1. Member Arrangement Patterns

The purpose of this section is to explain the details of the notion of the member arrangement pattern.

Member arrangement patterns explain how a set of [Member]s relate to one another within an Aspect or [Axis][1] or dimension. This is similar to how concept arrangement patterns explain the relationship between the Concept's and Abstracts within a set of [Line Items] or primary items.

Before we explain the member arrangement patterns, we need to clarify some terminology which is often confused or used incorrectly.

Member arrangement pattern example can be found here[2].

1.1. Hypercubes

To understand member arrangement patterns, it is first important to understand hypercubes[3]. The notion of a hypercube is simply a logical scheme that is used to be able to represent sets of information that tends to go together for one reason or another. Aspects (a.k.a. dimensions or [Axis]) are a way to differentiate one fact from another fact. For example, if you look at the complex fact[4] concept arrangement pattern you will note that the line item "Director, Salary" is reported three times:

Component: (Network and Table)	
Network	**50000 - Director Compensation** (http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/ConceptArrangementPatterns/CompoundFact/DirectorCompensation)
Table	Director Compensation [Table]

Slicers (applies to each fact value in each table cell)

Reporting Entity [Axis]	SAMP (http://www.SampleCompany.com)
Legal Entity [Axis]	Consolidated Entity [Member]

Director Compensation [Line Items]	Period [Axis] 2010-01-01 - 2010-12-31 / Director [Axis] John Doe [Member]	Jane Doe [Member]	Directors, All [Member]
Director [Hierarchy]			
Director, Salary	1,000	1,000	2,000
Director, Bonuses	1,000	1,000	2,000
Director, Fees	1,000	1,000	2,000
Director, Options Granted, at Fair Value	1,000	1,000	2,000

First for "John Doe", second for "Jane Doe", and third for "All directors" combined. This information is configured within the "Director Compensation [Table]" hypercube.

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[1] Member arrangement patterns examples, http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/2017-05-07/

[2] Member arrangement patterns, http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/2017-05-07/

[3] Hypercubes, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part01_Chapter02.8_Hypercubes.pdf

[4] Complex Fact, http://xbrlsite.azurewebsites.net/2019/Prototype/conformance-suite/Production/1000-ConceptArrangementPatterns/04-CompoundFact/evidence-package

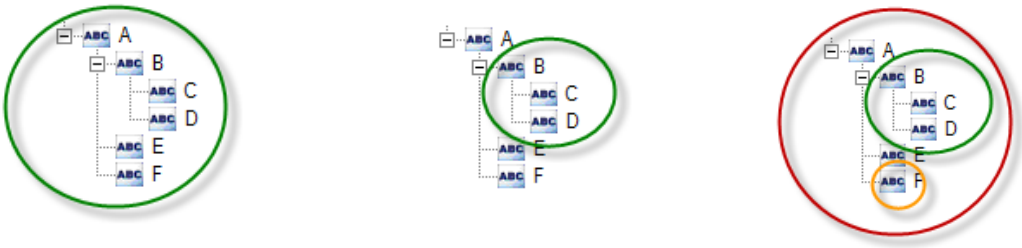
Withing a hypercube there are only two things which can be organized: [Line Items] which are explained using concept arrangement patterns and [Axis] which are explained by member arrangement patterns. Each [Axis] (a.k.a. Aspect or dimension) is organized individually within their domain of members.

1.2. Domain of Members

A **domain** is a cohesive set of members that go together. Something important to note is that in the US GAAP XBRL Taxonomy the way [Domain] is used is different than the standard definition of domain (i.e. a set of members).

The way [Domain] is used in the US GAAP XBRL Taxonomy is to define the ***root [Member] of a set*** of [Member]s that make up a domain. But that is an incorrect definition of the term domain. The appropriate definition of domain is simply a set of members. So be aware of the difference in the way the US GAAP XBRL Taxonomy. The IFRS XBRL Taxonomy does not use [Domain] to define the root concept of a set of members, they use [member], which is correct.

Consider the more general example:



Assume that the above trees are the [Member]s of an [Axis]. In the diagram, each circle represents a domain. In the graphic on the left, A is the root member of a domain with members A, B, C, D, E and F. The middle graphic, the circle shows a domain with the members B, C and D. The graphic on the right shows three different domains; the RED circle from the graphic on the right, the GREEN circle from the graphic in the middle, and another domain which has only one member F.

Domains have partitions. A partition is collectively exhaustive and mutually exclusive set of members within a domain. Partitions do not overlap. Given a set X, a partition is a division of X into non-overlapping and non-empty "parts" or "blocks" or "cells" that cover all of X. More formally, these "cells" are both collectively exhaustive and mutually exclusive with respect to the set being partitioned. A domain always has at least one partition and may have many partitions.

1.3. Associations Between Members

While above we provided a very basic example to help you become familiar with the ideas which we want to discuss, aggregation of members is a bit more complex. Here is the spectrum of domain partition or member aggregation models:

- **Complete flat non-aggregating set (Is-a)**: A flat non-aggregating set is a set which is (a) incomplete so it can never aggregate or (b) a set which describes non-numeric concepts which could never aggregate or (c) a set of numeric concepts which could be aggregated but the aggregated value is

illogical or never used. An example of a non-aggregating set is a subsequent events disclosure which is comprised of one or more subsequent event members. Subsequent events are never aggregated; they are simply a list of events that a non-aggregating set describes.

- **Complete flat aggregating set (Whole-part)**: A complete flat aggregating set is a set which is both complete and characterizes a numeric concept which can be mathematically aggregated/disaggregated. A complete flat set is semantically equivalent to a [Roll Up] concept arrangement pattern. The aggregation scheme is that the members of the list aggregate to the parent of those members. A complete flat set has no subdomains. A value of all classes of property, plant and equipment and the value of each class of property, plant and equipment is an example of a complete flat aggregating set.
- **Complete hierarchical aggregating set (Whole-part)**: A complete hierarchical aggregating set is a set comprised of a collection of complete flat sets, basically a domain which has one or more subdomains. A business rule will always describe the aggregation scheme. A breakdown of revenues by geographic area whereby the domain of geographic areas has a hierarchy within it of geographic regions such as "North America" which makes up one hierarchy and countries such as "United States" and "Canada" which comprise a second hierarchy nested within the first hierarchy.
- **Complex aggregating set (Whole-Part)**: A complex set is a set which has some other set of complex relations or set of subdomains expressed within a business rule.

The reason for providing this list of possible member aggregation models is that there is no standard way to represent such relations using the XBRL technical syntax. The relations can be represented, for example using XBRL Formula, but there is no agreed upon standard approach. There is no "standard" XBRL terminology at this time for these types of relations, all the terminology is taxonomy specific. This is because XBRL Dimensions does not address aggregation of domain members.

However, although XBRL Dimensions does not define how members of a domain aggregate or if they aggregate at all, you can use XBRL Formulas to clearly define such aggregation if aggregation exists. This XBRL Formulas definition both articulates the aggregation scheme and can also be used to validate XBRL instances against that scheme. XBRL Formulas can handle quite complex models.

But, since the SEC does not allow XBRL Formulas to be submitted with an XBRL-based public company financial filing to the SEC, these filings can have aggregation schemes which are inconsistent with aggregation schemes you may come up with or different than how you might interpret the XBRL taxonomy. Public companies creating XBRL-based digital financial reports which will be submitted to the SEC can still create a valid scheme of aggregation, test any XBRL instances created against that scheme in their XBRL-based financial report but not submit that XBRL Formula set with their XBRL-based financial filing. One way or another, SEC XBRL filers should prove that their XBRL instances do in fact follow their defined scheme by validating their XBRL instance.

1.4. Is-a (complete flat non-aggregating set)

An **Is-a** (complete flat nonaggregating set[5]) member arrangement pattern simply describes and uniquely identifies a fact so that one fact can be distinguished from another fact. An Is-a member arrangement pattern is semantically equivalent to a [Set] in that it has no mathematical relations. However, rather than one single concept describing a fact, both a Concept and a [Member] is used to describe a fact.

Component: (Network and Table)	
Network	**Subsequent Events** (http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/CompleteFlatSet/SubsequentEvents)
Table	Subsequent Events [Table]

Slicers (applies to each fact value in each table cell)

Reporting Entity [Axis]	SAMP (http://www.SampleCompany.com)
Legal Entity [Axis]	Consolidated Entity [Member]

Subsequent Event [Line Items]	Period [Axis]	
	2010-01-01 - 2010-12-31	
	Subsequent Event [Axis]	
	Purchase of Business [Member]	Uncollected Receivable [Member]
Subsequent Event [Hierarchy]		
Subsequent Event, Description	Description of subsequent event number 2 which relates to the purchase of a business and occurred on February 1, 2011.	Description of subsequent event number 1 which relates to the loss of an uncollectable receivable and occurred on January 16, 2011.
Subsequent Event, Date	2011-02-01	2011-01-16

And so, an "is-a" simply distinguishes one fact from some other fact using a [Member] of an [Axis] (a.k.a. Aspect or Dimension).

1.5. Whole-part (complete flat aggregating set)

A **whole-part** (complete flat aggregating set[6]) member arrangement pattern is semantically/logically equivalent to the roll up concept arrangement pattern. Recall that the concept arrangement pattern computes a total, or roll up, from a set of other concepts. This concept arrangement pattern is commonly referred to a "roll up", or the equation A + B = C. All concepts involved in this concept arrangement pattern have the same set of characteristics and all must be numeric.

The whole-part member arrangement pattern represents the same roll up relationship; however, what is being rolled up is each of the [Member]s of an [Axis]. And so, it is the [Member] of the [Axis] which changes, the Concept characteristic is constant for all facts.

Component: (Network and Table)						
Network	1123 - Disclosure - **Revenue Classified by Major Geographic Areas (Detail)**					
Table	Geographic Information [Table]					
Reporting Entity [Axis]	0000789019 http://www.sec.gov/CIK					
Legal Entity [Axis]	Entity [Domain]					
	Period [Axis] / Geographical [Axis]					
	2015-07-01/2016-06-30			2014-07-01/2015-06-30		
Geographic Information [Line Items]	United States	Other Countries	Geographical [Domain]	United States	Other Countries	Geographical [Domain]
Revenues	40,578,000,000 [1]	44,742,000,000	85,320,000,000 [2]	42,941,000,000 [1]	50,639,000,000	93,580,000,000

[5] Complete flat nonaggregating set, http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/2017-05-07/MAP01-CompleteFlatSet/evidence-package

[6] Complete flat aggregating set, http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/2017-05-07/MAP02-SimpleFlatAggregation/evidence-package

Here is a second example which we showed previously,

Component: (Network and Table)	
Network	**Director Compensation** (http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/SimpleFlatAggregation/DirectorCompensation)
Table	Director Compensation [Table]

Slicers (applies to each fact value in each table cell)

Reporting Entity [Axis]	SAMP (http://www.SampleCompany.com)
Legal Entity [Axis]	Consolidated Entity [Member]

Director Compensation [Line Items]	Period [Axis] 2010-01-01 - 2010-12-31		
	Director [Axis]		
	John Doe [Member]	Jane Doe [Member]	Directors, All [Member]
Director [Hierarchy]			
Director, Salary	1,000	1,000	2,000
Director, Bonuses	1,000	1,000	2,000
Director, Fees	1,000	1,000	2,000
Director, Options Granted, at Fair Value	1,000	1,000	2,000

Characteristics can represent a whole or some part of a whole. Parts may be related in different ways. The following is a summary of subclasses of whole-part types of relations which may, or may not, be applicable to financial reporting. Other subclasses of whole-part relations may exist. These are simply provided to help you see that there can be different types of whole-part relations.

- **Component-integral object**: Indicates that a component contains some integral object. For example, the component handle is part of the integral object cup; wheels are a component part of a car; a refrigerator is a component of a kitchen.
- **Member-collection**: Indicates that some member is part of some collection. For example a ship is part of a fleet. Or, a subsidiary is part of an economic entity.
- **Portion-mass**: Indicates that some portion is part of some mass. For example a slice is part of a pie.
- **Stuff-object**: Indicates that some "stuff" is part of some object. For example steel is part of a car.
- **Feature-activity**: Indicates that some feature is part of some activity. For example the feature "paying" is part of the activity "shopping".
- **Place-area**: Indicates that some physical place is part of some area. For example the place "Everglades" is part of the area "Florida".

The primary point of these examples is to show that similar type of whole-part relations can be provided for financial reporting.

1.6. Whole-part (complete hierarchical aggregating set)

A **whole-part** (complete hierarchical aggregating set[7]) adds a layer of complexity to a member aggregation pattern by representing a nested set of members. In the example below, note that one flat list of members is provided, a total is provided, but no subtotals:

[7] Complete hierarchical aggregating set, http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/2017-05-07/MAP03-NestedMemberAggregation/evidence-package

Component: (Network and Table)	
Network	**Sales Analysis, by Geographic Area** (http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/NestedMemberAggregation/SalesAnalysisByGeographicArea)
Table	Sales Analysis, by Geographic Area [Table]

Slicers (applies to each fact value in each table cell)

Reporting Entity [Axis]	SAMP (http://www.SampleCompany.com)
Legal Entity [Axis]	Consolidated Entity [Member]

Sales Analysis, by Geographic Area [Line Items]	Period: 2010-01-01 - 2010-12-31 / Geographic Area [Axis]						
	United States [Member]	Canada [Member]	North America Region [Member]	United Kingdom [Member]	Germany [Member]	Europe Region [Member]	Geographic Areas, All [Member]
Sales Analysis, by Geographic Area [Hierarchy]							
Sales	4,000,000	2,000,000	6,000,000	2,000,000	2,000,000	4,000,000	10,000,000

You can better see the hierarchy of relationships within a set of members in the model structure used to represent the relationships between the members of the geographic area axis:

Component: (Network and Table)	
Network	**Sales Analysis, by Geographic Area** (http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/NestedMemberAggregation/SalesAnalysisByGeographicArea)
Table	Sales Analysis, by Geographic Area [Table]

#	Label	Report Element Class	Period Type	Balance	Name
1	**Sales Analysis, by Geographic Area [Table]**	[Table]			pattern:SalesAnalysisByGeographicAreaTable
2	**Legal Entity [Axis]**	[Axis]			frm:LegalEntityAxis
3	Consolidated Entity [Member]	[Member]			frm:ConsolidatedEntityMember
4	**Geographic Area [Axis]**	[Axis]			frm:GeographicAreaAxis
5	Geographic Areas, All [Member]	[Member]			frm:GeographicAreasAllMember
6	North America Region [Member]	[Member]			frm:NorthAmericaRegionMember
7	United States [Member]	[Member]			pattern:UnitedStatesMember
8	Canada [Member]	[Member]			pattern:CanadaMember
9	Europe Region [Member]	[Member]			frm:EuropeRegionMember
10	United Kingdom [Member]	[Member]			pattern:UnitedKingdomMember
11	Germany [Member]	[Member]			pattern:GermanyMember
12	**Sales Analysis, by Geographic Area [Line Items]**	[Line Items]			pattern:SalesAnalysisByGeographicAreaLineItems
13	*Sales Analysis, by Geographic Area [Hierarchy]*	[Abstract]			pattern:SalesAnalysisByGeographicAreaHierarchy
14	Sales	[Concept] Monetary	For Period	Credit	pattern:Sales

This representation approach should be avoided.

1.7. Whole-part (multiple dimensions aggregating set)

A **whole-part** (multiple dimensions aggregating set[8]) is a representation of the exact same logical information as above, however, the nested hierarchy of members of a single dimension is instead represented as two dimensions and the aggregation works correctly.

Component: (Network and Table)	
Network	**Sales Analysis, by Geographic Area** (http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/MultipleCharacteristics/SalesAnalysisByGeographicArea)
Table	Sales Analysis, by Geographic Area [Table]

Slicers (applies to each fact value in each table cell)

Reporting Entity [Axis]	SAMP (http://www.SampleCompany.com)
Legal Entity [Axis]	Consolidated Entity [Member]

Sales Analysis, by Geographic Area [Line Items]	Period: 2010-01-01 - 2010-12-31 / Geographic Area [Axis]						
	North America Region [Member]			Europe Region [Member]			Geographic Areas, All [Member]
	Country [Axis]			Country [Axis]			Country [Axis]
	United States [Member]	Canada [Member]	Countries, All [Member]	United Kingdom [Member]	Germany [Member]	Countries, All [Member]	Countries, All [Member]
Sales Analysis, by Geographic Area [Hierarchy]							
Sales	4,000,000	2,000,000	6,000,000	2,000,000	2,000,000	4,000,000	10,000,000

You can see this much better by looking at the example provided. Essentially, what is being done is that the single dimension with a nested hierarchy was broken down into two simple non-nested hierarchies.

[8] Multiple dimensions aggregating set, http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/2017-05-07/MAP05-MultipleCharacteristics/evidence-package

Component: (Network and Table)	
Network	**Sales Analysis, by Geographic Area** (http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/MultipleCharacteristics/SalesAnalysisByGeographicArea)
Table	Sales Analysis, by Geographic Area [Table]

#	Label	Report Element Class	Period Type	Balance	Name
1	**Sales Analysis, by Geographic Area [Table]**	[Table]			pattern:SalesAnalysisByGeographicAreaTable
2	**Legal Entity [Axis]**	[Axis]			frm:LegalEntityAxis
3	Consolidated Entity [Member]	[Member]			frm:ConsolidatedEntityMember
4	**Geographic Area [Axis]**	[Axis]			frm:GeographicAreaAxis
5	Geographic Areas, All [Member]	[Member]			frm:GeographicAreasAllMember
6	North America Region [Member]	[Member]			frm:NorthAmericaRegionMember
7	Europe Region [Member]	[Member]			frm:EuropeRegionMember
8	**Country [Axis]**	[Axis]			pattern:CountryAxis
9	Countries, All [Member]	[Member]			pattern:CountriesAllMember
10	United States [Member]	[Member]			pattern:UnitedStatesMember
11	Canada [Member]	[Member]			pattern:CanadaMember
12	United Kingdom [Member]	[Member]			pattern:UnitedKingdomMember
13	Germany [Member]	[Member]			pattern:GermanyMember
14	**Sales Analysis, by Geographic Area [Line Items]**	[Line Items]			pattern:SalesAnalysisByGeographicAreaLineItems
15	*Sales Analysis, by Geographic Area [Hierarchy]*	[Abstract]			pattern:SalesAnalysisByGeographicAreaHierarchy
16	Sales	[Concept] Monetary	For Period	Credit	pattern:Sales

Note that the singe "Geographic Area [Axis]" was supplemented with a "Country [Axis]" and the representation fits into the logic that is currently understandable by XBRL.

1.8. Explicitly versus Implicitly Provided Dimensions

Aspects that distinguish one fact from another can be explicitly provided or implied. In this example representation, the business segments and geographic area axis is provided on all three hypercubes represented[9]:

Component: (Network and Table)	
Network	**Sales Analysis, Summary** (http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/ExplicitCharacteristics/SalesAnalysisSummary)
Table	Sales Analysis, Summary [Table]

Slicers (applies to each fact value in each table cell)

Reporting Entity [Axis]	SAMP (http://www.SampleCompany.com)
Legal Entity [Axis]	Consolidated Entity [Member]
Business Segment [Axis]	Business Segments, All [Member]
Geographic Area [Axis]	Geographic Areas, All [Member]

Sales Analysis, Summary [Line Items]	Period [Axis]	
	2010-01-01 - 2010-12-31	2009-01-01 - 2009-12-31
Sales Analysis, Summary [Hierarchy]		
Sales	32,038,000	35,805,000

Note that the "Legal Entity [Axis]", the "Business Segment [Axis]", and the "Geographic Area [Axis]" are all provided in the Sales Summary Analysis.

By contract, in this representation the "Business Segment [Axis]" and the "Geographic Area [Axis]" are NOT explicitly provided[10]:

[9] Dimensions Explicit, http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/2017-05-07/MAP06-ExplicitCharacteristics/evidence-package

[10] Dimensions Implied, http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/2017-05-07/MAP07-IntersectingTables/evidence-package

Component: (Network and Table)	
Network	**Income Statement (Fragment)** (http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/MemberArrangementPatterns/IntersectingTables/IncomeStatement)
Table	Income Statement (Fragment) [Table]

Slicers (applies to each fact value in each table cell)

Reporting Entity [Axis]	SAMP (http://www.SampleCompany.com)
Legal Entity [Axis]	Consolidated Entity [Member]

Income Statement (Fragment) [Line Items]	Period [Axis]	
	2010-01-01 - 2010-12-31	2009-01-01 - 2009-12-31
Income Statement [Roll Up]		
Sales	32,038,000	35,805,000

Logically, both the first example where dimensions are explicitly provided and the second example where two dimensions were implied are equivalent in every way.

If you think about it, the logic makes sense and XBRL-based reports follow this logic. For more information, please see the XBRL Dimensions Specification[11] which explains that "A Hypercube describes the Cartesian product of zero or more dimensions."

[11] XBRL International, XBRL Dimensions Specification, http://www.xbrl.org/specification/dimensions/rec-2012-01-25/dimensions-rec-2006-09-18+corrected-errata-2012-01-25-clean.html