

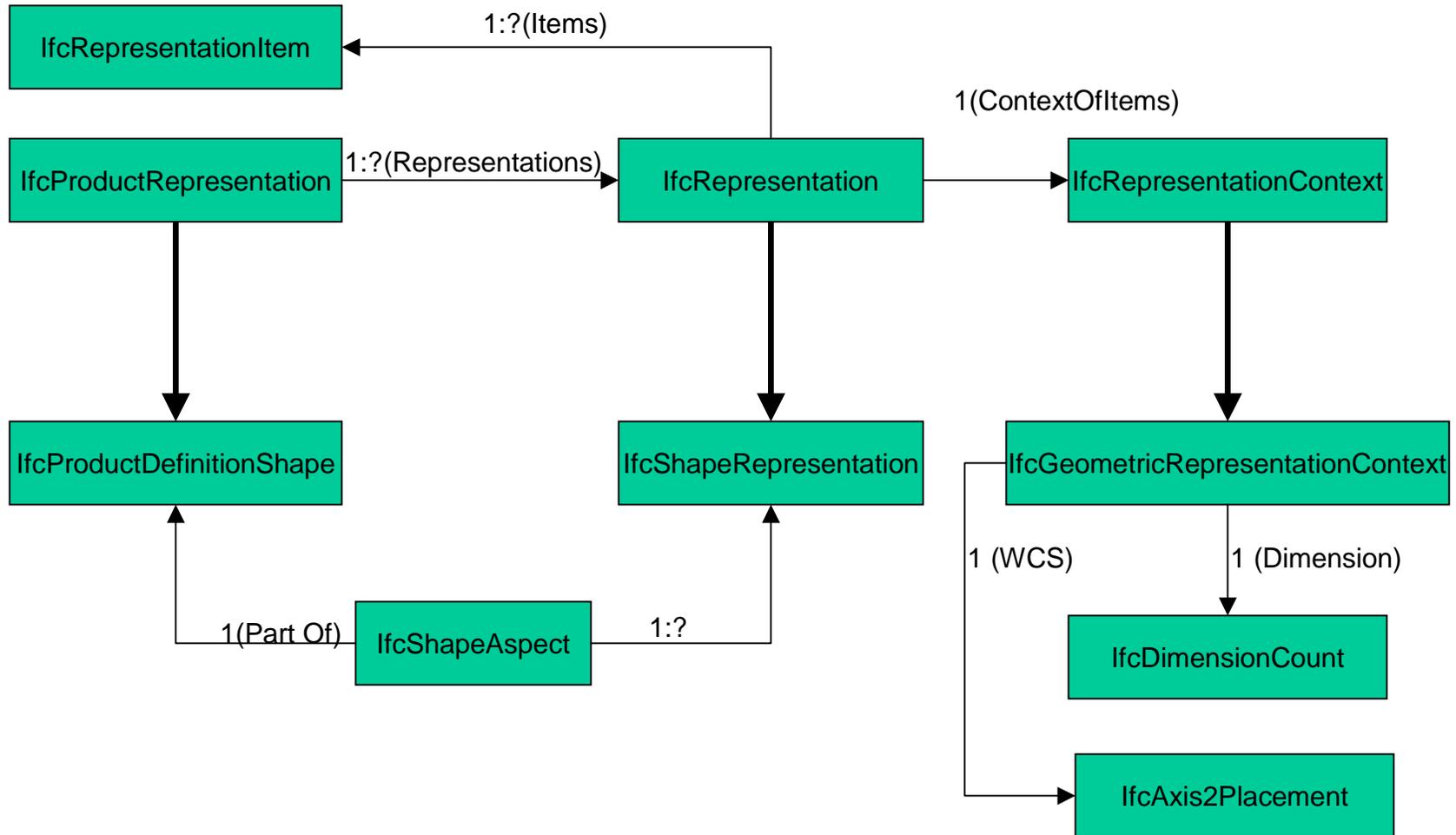
FM8

Costs and Financial Elements

The Problem

- Defining a model for costs that is generally acceptable and works (reasonably) well for the different ways of costing has proven to be difficult.
- Problem is that there is no general theory (axiom) for costing (that I know of) that works for all costing forms.
- IFC 2x contains a cost model that has been shown to be valid for cost estimating (particularly for tendering purposes) and for development of cost plans during design.
- But, does it work for O&M costing, life cycle costing, lease management etc.?
- How to define something that can approach the axiomatic?
- Try to start with something that is known to have a sound theoretical background, that works in practice.
- Then see if the ideas can be translated to a cost model.
- Starting point = the IFC representation/geometry models

Representation/Geometry Model Basics



Cost Representation Context

- The Cost Representation Context defines the context to which the cost elements (or representations of cost) are related.
 - It acts in a similar manner to IfcRepresentationContext for geometry/topology representations.
- A Context Identifier identifies the cost context as used
- A Context Type describes the type of a cost context and may be identified by the typical use cases e.g. Manufacture, Buy, Sell, Maintain, Replace, Life Cycle, Retail Property Management, Lease Management, Space Management, Asset Management etc.
 - cf: IfcRepresentationContext: Values for IfcGeometricRepresentationContext could be: 'Sketch','Outline','Design','Detail','UserDefined','NotDefined'
- The context of a cost is in the view of the actor using that cost e.g. a Sell context for one actor could be a Buy context for another actor.

Cost Representation

- A cost representation is one or more items that are related in a specified cost representation context as the representation of some cost.
 - cf: IfcRepresentation: A representation is one or more representation items that are related in a specified representation context as the representation of some concept.
- The representation type defines what the representation of the cost is e.g. budget, cost estimate, life cycle cost etc.
 - cf: RepresentationType: The description of the type of a representation context. The supported values for context type are to be specified by implementers agreements.

Example: For the subtype IfcShapeRepresentation the values can be 'GeometricSet', 'SurfaceModel', 'SolidModel', 'SweptSolid', 'Brep', 'CSG', 'BoundingBox', 'SectionedSpine', 'MappedRepresentation'

Forms of Cost Representation (Schedule)

* *OED = Oxford English Dictionary*

- Budget
 - A statement of probable revenue and expenditure for an ensuing period of time. (OED)
 - Typically, the period of time for which a budget is created is one year but this may vary.
- Estimate
 - An approximate calculation based on probabilities. (OED)
 - An estimate may proceed through various stages of approximation.
- Proposal
 - The cost for which an actor is prepared to carry out a specified piece of work (OED)
- Bill of Quantities
 - Document for tendering, usually prepared in a standard form, that comprises both a descriptive list of quantities of works and descriptions of the materials, workmanship and other matters required for a construction works (BS6100)

Cost Representation Item

- Each item in a cost that contributes to the representation of the cost is a cost representation item. For instance, basic material cost, discount, basic labor cost, labor factors (height, distance, hazardous conditions etc. allowance).
- Note that a cost representation item may be the line item in a cost representation or it may be a component of the line item.
 - cf: IfcRepresentationItem: A representation item is an element of product data that participates in one or more representations or contributes to the definition of another representation item. A representation item contributes to the definition of another representation item when it is referenced by that representation item.
 - Geometric representation items include curves, surfaces, points, placements etc.

Product Definition Cost

- A product definition cost defines all cost relevant information about an object. It allows for multiple cost representations of the same object.
- Note that, in comparison with shape definition that applies only to a product, cost definition applies to any type of object (class) that can have a cost including processes and resources.
 - cf: IfcProductDefinitionShape: The IfcProductDefinitionShape defines all shape relevant information about an IfcProduct. It allows for multiple geometric shape representations of the same product.

Cost Aspect

- Allows for grouping of cost representation items that represent aspects of the cost of a product. Thereby cost representations of components of the product cost representing a distinctive part of a product that can be explicitly addressed.
- e.g. all labor cost, all material cost, overhead cost, profit cost, total cost of all modifying factors etc.
 - cf: *IfcShapeAspect*: The *IfcShapeAspect* allows for grouping of shape representation items that represent aspects (or components) of the shape of a product. Thereby shape representations of components of the product shape representing a distinctive part of a product that can be explicitly addressed.

Cost Type/Instance Usage

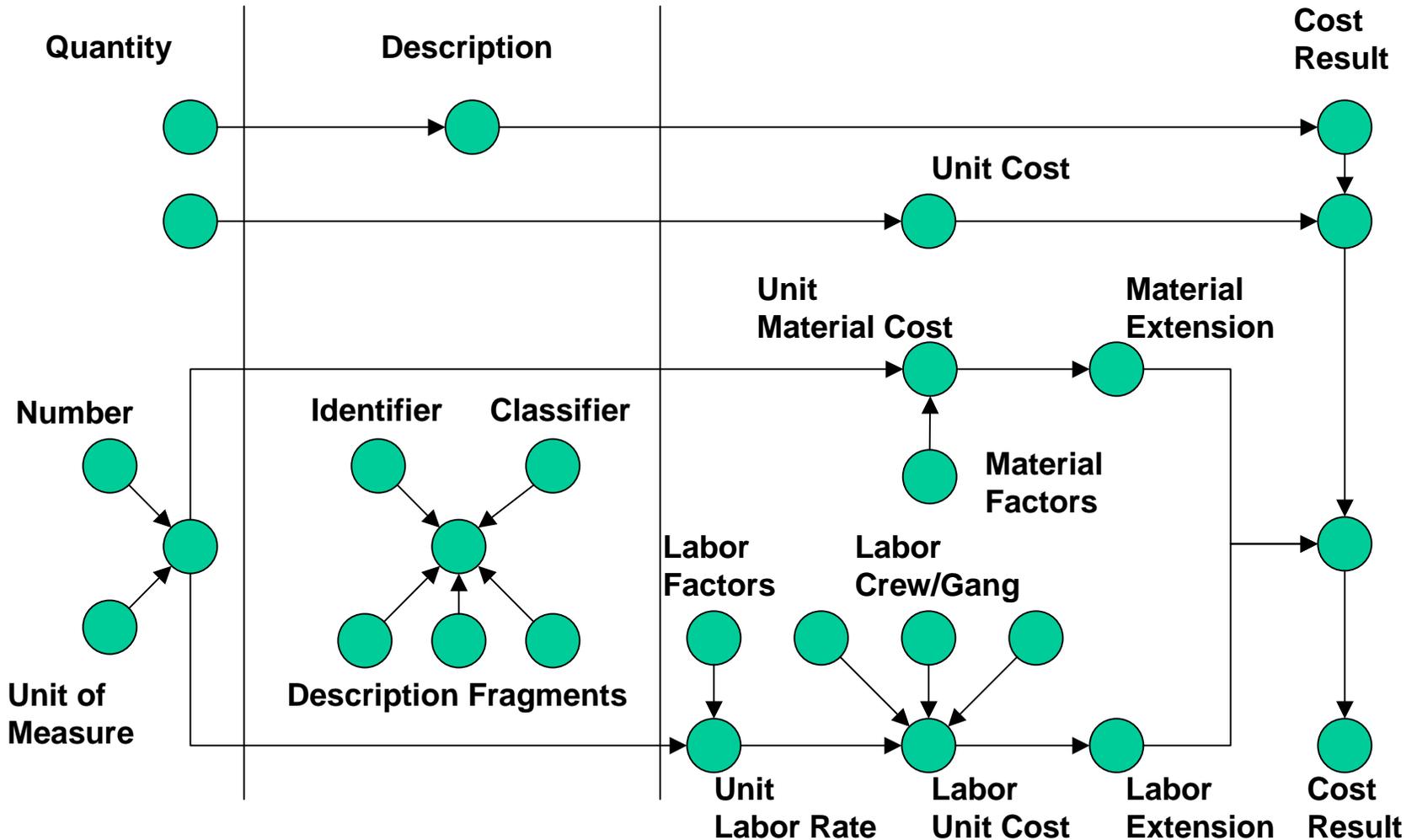
- There may be many items of the same type used in a project, each item having exactly the same cost ‘profile’.
- Rather than defining cost separately for each item, a type/instance usage is proposed.
 - This is the IfcRelCostsObjects usage from the IFC 2x (and previous releases) Model.
 - IfcRelCostsObjects is a subtype of IfcRelAssignsToControl (since cost is defined as a subtype of control)



Types of Cost Representation Item

- ??? Not a full list
- Cost Value
- Cost Modifier
- Cost Type
 - Label or enumeration?
- Cost Description
 - Needs to include aggregation relationship so that a description can be built up from other fragmentary descriptions.
- Cost Result

Cost Representation Item Breakdown

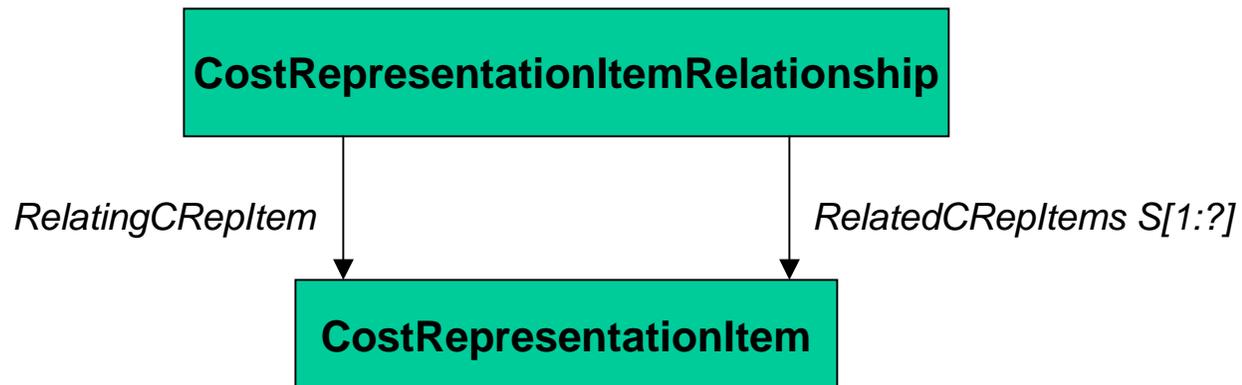


Cost Description

- A cost description may be:
 - a complete description in its own right
 - An assembly of description components
- A cost description may be from
 - Purpose generated text
 - Specification libraries (e.g. NBS, ARCOM etc.)
 - Standard work order descriptions libraries (e.g. HVCA)
 - Standard budget entries
 - ...etc.

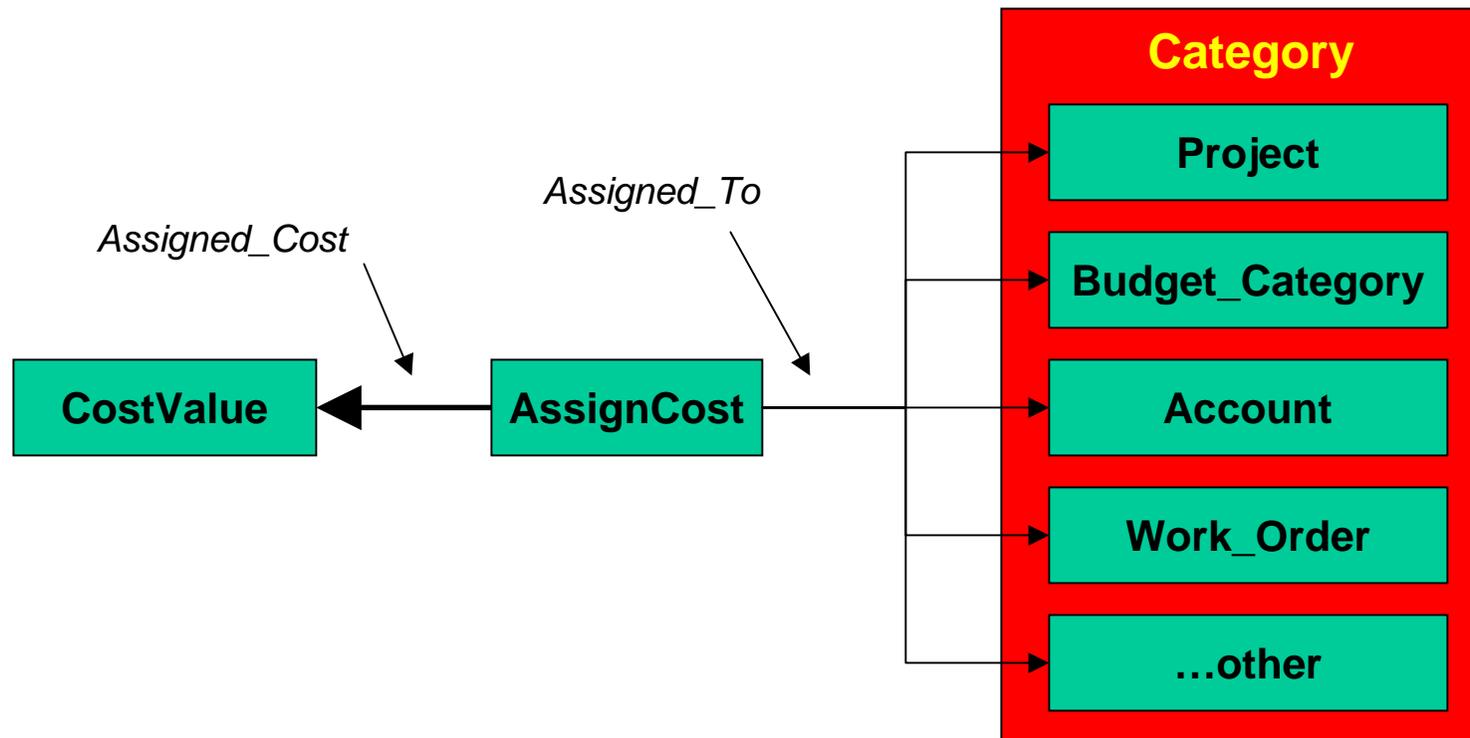
Cost Categorization

- A cost representation item may be a grouping of line representation items that form a predefined category (classification) of cost.
 - For instance, all copper bends in a piping system may be categorized with each line being an assignment of representation items for the different sizes of bend used.
- Categorizations may create a hierarchical organisation of cost (whole, section, part, group, type etc)
 - For instance, defining a labor cost to be applied as the sum of the hourly rates for the individual actors in the crew/gang that will be performing the process.
- Category names may be user defined (as a STRING) or be an enumerated list or be a classification list referenced from the classification association.



Assignment of Cost Value

- A cost value may have **multiple** assignments to cost categories for the purposes of analysis.
- Similar to ideas of multiple classification



Cost Result

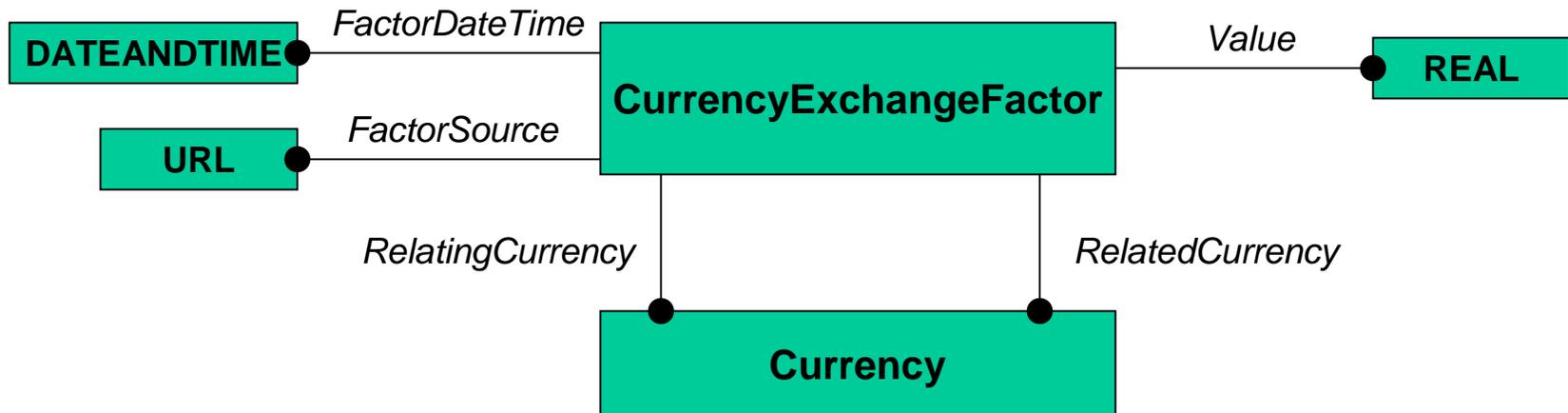
- Bringing together the value of cost representation items (to form the value of a higher level cost representation item) requires the application of mathematical operators (+, -, *, /)
 - cf: IfcBooleanResult: A Boolean result is the result of a regularized operation on two solids to create a new solid. Valid operations are regularized union, regularized intersection, and regularized difference. For purpose of Boolean operations, a solid is considered to be a regularized set of points. The final Boolean result depends upon the operation and the two operands. In the case of the difference operator the order of the operands is also significant. The operator can be either union, intersection or difference. The effect of these operators is described below:
 - Union on two solids is the new solid that is the regularization of the set of all points that are in either the first operand or the second operand or in both.
 - Intersection on two solids is the new solid that is the regularization of the set of all points that are in both the first operand and the second operand.
 - The result of the difference operation on two solids is the regularization of the set of all points which are in the first operand, but not in the second operand.
- Cost Result is a type of cost representation item

Currency

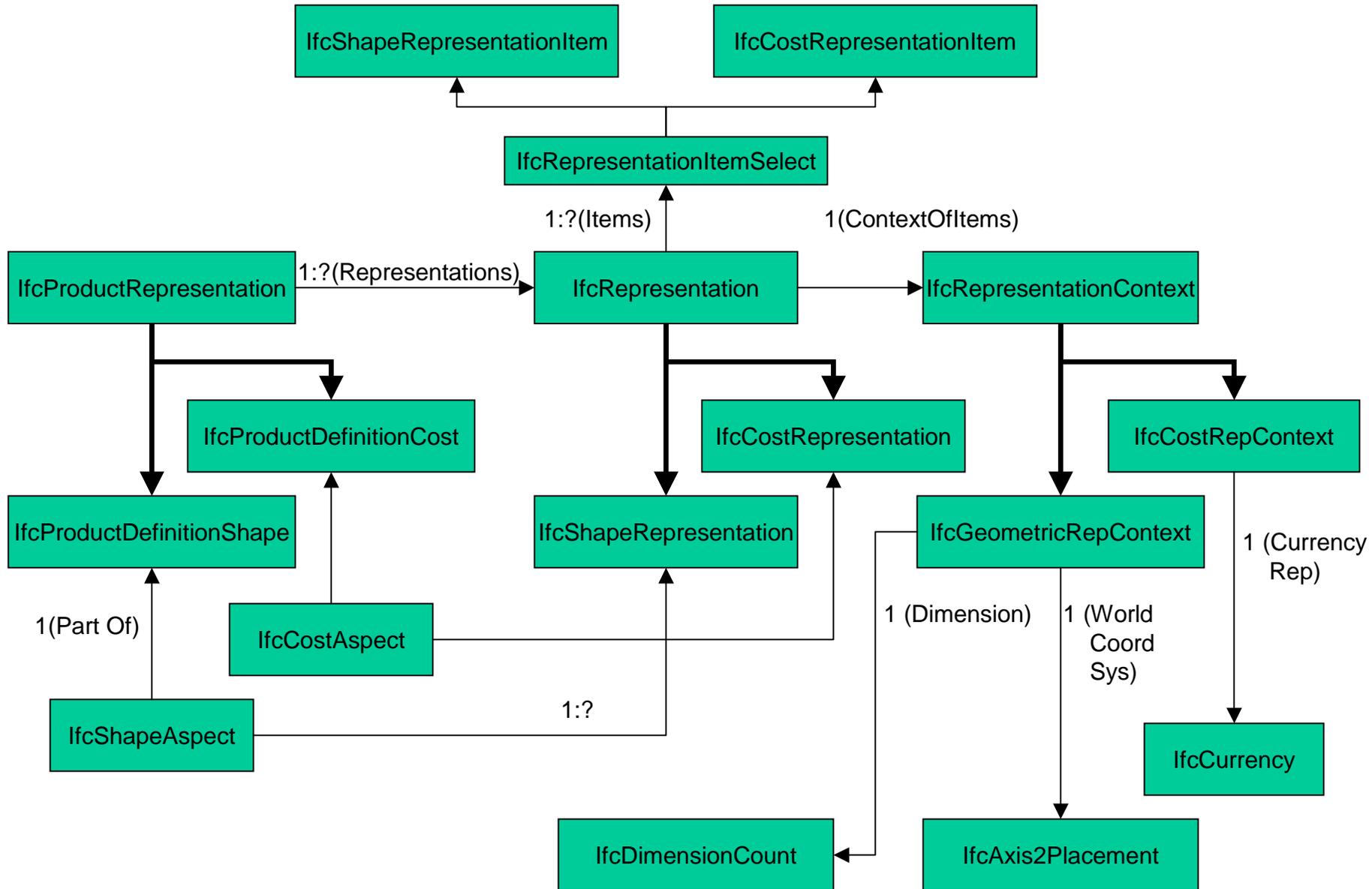
- Currency acts like the WCS in a geometry context in that it defines the context in which costs are represented.
- Currency is a cost representation item??
- A currency:
 - is the unit in which a monetary amount is expressed within a particular country or other geographical region.
 - has a name (e.g. dollar, pound, yen, escudo)
 - has a coded abbreviation which is internationally recognised.
 - may have an identity in the local language as well as its standard identity in English; this should be captured
 - Capture of local identity means that IFC exchanges will need to be 8 bit Unicode.
 - (see terminology model in ISO PAS 12006 Part 3)
- There is an international standard list of currencies and abbreviations (the current IFC model has an extensive list of abbreviations but this is not the complete ISO list).

Currency Exchange

- There may be a need to express a cost value in more than one currency
- Provision needs to be made for the exchange of a cost value from one currency to another using a currency exchange factor.
- A currency exchange factor is a measure of the value of one currency when measured against a unit of another currency. E.g the US dollar / GB pound currency exchange factor might be expressed as 1.41 USD/GBP.
- Currency exchange factors may vary on a day to day basis and are frequently determined by reference to a URL of preference.



Representation/Geometry/Cost



Does it Work for Schedules?

