

1. Representing Structures

The purpose of this section is to dive into the details related to the structures within an XBRL-based digital financial report. Networks and hypercubes are XBRL technical artifacts that are used when creating structures.

2. Networks

A network is a technical artifact that lets you separate associations into distinct structures because you want to or because you have to. Networks are discussed in more detail in the *Very Basic XBRL Primer*¹. Basically, every association must be represented within an XBRL network. Hypercubes may be used, but are not required and also offer certain specific advantages.

Fundamentally, the function of a network is to separate associations into distinct structures. If you use a network without one or more explicitly defined hypercubes then associations within the network are deemed to exist within one implied hypercube. So, all the associations within a network act the same whether they are also defined within an explicit hypercube or there is no explicit hypercube and therefore are governed by an implied hypercube.

The relationship between networks and hypercubes might seem a bit odd or even confusing. This is because networks are defined by the XBRL technical specification and hypercubes are defined later by the XBRL Dimensions specification and the two specifications need to work together.

Properly created software applications should automate the interaction between networks and hypercubes behind the scenes so business professionals do not need to concern themselves with these details. Just understand that networks are used to separate associations because (a) you want to or (b) you have to.

3. Hypercubes

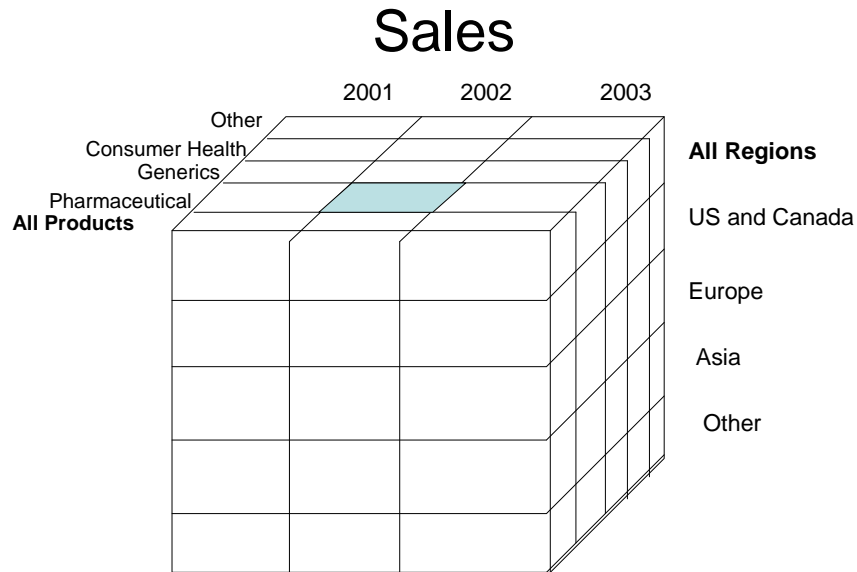
Hypercubes always exist within a network. To understand what a hypercube is, lets first look at the notion of a table. Below you see a table which shows sales information for four products over a period of three years which fits nicely into an easy to read and understand table or spreadsheet:

Product	2001	2002	2003
Widgets	3000	6500	8200
Gadgets	1200	1450	3000
Doohickeys	2500	3400	2000
Whatzits	500	670	1300

So, a table is information that has two dimensions. Above we see products in the rows and period in the columns. But what if you have more than two dimensions of

¹ *Very Basic XBRL Primer*, http://www.xbrlsite.com/mastering/Part00_Chapter01.B_XBRLPrimer.pdf

information. A cube adds a third dimension to the table. Below you see that we have added a region dimension with the values of "US and Canada", "Europe", "Asia", and "Other" to the table which results in a three dimensional object or cube.



A **hypercube** is the notion of a set of related information that tends to go together and that has multiple dimensions that are used to describe that information. A hypercube can have two, three, four, or even more dimensions potentially. For example, imagine the above cube which has the dimensions of period, product category, and region; but now we add an additional dimension of reporting scenario (i.e. actual sales, budgeted sales, and/or variance between actual and budgeted sales). So how can you possibly visualize more than two dimensions of information?

The answer is the notion of a slicer. A **slicer** enables a three dimensional, four dimensional, or even more dimensions to be represented on in a two dimensional (i.e. rows and columns) space. A good way to understand the notion of a slicer is to think of a pivot table. You put a slicer into the top portion of a pivot table in order to filter information so that you get a human-readable two dimensional row and column view of information. For example,

Analysis (With Breakdown)				
Entity	Sample Company			
Units	Euros			
Concept	Sales			
Sum of Value		Period		
Product	Region	2001	2002	2003
Consumer Health	Asia	1,025	1,263	1,457
	Europe	2,462	2,592	2,834
	Other Regions	1,365	1,340	767
	US and Canada	2,570	3,074	2,765
Consumer Health Total		7,421	8,270	7,823
Generics	Asia	503	634	807
	Europe	1,359	1,383	1,616
	Other Regions	918	890	489
	US and Canada	1,378	1,660	1,508
Generics Total		4,158	4,567	4,420
Other	Asia	1,315	1,398	895
	Europe	2,826	2,746	1,790
	Other Regions	1,200	1,154	540
	US and Canada	3,038	3,225	1,673
Other Total		8,379	8,523	4,899
Pharmaceuticals	Asia	2,009	2,471	2,864
	Europe	4,233	4,732	5,317
	Other Regions	1,690	1,715	1,147
	US and Canada	4,576	5,527	5,568
Pharmaceuticals Total		12,507	14,446	14,896
Grand Total		32,465	35,805	32,038

A hypercube is a logical scheme that is used to be able to represent sets of information that tends to go together. Reported facts don't simply float freely in space. Every fact that is provided with in a report is associated with at least one hypercube.

The notion of a hypercube comes from a common model used when working with information, the multidimensional model².

Below you see two hypercubes that represent two versions of the same information, sales by business segment and by geographic area. The first hypercube holds the geographic area at all geographic areas and then shows a breakdown of sales by business segment. The second holds the business segment constant at the total for all business segments and then shows a breakdown of sales by geographic area:

Sales by business segment:

² Wikipedia, *Dimensional Modeling*, https://en.wikipedia.org/wiki/Dimensional_modeling

Component: (Network and Table)				
Network		Sales Analysis, by Business Segment		
Table		Sales Analysis, by Business Segment [Table]		
Reporting Entity [Axis]	SAMP http://www.SampleCompany.com			
Legal Entity [Axis]	Consolidated Entity [Member]			
Geographic Area [Axis]	Geographic Areas, All [Member]			
Unit [Axis]	USD			
		Period [Axis]		
Sales Analysis, by Business Segment [Line Items]	Business Segment [Ax...]	2010-01-01/2010-12-31	2009-01-01/2009-12-31	2008-01-01/2008-12-31
Sales Analysis, by Business Segment [Hierarchy]				
Sales	Business Segments, All [Member]	32,038,000	35,805,000	32,465,000
	Pharmaceuticals Segment [Member]	20,181,000	18,150,000	15,275,000
	Generics Segment [Member]	2,433,000	1,973,000	1,823,000
	Consumer Health Segment [Member]	6,675,000	6,514,000	5,752,000
	Other Segments [Member]	2,749,000	9,168,000	9,615,000

Sales by geographic area:

Component: (Network and Table)				
Network		Sales Analysis, by Geographic Area		
Table		Sales Analysis, by Geographic Area [Table]		
Reporting Entity [Axis]	SAMP http://www.SampleCompany.com			
Business Segment [Axis]	Business Segments, All [Member]			
Legal Entity [Axis]	Consolidated Entity [Member]			
Unit [Axis]	USD			
		Period [Axis]		
Sales Analysis, by Geographic Area [Line Items]	Geographic Area [Ax...]	2010-01-01/2010-12-31	2009-01-01/2009-12-31	2008-01-01/2008-12-31
Sales Analysis, by Geographic Area [Hierarchy]				
Sales	Geographic Areas, All [Member]	32,038,000	35,805,000	32,465,000
	North America Region [Member]	10,214,000	12,649,000	10,137,000
	Europe Region [Member]	11,901,000	10,374,000	10,396,000
	Asia Region [Member]	5,639,000	4,371,000	3,210,000
	Other Regions [Member]	4,284,000	8,411,000	8,722,000

By “pivoting” the information by different combinations of business segments and geographic areas you can see different versions of information. This is somewhat like serializing each version of the information onto a printed report that shows all the different versions of the pivot table.

The multidimensional model was explained in the chapter, *Introduction to Conceptual Model of a Digital Financial Report*³, so we will not repeat that here. We do want to remind you of a couple of things however.

3.1. Difference between Signal and Noise

Constructing hypercubes effectively is a learned skill. There is a big difference between providing “signal” which is more information and “noise” which is unimportant stuff that just gets in the way⁴. Contrast these two hypercube dimensions:

³ *Introduction to Conceptual Model of a Digital Financial Report*, http://xbrl.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.1_IntroductionToTheConceptualModelOfDigitalFinancialReport.pdf

⁴ Representing Information Logically, <http://xbrl.squarespace.com/journal/2020/12/30/representing-information-logically.html>

Four dimensions⁵

Component: (Network and Table)	
Network	AA: Statement: Financial Highlights (http://www.ABCCCompany.com/company/role/level4/FinancialHighlightsSchedule)
Table	Financial Highlights [Table]

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

Reporting Entity [Axis]	10810137d58f76b84aaa (http://standards.iso.org/iso/17442)
Legal Entity [Axis]	Consolidated Entity [Member]
Report Date [Axis]	Reported as of March 18, 2021 [Member]
Reporting Scenario [Axis]	Actual [Member]

Financial Highlights [Line Items]	Period [Axis]				
	2020-01-01 - 2020-12-31	2019-01-01 - 2019-12-31	2018-01-01 - 2018-12-31	2017-01-01 - 2017-12-31	2016-01-01 - 2016-12-31
Financial Highlights [Hierarchy]					
Revenues, Net	4,000,000	5,000,000	4,000,000	4,000,000	4,000,000
Income (Loss) from Continuing Operations	500,000	(4,000,000)	(4,000,000)	(4,000,000)	(4,000,000)
Net Income (Loss)	500,000	(4,000,000)	(4,000,000)	(4,000,000)	(4,000,000)
Cash Flow Provided by (used in) Operating Activities, Net	(1,000,000)	4,000,000	0	0	0
Capital Additions		650,000	550,000	450,000	350,000
Average Number of Employees	300	250	250	240	220

Eight dimensions⁶

Component: (Network and Table)	
Network	AA: Statement: Financial Highlights (http://www.ABCCCompany.com/company/role/level4/FinancialHighlightsSchedule)
Table	Financial Highlights [Table]

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

Reporting Entity [Axis]	10810137d58f76b84aaa (http://standards.iso.org/iso/17442)
Legal Entity [Axis]	Consolidated Entity [Member]
Report Date [Axis]	Reported as of March 18, 2021 [Member]
Reporting Scenario [Axis]	Actual [Member]
Property, Plant and Equipment, Description of Major Class [Axis]	Property, Plant and Equipment, All Major Classes [Member]
Customer [Axis]	All Customers [Member]
Debt Instrument, Identifier [Axis]	All Debt Instruments [Member]
Business Segment [Axis]	Business Segments, All [Member]
Related Party, Name [Axis]	All Related Parties [Member]
Director Name [Axis]	All Directors [Member]
Share Ownership Plan, Identifier [Axis]	All Share Ownership Plans [Member]
Reconciling Item, Type [Axis]	All Reconciling Items of Cash and Cash Equivalents [Member]

Financial Highlights [Line Items]	Period [Axis]				
	2020-01-01 - 2020-12-31	2019-01-01 - 2019-12-31	2018-01-01 - 2018-12-31	2017-01-01 - 2017-12-31	2016-01-01 - 2016-12-31
Financial Highlights [Hierarchy]					
Revenues, Net	4,000,000	5,000,000	4,000,000	4,000,000	4,000,000
Income (Loss) from Continuing Operations	500,000	(4,000,000)	(4,000,000)	(4,000,000)	(4,000,000)
Net Income (Loss)	500,000	(4,000,000)	(4,000,000)	(4,000,000)	(4,000,000)
Cash Flow Provided by (used in) Operating Activities, Net	(1,000,000)	4,000,000	0	0	0
Capital Additions		650,000	550,000	450,000	350,000
Average Number of Employees	300	250	250	240	220

Logically, the two representations are identical. Running each through an XBRL Formula processor shows this. Balancing the needs of humans and the needs of computers reading information is a learned skill.

⁵ Financial highlights, four dimensions, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/xasb/reference-implementation/evidence-package/contents/index.html#Rendering-FinancialHighlightsSchedule-gaap_FinancialHighlightsTable.html

⁶ Financial highlights, eight dimensions, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/xasb/reference-implementation-many-dim/evidence-package/contents/index.html#Rendering-FinancialHighlightsSchedule-qaap_FinancialHighlightsTable.html

3.2. *Important Information to Keep in Mind*

Note that the term hypercube and the term [Table] are synonyms. Likewise, the term dimension, aspect, and [Axis] are synonyms.

A hypercube is an abstract notion which was invented to communicate an idea. Hypercubes can be explicitly defined within the XBRL technical syntax, but an implied hypercube exists when an explicitly defined hypercube is not provided.

In XBRL, there are three core aspects that exist that are always used to describe a fact: entity, period, and concept. Additional noncore aspects can be added to the three core aspects by defining the noncore aspect you need to use within an XBRL taxonomy.

When you represent information within an explicitly defined hypercube, that hypercube has a name and because of that, the hypercube can be used to identify and extract information from within a report. When you define information without an explicit hypercube, i.e. an implied hypercube, you cannot use the name of the hypercube to identify and work with information from a report because there is no physical hypercube that exists, it is only implied therefore it does not have a name.

When the same hypercube is used to represent two different fragments of a report, because each of the two fragments have the same name, you cannot distinguish one fragment from another using the hypercube name (i.e. because it is the same); so you have to also use the network in which the hypercube exists in order to effectively differentiate one hypercube from the other. You can never use a hypercube twice within one network.

XBRL International encourages not mixing dimensional and nondimensional models⁷, i.e. use only explicit hypercubes or use no hypercubes at all. Note that both the US GAAP and IFRS XBRL taxonomies both mix dimensional models.

There tend to be two sound strategies for naming hypercubes. The first strategy is to give every hypercube the same name, say “my:Hypercube”. That approach forces some good modeling practices such as one hypercube per network and also forces software to use one single identifier, the network, to identify a set of information. The other approach is to always use unique, or isomorphic, hypercubes meaning that each named hypercube represents one single set of information.

4. **Contrasting Hypercube Structures**

In this section I will help you understand hypercubes by comparing and contrasting a number of different hypercubes. All of these hypercubes are 100% the same in terms of the meaning conveyed by the information. The only difference is the approach used to represent the hypercube. The objective is to make the differences between each of these approaches clear. You can download the XBRL files and examine them⁸.

⁷ XBRL International, *XBRL International Guidance Clarifies XBRL Dimensions Semantics*, <http://xbrl.squarespace.com/journal/2015/3/31/xbrl-international-guidance-clarifies-xbrl-dimensions-semant.html>

⁸ Download XBRL files, <http://xbrl.azurewebsites.net/2020/Examples/Hypercubes/ComparisonOfHypercubes.zip>

4.1. Implied Hypercube (i.e. no explicit hypercube defined)

To start, consider a fragment of a financial report that is represented without using a hypercube at all. When no hypercube is explicitly defined there exists one implied hypercube⁹.

Component: (Network and Table)			
Network	30000 - Unknown - Property, Plant, and Equipment, by Component		
Table	Implied [Table]		
Reporting Entity [Axis]	SAMP http://www.SampleCompany.com		
Unit [Axis]	USD		
Period [Axis]	▼		
Implied [Line Items]	2020-12-31	2019-12-31	
Property, Plant and Equipment, Net [Roll Up]			
Land	5,347,000	1,147,000	
Buildings, Net	244,508,000	366,375,000	
Furniture and Fixtures, Net	34,457,000	34,457,000	
Computer Equipment, Net	4,169,000	5,313,000	
Other Property, Plant and Equipment, Net	6,702,000	6,149,000	
Property, Plant and Equipment, Net, Total	295,183,000	413,441,000	

Notice at the top of the image where the name of “Table” is indicated to be “Implied [Table]”. Essentially, if a set of facts that exist within one network does not have an explicitly defined hypercube; then you can assume that each of those facts exists in one single implied hypercube which we have simply given the name “ImpliedTable”.

Representing information without an explicit hypercube within a financial report is not considered a best practice. Explicit hypercubes are the best way to go. A disadvantage of not using an explicit hypercube is that only core dimensions can be used; no noncore dimensions can be added because that requires the use of an explicitly defined hypercube.

4.2. Explicit Hypercube with no Dimensions

In this example we have a fragment of a report that has been represented using an explicit hypercube labeled “Property, Plant and Equipment, by Component [Table]”. However, no additional noncore dimensions were defined¹⁰.

⁹ Implied hypercube example, <http://xbrlsite.azurewebsites.net/2020/Examples/Hypercubes/01-ImpliedHypercube/RollUp-SampleInstance.xml>

¹⁰ Explicit hypercube with no dimensions example, <http://xbrlsite.azurewebsites.net/2020/Examples/Hypercubes/02-ExplicitHypercubeNoAxis/RollUp-SampleInstance.xml>

Component: (Network and Table)			
Network	30000 - Unknown - Property, Plant, and Equipment, by Component		
Table	Property, Plant and Equipment, by Component [Table]		
Reporting Entity [Axis]	SAMP http://www.SampleCompany.com		
Unit [Axis]	USD		
	Period [Axis] ▼		
Property, Plant and Equipment, by Component [Line Items]	2020-12-31	2019-12-31	
Property, Plant and Equipment, Net [Roll Up]			
Land	5,347,000	1,147,000	
Buildings, Net	244,508,000	366,375,000	
Furniture and Fixtures, Net	34,457,000	34,457,000	
Computer Equipment, Net	4,169,000	5,313,000	
Other Property, Plant and Equipment, Net	6,702,000	6,149,000	
Property, Plant and Equipment, Net, Total	295,183,000	413,441,000	

You can see that in the first example what was called “Implied [Table]” is now called “Property, Plant and Equipment, by Component [Table]”. As such, you can now identify the set of facts using the hypercube that contains the set of facts by its name. Further, there is nothing wrong with representing a set of information using a hypercube but not associating any additional noncore dimensions with that hypercube. That is perfectly legitimate per the XBRL technical specification.

4.3. Explicit Hypercube, One Noncore Dimension, no Dimension Default

In this example we have a fragment of a report that has been represented using an explicit hypercube labeled “Property, Plant and Equipment, by Component [Table]”. In addition, we added the dimension “Legal Entity [Axis]” and one member of that dimension’s domain, “Consolidated Entity [Member]”¹¹.

Component: (Network and Table)			
Network	30000 - Unknown - Property, Plant, and Equipment, by Component		
Table	Property, Plant and Equipment, by Component [Table]		
Reporting Entity [Axis]	SAMP http://www.SampleCompany.com		
Legal Entity [Axis]	Consolidated Entity [Member]		
Unit [Axis]	USD		
	Period [Axis] ▼		
Property, Plant and Equipment, by Component [Line Items]	2020-12-31	2019-12-31	
Property, Plant and Equipment, Net [Roll Up]			
Land	5,347,000	1,147,000	
Buildings, Net	244,508,000	366,375,000	
Furniture and Fixtures, Net	34,457,000	34,457,000	
Computer Equipment, Net	4,169,000	5,313,000	
Other Property, Plant and Equipment, Net	6,702,000	6,149,000	
Property, Plant and Equipment, Net, Total	295,183,000	413,441,000	

In this representation approach, the legal entity is explicitly identified as being the consolidated reporting entity. Whereas in the first and second representations the

¹¹ Explicit hypercube, one noncore dimension, no default dimension example, <http://xbrlsite.azurewebsites.net/2020/Examples/Hypercubes/03-ExplicitHypercubeWithAxisNoDefault/RollUp-SampleInstance.xml>

reader of the information and software would have to imply that the information is related to the consolidated entity.

One important point being made by this representation is that the notion of a dimension default is not used to represent the “Consolidated Entity [Member]”. As such, the dimensional information physically exists within the XBRL instance which you can see if you examine the XBRL of the XBRL instance:

```

    - <segment>
      <xbrldi:explicitMember dimension="pattern:LegalEntityAxis">pattern:ConsolidatedEntityMember</xbrldi:explicitMember>
    </segment>
  </entity>
  
```

The next example will make the notion of a dimension default and its purpose clear.

4.4. Explicit Hypercube, One Noncore Dimension, With a Dimension Default

In this example the only thing that has changed is that we added a dimension default to the noncore dimension that has been provided “Legal Entity [Axis]”. What adding the dimension default achieves is making the representation more flexible¹².

Component: (Network and Table)			
Network	30000 - Unknown - Property, Plant, and Equipment, by Component		
Table	Property, Plant and Equipment, by Component [Table]		
Reporting Entity [Axis]	SAMP http://www.SampleCompany.com		
Legal Entity [Axis]	Consolidated Entity [Member]		
Unit [Axis]	USD		
	Period [Axis] ▼		
Property, Plant and Equipment, by Component [Line Items]	2020-12-31	2019-12-31	
Property, Plant and Equipment, Net [Roll Up]			
Land	5,347,000	1,147,000	
Buildings, Net	244,508,000	366,375,000	
Furniture and Fixtures, Net	34,457,000	34,457,000	
Computer Equipment, Net	4,169,000	5,313,000	
Other Property, Plant and Equipment, Net	6,702,000	6,149,000	
Property, Plant and Equipment, Net, Total	295,183,000	413,441,000	

Suppose that you also wanted to represent the line item “Property, Plant and Equipment, Net” on the balance sheet. If you look at the XBRL instance of the example above, the dimension information is explicitly provided within the context of the fact as we have pointed out. However, in the XBRL instance of this example, the dimensional information does not explicitly appear within the XBRL instance context.

You might be asking yourself, why does this matter? It matters because many times one fact appears in two different fragments of a report. For example, you see the breakdown of the subcomponents of property, plant, and equipment provided in this fragment. You can imagine that the total of this breakdown of subcomponents would also appear, say, as a line item on the balance sheet.

What a dimension default does is make it possible to use the same fact in two different fragments of a report rather than having to provide duplicate facts, one for each

¹² Explicit hypercube, one noncore dimension, with a dimension default, <http://xbrlsite.azurewebsites.net/2020/Examples/Hypercubes/04-ExplicitHypercubeWithAxisWithDefault/RollUp-SampleInstance.xml>

fragment, when in reality you only have one fact. That is the role of a dimension default, to enable the interconnections between hypercubes of information.

4.5. Explicit Hypercube, Adding Additional Members, Including Dimensional Aggregation

In this example we add two additional members to the single noncore dimension “Legal Entity [Axis]”. The members added are “Business Unit Alpha [Member]” and “Business Unit Bravo [Member]”. Further, the sum of each business unit aggregates to the consolidated entity. That aggregation across members of the dimension need to be validated using an XBRL Formula as XBRL calculations cannot validate information across the members of a dimension. What adding this information achieves is provide additional details for the reported facts which disaggregates the information by business unit¹³.

Component: (Network and Table)						
Network	30000 - Unknown - Property, Plant, and Equipment, by Component					
Table	Property, Plant and Equipment, by Component [Table]					
Reporting Entity [Axis]	SAMP http://www.SampleCompany.com					
Unit [Axis]	USD					
	Period [Axis]	Legal Entity [Axis]				
		2020-12-31			2019-12-31	
Property, Plant and Equipment, by Component [Line Items]	Business Unit Alpha [Member]	Business Unit Bravo [Member]	Consolidated Entity [Member]	Business Unit Alpha [Member]	Business Unit Bravo [Member]	Consolidated Entity [Member]
Property, Plant and Equipment, Net [Roll Up]						
Land	5,300,000	47,000	5,347,000	1,100,000	47,000	1,147,000
Buildings, Net	244,000,000	508,000	244,508,000	366,000,000	375,000	366,375,000
Furniture and Fixtures, Net	34,400,000	57,000	34,457,000	34,400,000	57,000	34,457,000
Computer Equipment, Net	4,000,000	169,000	4,169,000	5,000,000	313,000	5,313,000
Other Property, Plant and Equipment, Net	6,000,000	702,000	6,702,000	6,000,000	149,000	6,149,000
Property, Plant and Equipment, Net, Total	293,700,000	1,483,000	295,183,000	412,500,000	941,000	413,441,000

4.6. Explicit Hypercube, Adding Second Noncore Dimension

In this example we have add a second noncore dimension “Scenario [Axis]” that has a single member “Actual [Member]”. What adding this information achieves is that it makes explicit that the information provide within this fragment is “actual” as contrast to “forecasted” information¹⁴.

Component: (Network and Table)						
Network	30000 - Unknown - Property, Plant, and Equipment, by Component					
Table	Property, Plant and Equipment, by Component [Table]					
Reporting Entity [Axis]	SAMP http://www.SampleCompany.com					
Unit [Axis]	USD					
	Period [Axis]	Legal Entity [Axis]			Scenario [Axis]	
		2020-12-31			2019-12-31	
Property, Plant and Equipment, by Component [Line Items]	Business Unit Alpha [Member]	Business Unit Bravo [Member]	Consolidated Entity [Member]	Business Unit Alpha [Member]	Business Unit Bravo [Member]	Consolidated Entity [Member]
Property, Plant and Equipment, Net [Roll Up]	Actual [Member]	Actual [Member]	Actual [Member]	Actual [Member]	Actual [Member]	Actual [Member]
Land	5,300,000	47,000	5,347,000	1,100,000	47,000	1,147,000
Buildings, Net	244,000,000	508,000	244,508,000	366,000,000	375,000	366,375,000
Furniture and Fixtures, Net	34,400,000	57,000	34,457,000	34,400,000	57,000	34,457,000
Computer Equipment, Net	4,000,000	169,000	4,169,000	5,000,000	313,000	5,313,000
Other Property, Plant and Equipment, Net	6,000,000	702,000	6,702,000	6,000,000	149,000	6,149,000
Property, Plant and Equipment, Net, Total	293,700,000	1,483,000	295,183,000	412,500,000	941,000	413,441,000

¹³ Explicit hypercube, adding additional members, including dimensional aggregation example, <http://xbrl.azurewebsites.net/2020/Examples/Hypercubes/05-ExplicitHypercubeWithAggregation/RollUp-SampleInstance.xml>

¹⁴ Explicit hypercube, adding second noncore dimension example, <http://xbrl.azurewebsites.net/2020/Examples/Hypercubes/06-ExplicitHypercubeWithAggregationTwoAxis/RollUp-SampleInstance.xml>

4.7. Summary

Logically, each and every representation shown above is the same except for the fact that the last two representations provide additional detailed facts. But the representation approaches used were each slightly different.

The number one takeaway you should have is a conscious understanding of the differences. Which representation approach to use depends on your reporting situation. All things considered, the following is always good advice and the best practice approach to representing information:

1. Always use explicit uniquely named hypercubes and have every fact reported within at least one hypercube. Both the SEC, ESMA, and XBRL international¹⁵ suggest this approach.
2. Always provide a dimension default for every dimension.
3. Only provide noncore dimensions to the extent that they are helpful in making facts distinguishing from one another.
4. Avoid adding unnecessary, meaningless, or ambiguous hierarchy within your line items concepts or dimensions members.

Note that any additional dimensions or line items can be included within a hypercube and all of these representation patterns apply.

5. Structure Representation Strategy

In this section I help you understand the different structure representation strategies, understand the pros and cons of each, and help you pick structure representation strategy that works best for you for your situation.

There are two fundamental ways to **identify** a structure using a machine-based process:

1. **Using a unique identifier:** Pointing to some unique identifier that provides a “handle” which you can use to “grab” that thing.
2. **Prototype theory:** Looking at the specification or description of some thing and using that specification/description to examine the properties of some set of things to determine if a specific thing is what you are looking for. (i.e. undisputed example)

As an example, one can understand that something is a “chair” by (#1) seeing a label “chair” and identifying that thing as being a chair; or (#2) understanding as many properties as possible about what a “chair” is; looking at the properties of a thing until the “chair” is identified and given no other instance or indicator that there is something better that meets the specification better; you can reliably conclude that what you have found using the properties is likely the chair (or other thing) you have been looking for.

¹⁵ XBRL International Guidance Clarifies Dimensions Semantics,
<http://xbrl.squarespace.com/journal/2015/3/31/xbrl-international-guidance-clarifies-xbrl-dimensions-semant.html>

Using XBRL there are two technical artifacts that can be used to **represent structures**: Networks and Hypercubes. There are two things that drive whether you use a Network and/or Hypercube to define something:

1. Because you have to in order to prevent a technical conflict.
2. Because you want to in order to organize something in a particular way.

Given the two ways to *identify* structures and the two ways to *represent* structures, there seems to be essentially four approaches or strategies for representing structures effectively:

1. **Hypercube as Unique Identifier**: Explicitly define a *unique hypercube* to identify each structure.
2. **Network as Unique Identifier**: Explicitly define a *unique network* to identify each structure (with all structures using the same hypercube).
3. **Disclosure Specification of Prototype**: Explicitly define a *specification* to describe each structure (with neither a hypercube nor a network explicitly describing the structure).
4. **Hypercube as Unique Identifier Plus Disclosure Specification of Prototype**: Explicitly define a structure using *a unique hypercube and also define a specification* for each structure.
5. **Network as Unique Identifier Plus Disclosure Specification of Prototype**: Explicitly define a structure using *a unique network and also define a specification* for each structure.

There are other approaches that can be used, but the approaches will not work to let you identify the structure or determine if the structure is represented correctly. I will go over the first four approaches that work first; then show you several approaches that do not work in order to contrast approaches that do work and approaches that will not work.

5.1. Hypercube as Unique Identifier

Using this approach, each hypercube is given a unique name and therefore the unique name can be used to identify the structure¹⁶:

¹⁶ Example of approach 1, Hypercube as Unique Identifier, <http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach1/>

Component: (Network and Table)																
Network	02-Comprehensive Income (http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome)															
Table	Comprehensive Income Statement [Hypercube] Unique Hypercube Name															
Slicers (applies to each fact value in each table cell)																
Reporting Entity [Axis]	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)															
<table border="1"> <thead> <tr> <th rowspan="2">Comprehensive Income Statement [Line Items]</th> <th>Period [Axis]</th> </tr> <tr> <th>2020-01-01 - 2020-12-31</th> </tr> </thead> <tbody> <tr> <td>Comprehensive Income [Roll Up]</td> <td></td> </tr> <tr> <td>Revenues</td> <td>7,000</td> </tr> <tr> <td>(Expenses)</td> <td>(3,000)</td> </tr> <tr> <td>Gains</td> <td>1,000</td> </tr> <tr> <td>(Losses)</td> <td>(2,000)</td> </tr> <tr> <td style="text-align: right;">Comprehensive Income</td> <td style="background-color: #d9ead3;">3,000</td> </tr> </tbody> </table>		Comprehensive Income Statement [Line Items]	Period [Axis]	2020-01-01 - 2020-12-31	Comprehensive Income [Roll Up]		Revenues	7,000	(Expenses)	(3,000)	Gains	1,000	(Losses)	(2,000)	Comprehensive Income	3,000
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(Losses)	(2,000)															
Comprehensive Income	3,000															

Given that each hypercube is unique and can therefore be used to reliably identify the structure and given that the structure is considered to be an undisputed example of the disclosure, there is no need to provide disclosure mechanics rules because there is enough information in the structure to provide a specification for evaluating if other structures created are consistent with the provided prototype.

5.2. Network as Unique Identifier

Using this approach, every hypercube has exactly the same name and therefore it cannot be used to identify a structure; however, the network has a unique name and therefore it can be used as a unique identifier¹⁷:

Component: (Network and Table)																
Network	02-Comprehensive Income (http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome)															
Table	Hypercube [Hypercube] Every hypercube the same															
Slicers (applies to each fact value in each table cell)																
Reporting Entity [Axis]	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)															
<table border="1"> <thead> <tr> <th rowspan="2">Hypercube [Line Items]</th> <th>Period [Axis]</th> </tr> <tr> <th>2020-01-01 - 2020-12-31</th> </tr> </thead> <tbody> <tr> <td>Comprehensive Income [Roll Up]</td> <td></td> </tr> <tr> <td>Revenues</td> <td>7,000</td> </tr> <tr> <td>(Expenses)</td> <td>(3,000)</td> </tr> <tr> <td>Gains</td> <td>1,000</td> </tr> <tr> <td>(Losses)</td> <td>(2,000)</td> </tr> <tr> <td style="text-align: right;">Comprehensive Income</td> <td style="background-color: #d9ead3;">3,000</td> </tr> </tbody> </table>		Hypercube [Line Items]	Period [Axis]	2020-01-01 - 2020-12-31	Comprehensive Income [Roll Up]		Revenues	7,000	(Expenses)	(3,000)	Gains	1,000	(Losses)	(2,000)	Comprehensive Income	3,000
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Gains	1,000															
(Losses)	(2,000)															
Comprehensive Income	3,000															

Note that this will only work if those creating XBRL instances are required to use the network name from the base taxonomy within their report and/or extension taxonomy. Just like the first case, no disclosure mechanics rules are necessary because the base taxonomy disclosure is a prototype specification and undisputed example and therefore can be used to evaluate reports to see if the disclosure mechanics of a report is consistent with the prototypes provided in the base taxonomy.

¹⁷ Example of approach 2, Network as Unique Identifier, <http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach2/>

5.3. Disclosure Specification as Prototype

Using this approach, there is no reliable unique identifier for the hypercube or the network; however, a specification is provided that indicates the characteristics of a disclosure and provides a unique name for each disclosure¹⁸:

Component: (Network and Table)	
Network	02-Comprehensive Income (http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome)
Table	(Implied) No reliable identifier

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

Reporting Entity [Axis]	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)
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Comprehensive Income [Roll Up]		Period [Axis]
		2020-01-01 - 2020-12-31
Comprehensive Income [Roll Up]		
Revenues		7,000
(Expenses)		(3,000)
Gains		1,000
(Losses)		(2,000)
Comprehensive Income		3,000

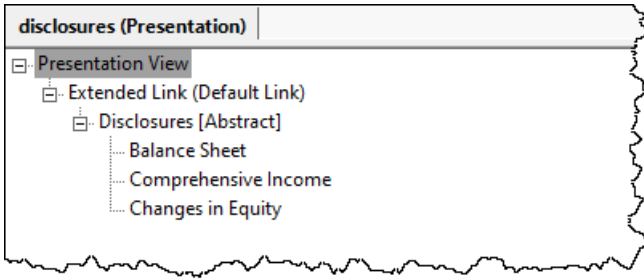
Even though there are no unique names for either hypercubes or networks, the disclosure can be identified using a specification of the disclosure mechanics rules and a list of uniquely named disclosures:

Primary Information									
#	Disclosure	Cate...	Level	Pattern	Disclosure...	Disclosure Consistent	Applicable	Representation Concept [TEXT BLOCK]	Representation Concept DETAIL
1	Balance Sheet	Unkn...	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Assets
Rules Line of Reasoning This disclosure: disclosures:BalanceSheet - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:Hierarchy - cm:Hierarchy REQUIRES concept: sfac6:Assets - The Hierarchy MUST contain the Level 4 Detailed Concept: sfac6:Liabilities - The Hierarchy MUST contain the Level 4 Detailed Concept: sfac6:Equity									
2	Changes in Equity	Unkn...	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Equity
Rules Line of Reasoning This disclosure: disclosures:ChangesInEquity - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:RollForward - cm:RollForward REQUIRES beginning/ending balance: sfac6:Equity									
3	Comprehensive Inc...	Unkn...	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Comprehensive Income
Rules Line of Reasoning This disclosure: disclosures:ComprehensiveIncome - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:RollUp - cm:RollUp REQUIRES total: sfac6:ComprehensiveIncome									

In order to uniquely identify and be able to refer to each structure, a unique disclosure name must be created otherwise there is no way to refer to a disclosure because there are no unique network names or hypercube names that can be referred to. In this case, a separate XBRL taxonomy schema¹⁹ is created to name disclosures. This can be done as part of the creation of a base taxonomy or supplemental to the base taxonomy after it has been created:

¹⁸ Approach 3, Disclosure Specification as Prototype, <http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach3/>

¹⁹ XBRL taxonomy schema with uniquely named disclosures, <http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach3/disclosures.xsd>



5.4. Hypercube as Unique Identifier Plus Disclosure Specification of Prototype

Using this approach is essentially a combination of approach #1 and approach #3 so you have both unique hypercubes that can be used to identify structures and the disclosures they represent and specifications that describe the disclosures²⁰:

Component: (Network and Table)	
Network	02-Comprehensive Income (http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome)
Table	Comprehensive Income Statement [Hypercube]

Every hypercube is unique

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

Reporting Entity [Axis]	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)
-------------------------	--

Comprehensive Income Statement [Line Items]	Period [Axis]
	2020-01-01 - 2020-12-31
Comprehensive Income [Roll Up]	
Revenues	7,000
(Expenses)	(3,000)
Gains	1,000
(Losses)	(2,000)
Comprehensive Income	3,000

You see above that the comprehensive income statement²¹ can be reliably identified using the hypercube used to represent that structure. The same is true for the balance sheet structure²² and changes in equity structure²³.

As can be seen per the disclosure mechanics rules, the unique hypercube name is used to help identify the disclosure in the disclosure mechanics rules. In addition, there is information such as the information model (i.e. roll up, roll forward), the total concept of the roll up or instance concept of a roll forward, or other information that is useful in specifying or identifying a structure which represents some specific disclosure.

²⁰ Approach 4, Hypercube as Unique Identifier Plus Disclosure Specification of Prototype, <http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach4/>

²¹ Human readable, comprehensive income, http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach4/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-sfac6_ComprehensiveIncomeStatementHypercube.html

²² Human readable, balance sheet, http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach4/evidence-package/contents/index.html#Rendering-BalanceSheet-sfac6_BalanceSheetHypercube.html

²³ Human readable, changes in equity structure, http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach4/evidence-package/contents/index.html#Rendering-ChangesInEquity-sfac6_ChangesInEquityHypercube.html

However, if you either (a) remove all information other than the name of the hypercube or (b) use only the name of the hypercube; you get the same result.

Note that in approach #3's disclosure mechanics rules hypercubes are not used.

#	Disclosure	Cate...	Level	Pattern	Disclosure...	Disclosure...	Applicable	Representation Concept [TEXT BLOCK]	Representation Concept DETAIL
1	Balance Sheet	Unkn...	Level4Detail	Hierarchy	True	CONSISTE...	True	NOT-EXPECTED	Assets
Rules Line of Reasoning This disclosure: disclosures:BalanceSheet - MUST be represented using the Hypercube/Table named: sfac6:BalanceSheetHypercube - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:Hierarchy - cm:Hierarchy REQUIRES concept: sfac6:Assets - The Hierarchy MUST contain the Level 4 Detailed Concept: sfac6:Liabilities - The Hierarchy MUST contain the Level 4 Detailed Concept: sfac6:Equity									
2	Changes in Equity	Unkn...	Level4Detail	RollForward	True	CONSISTE...	True	NOT-EXPECTED	Equity
Rules Line of Reasoning This disclosure: disclosures:ChangesInEquity - MUST be represented using the Hypercube/Table named: sfac6:ChangesInEquityHypercube - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:RollForward - cm:RollForward REQUIRES beginning/ending balance: sfac6:Equity									
3	Comprehensive Inc...	Unkn...	Level4Detail	RollUp	True	CONSISTE...	True	NOT-EXPECTED	Comprehensive Income
Rules Line of Reasoning This disclosure: disclosures:ComprehensiveIncome - MUST be represented using the Hypercube/Table named: sfac6:ComprehensiveIncomeStatementHypercube - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:RollUp - cm:RollUp REQUIRES total: sfac6:ComprehensiveIncome									

As such, providing both a unique hypercube plus the disclosure mechanics rules seems redundant or overkill. However, this is only the case if the base taxonomy structures can be used as undisputed examples of a specification of a disclosure.

5.5. Network as Unique Identifier Plus Disclosure Specification of Prototype

Using this approach is essentially a combination of approach #2 and approach #3 so you have both unique hypercubes that can be used to identify structures and the disclosures they represent and specifications that describe the disclosures²⁴:

Component: (Network and Table)	
Network	02-Comprehensive Income (http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome)
Table	Hypercube [Hypercube]
Every hypercube the same	
Slicers (applies to each fact value in each table cell)	
Reporting Entity [Axis]	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)

	Period [Axis]
Hypercube [Line Items]	2020-01-01 - 2020-12-31
Comprehensive Income [Roll Up]	
Revenues	7,000
(Expenses)	(3,000)
Gains	1,000
(Losses)	(2,000)
Comprehensive Income	3,000

²⁴ Approach 5, Network as Unique Identifier Plus Disclosure Specification of Prototype, <http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach5/>

In addition to the unique network identifier, disclosure mechanics rules are provided however in this case the disclosure mechanics rules do not leverage the unique network identifier to identify the disclosure that the structure is representing²⁵:

Primary Information									
#	Disclosure	Cate...	Level	Pattern	Disclosure...	Disclosure Consistent	Applicable	Representation Concept [TEXT BLOCK]	Representation Concept DETAIL
1	Balance Sheet	Unkn...	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Assets
Rules Line of Reasoning This disclosure: disclosures:BalanceSheet - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:Hierarchy - cm:Hierarchy REQUIRES concept: sfac6:Assets - The Hierarchy MUST contain the Level 4 Detailed Concept: sfac6:Liabilities - The Hierarchy MUST contain the Level 4 Detailed Concept: sfac6:Equity									
2	Changes in Equity	Unkn...	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Equity
Rules Line of Reasoning This disclosure: disclosures:ChangesInEquity - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:RollForward - cm:RollForward REQUIRES beginning/ending balance: sfac6:Equity									
3	Comprehensive Inc...	Unkn...	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Comprehensive Income
Rules Line of Reasoning This disclosure: disclosures:ComprehensiveIncome - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:RollUp - cm:RollUp REQUIRES total: sfac6:ComprehensiveIncome									

As such, providing both a uniquely identifiable structure plus the disclosure mechanics rules in order to identify the disclosure appears redundant or overkill. However, this is can only be the case if (a) networks from the base taxonomy are used in reports and (b) the base taxonomy can be views as an undisputed example of the disclosure.

5.6. Pathological Example Provided for Contrast

Note that this is a pathological example provided for contrast and not considered a viable approach to representing structures that are used to provide disclosures within an XBRL-based report. Note the following structure²⁶:

Component: (Network and Table)	
Network	02-Comprehensive Income (http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome)
Table	(Implied)

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

Reporting Entity [Axis]	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)
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Comprehensive Income [Roll Up]	Period [Axis]
	2020-01-01 - 2020-12-31
Comprehensive Income [Roll Up]	
Revenues	7,000
(Expenses)	(3,000)
Gains	1,000
(Losses)	(2,000)
Comprehensive Income	3,000

Assume that the reporting economic entity created their own network identifiers similar to XBRL-based financial statements submitted to the SEC.

²⁵ Disclosure mechanics rules validation result, <http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach5/DisclosureMechanicsRulesValidationResults.jpg>

²⁶ Approach 6, Pathological Example Provided for Contrast, <http://xbrlsite.azurewebsites.net/2020/structure-representation-strategy/Approach6/>

How exactly would you refer to this structure within an XBRL-based digital financial report? Note that the network identifier would be unique for a reporting economic entity, but every economic entity would provide a different unique network identifier for this or any other structure. Further, there is no hypercube at all and so that cannot be leveraged to identify the structure. If the reporting economic entity used an extension hypercube, that would not be helpful in identifying the structure.

Suppose you wanted to write rules that specify what each of the three disclosures looked like in order to control a machine-based process; the balance sheet, comprehensive income, and changes in equity. Suppose you wanted to, say, create the rules below:

Primary Information									
#	Disclosure	Cate...	Level	Pattern	Disclosure...	Disclosure Consistent	Applicable	Representation Concept [TEXT BLOCK]	Representation Concept DETAIL
1	Balance Sheet	Unkn...	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Assets
Rules Line of Reasoning This disclosure: disclosures:BalanceSheet - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:Hierarchy - cm:Hierarchy REQUIRES concept: sfac6:Assets - The Hierarchy MUST contain the Level 4 Detailed Concept: sfac6:Liabilities - The Hierarchy MUST contain the Level 4 Detailed Concept: sfac6:Equity									
2	Changes in Equity	Unkn...	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Equity
Rules Line of Reasoning This disclosure: disclosures:ChangesInEquity - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:RollForward - cm:RollForward REQUIRES beginning/ending balance: sfac6:Equity									
3	Comprehensive Inc...	Unkn...	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Comprehensive Income
Rules Line of Reasoning This disclosure: disclosures:ComprehensiveIncome - MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:RollUp - cm:RollUp REQUIRES total: sfac6:ComprehensiveIncome									

Note that the rules above refer to a disclosure: "disclosures:BalanceSheet", "disclosures:ChangesInEquity", "disclosures:ComprehensiveIncome". But you have nothing of the sort to refer to in this pathological example, it has not been defined.