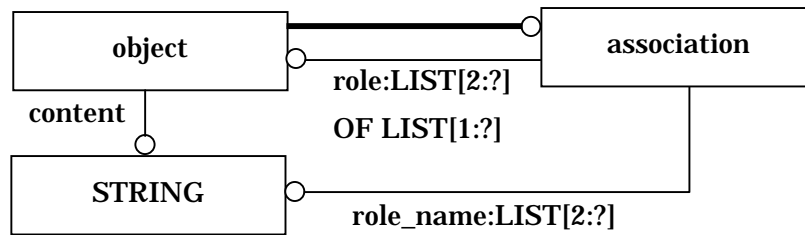


## GPM/NPM Basics

### 3. GPM

GPM is a model that describes one to many relationships. It defines that objects are simply connected to objects via associations. This is called a CORE MODEL as described in figure 1 by EXPRESS-G\*.



**Fig. 1 GPM expression in EXPRESS-G**

\*Note: EXPRESS-G

EXPRESS-G is a diagram representation of EXPRESS language defined in STEP. A rectangle shows an object (called ENTITY in STEP), a bold line shows an inheritance, a thin line shows an attribute of the object, a string on the line shows connection name and its condition and a circle shows a direction of the connection. If there is no condition description with colon (:), there is one connected entity. If there is LIST[min, max] for the condition, there is an array and the value order in the array should be kept. If there is no order in the array, SET[min, max] is used. If max is "?", the maximum number of existence is infinity. If the dimension of the array is larger than 2, the description should be like LIST[2:?] OF LIST [1, ?]. In this case, LIST is referred by LIST or SET. Another detail definitions are shown in ISO 10303-11.

The GPM has the following features:

- An object has a content described with strings.
- An association is inherited from an object; therefore the association has content with strings; it is an association name.
- Number of roles with the association is more than 2; each role is connected to more than one object; the order of roles with the association should be kept. Due to these natures, multiple relationships between objects are described rather than binary relationships.

- The role\_name should be described for each role.
- The role content is corresponding to the role\_name, then role content is clarified. This is not described in the EXPRESS-G diagram.
- There is a possibility that the association becomes the subject.

Figure 2 shows a basic implementation structure for GPM core model. In the GPM core model, subject (S) + verb (V = association) + objects (O) are written.

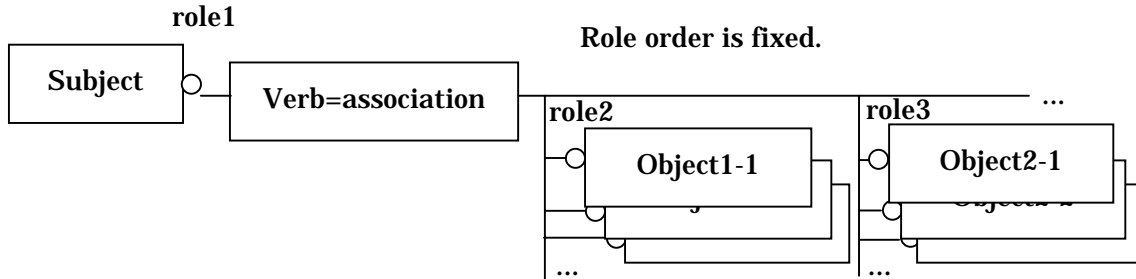


Fig. 2 Basic implementation structure for GPM

S and O are connected via V and atomic sentences are generated. V can have multiple O.

In the practical implementation, identical S are bound to one S, and a set of V-O data are connected to S, like figure 10. Then, the subject can have multiple verbs in free order and each verb can have multiple objects in fixed order.

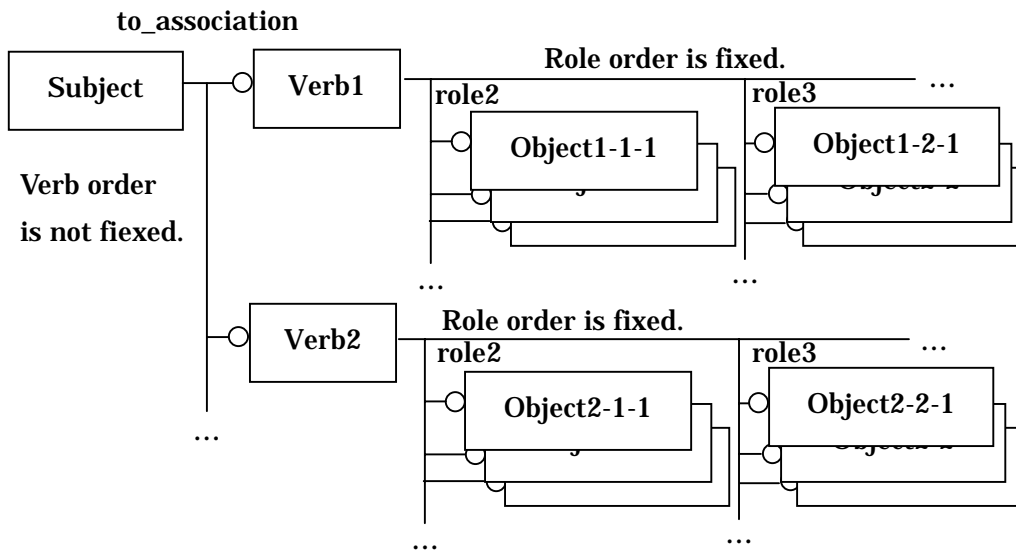


Fig. 3 Another example of the implementation structure for GPM

Standardizations and data model in a plant life cycle are proposed in STEP, EPISTLE, POSC/CAESAR and so on as described in previous pages. These standards are useful for us to integrate data; however we use none of the core model defined in those standards. Table 1 shows the compared results among STEP, EPISTLE and GPM.

Table 1 Comparison between models

Item	STEP	EPISTLE	GPM
Flexible / Extensible	NG: Definitions by EXPRESS are rigid.	O: Class and instance definitions are flexible, but association definitions are not.	E: Class, association and instance definitions are flexible.
Persistent	NG: depends on EXPRESS specification change.	G: Data (classes, instances) can be added without associations.	E: All data (Classes, associations and instances) can be added.
Up to date	NG: very slow.	E: Once enterprise codes are defined, very fast.	E: very fast.
Comprehensive	G: ARM is comprehensive, but AIM is not.	?	O: Core model is comprehensive, but libraries are difficult.
Practical	O: Mainly used for data exchange, but cannot exchange all the attributes.	O: Drawings and geometric data cannot be expressed.	G: Registration and search from huge amount of data is a problem.
Acknowledged	E: ISO-10303	E: ISO-15926	NG: not recognized as a standard.
Tools	STEP Tools, Inc. etc.	Quillion	Hitachi etc.

(N)NO GOOD < (O)OK < (G)GOOD < (E)EXCELLENT

We did not use the core model defined in STEP due to the following problems:

- ENTITY defined in EXPRESS is very rigid. Therefore it is hard to modify translator according to model changes.
- Different version of EXPRESS data cannot be processed in the translator.
- It is difficult to collaborate between different AP numbers
- There is no EXPRESS expression for ARM.

- Modification requirements from each company cannot be taken into the standard swiftly.
- Data in different files cannot be easily integrated.
- Huge volume data is outside of scopes

We use the similar core model defined in EPISTLE and POSC/CAESAR. However we did not use its core model in straight forward way due to the following problems:

- Associations (Association instances) are parts of core model. We thought it is not necessary in the core model.
- It does not have the standard for the drawing and 3D geometric models.
- It expresses things with one to one sentences.