that a Containment Early Binding needs to exist in addition to the other two bindings.

The following list summarizes the differences found between the CEB and the STEB for the chosen example.

— The CEB description is half a page. The STEB description requires two full pages.
— The CEB description uses much shorter names than the STEB because most of the conflicting EXPRESS attribute names are mapped into XML attributes by the CEB and XML elements by the STEB.
— The CEB description of the application_context_element data items is much simpler than the STEB description because inheritance is mapped more directly in the CEB.
— The CEB makes it clear that the item being described is a product_definition. In the STEB the item being described could be any of the instances shown in the Part 21 file.
— A STEB application can change references between data instances without contradicting the rules of the DTD.

The following summarizes the differences between the CEB and the OSEB for the chosen example

— The two descriptions are almost the same size.

— A person reading the OSEB file must make many searches to find the element containing a referenced data item.
— The OSEB description is very similar to a SDAI model as described in Part 22.
— An OSEB application can make many changes to the data that meet the requirements of the DTD but contradict the rules described by the EXPRESS schema.

# 2 Examples

## *2.1 Example data using EXPRESS and Part 21*

The example data was taken from a STEP Part 21 file written by a Pro/Engineer CAD system. The data is a subset of the full file. The file contains a product definition instance for a "tire" and all of the instances referenced directly or indirectly from that tire.

The EXPRESS schema given in the example is the subset of AP-203 required to describe the instances in the Part 21 file.

```
SCHEMA configuration_controlled_design
ENTITY product;
  id                 : identifier;
  name               : label;
  description        : text;
  frame_of_reference : SET [1:?] OF product_context;
UNIQUE
  UR1 : id;
END_ENTITY; -- product

ENTITY product_definition_formation;
  id          : identifier;
  description : text;
  of_product  : product;
UNIQUE
  UR1 : id, of_product;
END_ENTITY; -- product_definition_formation

ENTITY product_definition_formation_with_specified_source
  SUBTYPE OF (product_definition_formation);
  make_or_buy : source;
END_ENTITY; -- product_definition_formation_with_specified_source

ENTITY product_definition;
  id                 : identifier;
  description        : text;
  formation          : product_definition_formation;
  frame_of_reference : product_definition_context;
END_ENTITY; -- product_definition

ENTITY design_context
  SUBTYPE OF (product_definition_context);
WHERE
  WR1: SELF.life_cycle_stage = 'design';
END_ENTITY; -- design_context

ENTITY product_definition_context
  SUBTYPE OF (application_context_element);
  life_cycle_stage : label;
```

```
END_ENTITY; -- product_definition_context

ENTITY mechanical_context
  SUBTYPE OF (product_context);
WHERE
  WR1: SELF.discipline_type = 'mechanical';
END_ENTITY; -- mechanical_context

ENTITY product_context
  SUBTYPE OF (application_context_element);
  discipline_type : label;
END_ENTITY; -- product_context

ENTITY application_context_element
  SUPERTYPE OF (ONEOF (product_context,
product_definition_context,
  product_concept_context));
  name              : label;
  frame_of_reference : application_context;
END_ENTITY; -- application_context_element

ENTITY application_context;
  application : text;
INVERSE
  context_elements : SET [1:?] OF application_context_element FOR
                       frame_of_reference;
END_ENTITY; -- application_context

TYPE identifier = STRING;
END_TYPE; -- identifier

TYPE label = STRING;
END_TYPE; -- label

TYPE text = STRING;
END_TYPE; -- text

TYPE source = ENUMERATION OF
  (bought,
   not_known,
   made);
END_TYPE; -- source
END_SCHEMA; -- configuration controlled design
```

The Part 21 data is:

```
#421420 = PRODUCT_DEFINITION ('DESIGN', '', #670750, #670720);
#670700 = APPLICATION_CONTEXT ('CONFIGURATION CONTROLLED 3D
DESIGNS OF MECHANICAL PARTS AND ASSEMBLIES');
#670720 = PRODUCT_DEFINITION_CONTEXT ('', #670700, 'DESIGN');
#670730 = MECHANICAL_CONTEXT ('', #670700, 'MECHANICAL');
#670740 = PRODUCT ('TIRE', 'TIRE', 'NOT SPECIFIED', (#670730));
#670750 = PRODUCT_DEFINITION_FORMATION_WITH_SPECIFIED_SOURCE
('3', 'LAST_VERSION', #670740, .MADE.);
```

## 2.2 Example data using the Containment Early Binding

```
<STEP-product_definition>
<product_definition id=" design"  description = " " >
   <formation>
      <product_definition_formation_with_specified_source
         id = " 3"  description = " LAST_VERSION"
         make_or_buy = " made"  UR1 = " true" >
            <of_product>
               <product id =" TIRE"  name =" TIRE"
                    description =" NOT SPECIFIED"
                    UR1 =" true" >
                     <product.frame_of_reference>
                         <mechanical_context  name=" "
                           frame_of_reference = " SID-10"
                           discipline_type = " MECHANICAL"
                           WR1 = " true" />
                     </product.frame_of_reference>
               </product>
            </of_product>
      </product_definition_formation_with_specified_source>
   </formation>
   <product_definition.frame_of_reference>
      <product_definition_context name=" "
            frame_of_reference = " SID-10"
            life_cycle_stage = " DESIGN" />
   </product_definition.frame_of_reference>
</product_definition>

<inverse-instance SYSTEM-ID = " SID_10" >
   <application_context
      text = "CONFIGURATION CONTROLLED 3D DESIGNS OF MECHANICAL
      PARTS AND ASSEMBLIES"  context_elements = "true"/>
</inverse-instance>
</STEP-product_definition>
```

### 2.3 Example data using the Strongly Typed Early Binding

```
<configuration_controlled_design>
<product_definition id = " #421420" >
    <product_definition.id>
        <identifier>
          <string> " design" </string>
        </identifier>
    </product_definition.id>
    <product_definition.description>
        <text>
          <string> " "  </string>
        </text>
    </product_definition.description>
    <product_definition.formation>
        <product_definition_formation-ref refid = " #670750" />
    </product_definition.formation>
    <product_definition.frame_of_reference>
        <product_definition_context-ref refid = " #670720" />
    <product_definition.frame_of_reference>
</product_definition>

<product_definition_formation id = " #670750">
    <product_definition_formation.id>
        <identifier>
          <string> " 3" </string>
        </identifier>
    </product_definition_formation.id>
    <product_definition_formation.description>
        <text>
          <string> " LAST VERSION"  </string>
        </text>
    </product_definition_formation.description>
    <product_definition_formation.of_product>
        <product-ref refid = " #670740">
    </product_definition_formation.of_product>
    <product_definition_formation-subtypes
        <product_definition_formation_with_specified_source
          id = " ?" >
          <product_definition_with_specified_source.make_or_buy>
             <source> " MADE"  </source>
          </product_definition_with_specified_source.make_or_buy>
        </product_definition_formation_with_specified_source>
    </product_definition_formation-subtypes>
</product_definition_formation>

<product id = "#670740">
    <product.id>
        <identifier>
          <string> " TIRE" </string>
        </identifier>
    </product.id>
    <product.name>
        <label>
          <string> " TIRE" </string>
        </label>
    </product.name>
    <product.description>
        <identifier>
          <string> " NOT SPECIFIED" </string>
        </identifier>
```

```
    </product.description>
    <product.frame_of_reference>
        <set-of-product_context>
          <product_context_ref refid = " #670730" />
        <set-of-product_context>
    <product.frame_of_reference>
</product>

<application_context_element id = "#670730">
    <application_context_element.name>
        <label>
          <string> " " </string>
        </label>
    </application_context_element.name>
    <application_context_element.frame_of_reference>
        <application_context-ref refid = " #670700" />
    </application_context_element.frame_of_reference>
    <application_context_element-subtypes>
        <product_context id = " ?" >
          <product_context.discipline_type>
             <label>
               <string>" MECHANICAL" </string>
             </label>
          </product_context.discipline_type>
          <product_context-subtypes>
             <mechanical_context id = " ??" >
             </mechanical_context>
          </product_context-subtypes>
        </product_context>
    </application_context_element-subtypes>
<application_context_element>

<application_context_element id = "#670720">
    <application_context_element.name>
        <label>
          <string> " " </string>
        </label>
    </application_context_element.name>
    <application_context_element.frame_of_reference>
        <application_context-ref refid = " #670700" />
    </application_context_element.frame_of_reference>
    <application_context_element-subtypes>
        <product_definition_context id = " ?" >
          <product_definition_context.life_cycle_stage>
             <label>
               <string>" DESIGN" </string>
             </label>
          </product_definition_contet.life_cycle_stage>
        </product_definition_context>
    </application_context_element-subtypes>
<application_context_element>

<application_context id = "#670700">
    <application_context.application>
        <text>
        <string>" CONFIGURATION CONTROLLED 3D DESIGNS OF
         MECHANICAL PARTS AND ASSEMBLIES" </string>
        </text>
    </application_context.application>
</application_context>
</configuration_controlled_design>
```

Small issues observed while making the STEB binding example

- Id attribute defined by binding often has same name as an attribute in the EXPRESS entity.
- Unlike Part 21, the STEB gives subtypes have their own id.
- Not clear to which part of a complex instance should be addressed in an entity_id reference (see frame_of_reference in example)
  - The root?
  - The member of the complex with the referenced type?

## 2.4 Example data using the Object Serialization Early Binding

```
<iso-10303-28>
   <express-data>
         <osb:xchange>
            <osb:edo edoid="mdl1" eckeyid="ecw1">            <osb:ecw
x-id="ecw1">                  <osb:eckey tech="J2EE">
<osb:nv>                           <osb:n>id</osb:n>
                        <osb:v>com.steptools.pdc.PDHome</osb:v>
                          </osb:nv>
                          <osb:home>ProductDefinitionHome</osb:home>
                     </osb:eckey>
                  </osb:ecw>
                  <osb:modelcontents id="mdl1" contents="objset1"/>
                  <osb:collection x-id="objset1" size="6"
                           contents="#421420" contents= “#67050”
                           contents=”#670740” contents=”#670730”
                           contents=”#670720” contents=”#670700”/>
               <Product_definitionData x-id = “#421420” id = “id1”
                     description = “ds1” formation = “#670750”,
                     frame_of_reference = “#670720”/>
               <Product_definition_formation_with_specified_sourceData
                     x-id = “#670750” id = “id2” description = “ds2”
                     of_product = “#670740” make_or_buy = “mb1”/>
               <ProductData x-id = “#670740” id = “id3” name= “nm1”
                     description = “ds3” frame_of_reference = “cl1”/>
               <Mechanical_contextData x-id = “#670730”
                     name = “nm3” frame_of_reference = “#670700”
                     discipline_type = “dt1”/>
               <Product_definition_contextData x-id = “#670720”
                     name = “nm2” frame_of_reference = “#670700”
                     life_cycle_stage = “ls1”/>
               <Application_contextData x-id = “#670700”
                     application = “ap1”/>
               <osb:collection x-id = “cl1” size = 1
                     contents = “#670730”/>
               <osb:String x-id = “id1”>Design</osb:String>
               <osb:String x-id = “ds1”></osb:String>
               <osb:String x-id = “id2”>3</osb:String>
               <osb:String x-id = “ds2”>LAST_VERSION</osb:String>
               <osb:String x-id = “id3”>TIRE</osb:String>
               <osb:String x-id = “nm1”>TIRE</osb:String>
               <osb:String x-id = “ds3”>NOT SPECIFIED</osb:String>
               <osb:String x-id = “nm2”></osb:String>
               <osb:String x-id = “dt1”>MECHANICAL</osb:String>
               <osb:String x-id = “ls1”>DESIGN</osb:String>
               <osb:String x-id = “ap1”>CONFIGURATION CONTROLLED 3D
                     DESIGNS OF MECHANICAL PARTS AND
                     ASSEMBLIES</osb:String>
               <osb:Source x-id = “mb1” val = “MADE”/>
               </osb:edo>
         </osb:xchange>
    </express-data>
</iso-10303-28>
```

Small issues observed while making the STEB binding example

— Not clear if all element belong in the ModelContents or just one element, or just the elements defined by EXPRESS entity instances as shown in the example.