1.   Structures

The purpose of this section is to show that a financial report can be decomposed into fragments or as we will call them structures. A structure is a logical fragment of a portion of a financial report. I have used the terms block and fact set to refer to these logical structures.

The term b**lock**[1] was used to describe a specific type of fragment in XBRL-based digital financial reports. But there is a better term than Block; that term is **Fact Set**. The terms Block and Fact Set as I use them are synonyms. This chapter explains what a Fact Set (or Block, I will use the term Fact Set for the rest of the document) is and how that notion can be leveraged when working with an XBRL-based digital financial report.

1.1.   Decomposing a Financial Report

A full financial **report** is made up of **fragments**, or report fragments as the *US GAAP Financial Reporting Taxonomy Architecture* calls them[2]. The *US GAAP Financial Reporting Taxonomy Architecture* goes on to explain the notion of a **schedule**. The architecture document says, "A 'Schedule' appears as a set of concepts within a relationship group and the root concept of a schedule is a text block.[3]" And then the architecture discusses **facts** and relations between fragments and facts even providing a UML diagram to explain the relationship[4].

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[1] *Understanding Block Semantics*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/UnderstandingBlockSemantics. pdf

[2] FASB, *US GAAP Financial Reporting Taxonomy Architecture Version 2014*, page 4, https://www.fasb.org/cs/ContentServer?c=Document_C&cid=1176163689810&d=&pagename=FASB%2F Document_C%2FDocumentPage

[3] FASB, *US GAAP Financial Reporting Taxonomy Architecture Version 2014*, page 15, Section 3.2.2 Schedules, https://www.fasb.org/cs/ContentServer?c=Document_C&cid=1176163689810&d=&pagename=FASB%2F Document_C%2FDocumentPage

[4] FASB, *US GAAP Financial Reporting Taxonomy Architecture Version 2014*, page 13, Figure 6, https://www.fasb.org/cs/ContentServer?c=Document_C&cid=1176163689810&d=&pagename=FASB%2F Document_C%2FDocumentPage

Figure 6 below illustrates that for an instance to faithfully represent *both* bodies of information *and* their relationship to each other there must be a many-to-many relationship between fragments and facts. It is not, and cannot ever be, enough to treat every fragment in a report as if it were a sequence of digits to represent one and only one numeric fact.

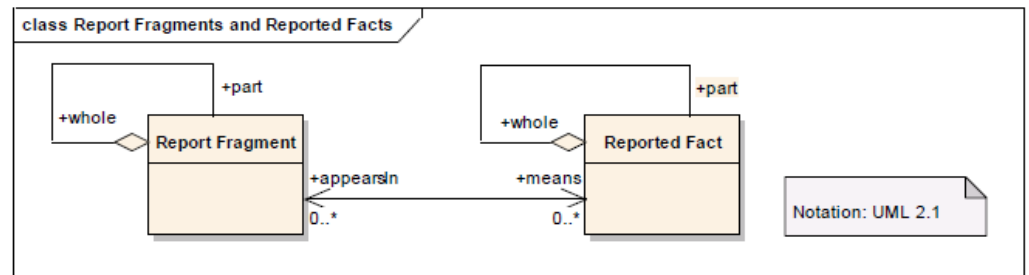**Figure 6. Many-to-Many Relationship Between Fragments and Facts**

Figure 7, below, is an example of this abstract figure. The narrative on the left, broken into three parts by the report author for layout reasons, is straightforward. Likewise, the relationship between the two facts on the right is also straightforward, as one is more general than the other. But the correspondence between the fragments and facts is

So, the descriptions of these terms and the relations between the terms is not necessarily clear as provided by the *US GAAP Financial Reporting Taxonomy Architecture*; however, the architecture is trying to articulate the pieces of a financial report, what those pieces do, and how the pieces interact with one another.

I have similarly decomposed the objects of a financial report. The following is a comparison of the terms that I use reconciled to the terms the *US GAAP Financial Reporting Taxonomy Architecture* uses as best as possible:

Definition	My Term	US GAAP Financial Reporting Taxonomy Term
A **report** is information published by a reporting entity at some point in time for some purpose.	Report	Financial Report
A **fragment** is a set of one to many fact sets which go together for some specific purpose within a report.	Fragment	Report Fragment
A **fact set** is a set of facts which go together (tend to be cohesive and share a certain common nature) for some specific purpose within a report.	Fact Set	Schedule
A **fact** is reported. A fact defines a single, observable, reportable piece of information contained within a report contextualized for unambiguous interpretation or analysis by one or more distinguishing aspects.	Fact	Fact

All the terms correlate pretty well with the possible exception of "fact set" and "schedule". The way the US GAAP Financial Reporting Taxonomy Architecture uses the term schedule is not as clear as it needs to be. While I did not provide the complete logical model of a financial repot above, understanding that complete model is helpful. You can find the *Logical Theory Describing a Business Report*[5].

1.2. Example Decomposition

To better solidify the understanding of these terms let me provide a specific example. I will use the Microsoft 2017 10-K[6] report to explain the difference between a report, fragment, fact set, and fact. You can use the SEC Interactive Data Viewer[7], the freely available XBRL Cloud Viewer[8], or any tool of your choice that provides the sorts of information I will show you in this section.

So, here is a partial view of the Microsoft 10-K report. You see the fragments of that report in a list on the left circled in red. You see the rendering of the selected fragment on the right.

If you change to the "Fact Table" view you see what the XBRL Cloud viewer calls that Fact Table; I call this same thing the "Fact Set". It is simply the individual facts that make up the selected report fragment.

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[5] Charles Hoffman, CPA and Rene van Egmond, *Logical Theory Describing a Business Report*, http://xbrlsite.azurewebsites.net/2019/Library/LogicalTheoryDescribingBusinessReport.pdf

[6] Microsoft 10-K for 2017, https://www.sec.gov/Archives/edgar/data/789019/000156459017014900/0001564590-17-014900-index.htm

[7] Microsoft 10-K in SEC Interactive Data Viewer, https://www.sec.gov/cgi-bin/viewer?action=view&cik=789019&accession_number=0001564590-17-014900&xbrl_type=v

[8] Microsoft 10-K in XBRL Cloud Viewer, https://edgardashboard.xbrlcloud.com/flex/viewer/XBRLViewer.html#instance=http://www.sec.gov/Archives/edgar/data/789019/000156459017014900/msft-20170630.xml

#	Reporting Entity	Period	Legal Entity [Axis]	Concept	Fact Value	Unit	Roundi	Parenthetical Explanations
1	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Document Type	10-K			
2	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Amendment Flag	false			
3	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Document Period End Date	2017-06-30			
4	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Document Fiscal Year Focus	2017			
5	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Document Fiscal Period Focus	FY			
6	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Trading Symbol	MSFT			
7	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Entity Registrant Name	MICROSOFT CORPORATION			
8	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Entity Central Index Key	0000789019			
9	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Current Fiscal Year End Date	--06-30			
10	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Entity Well Known Seasoned Issuer	Yes			
11	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Entity Current Reporting Status	Yes			
12	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Entity Voluntary Filers	No			
13	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Entity Filer Category	Large Accelerated Filer			
14	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Entity Listing Par Value Per Share	0.00000625	USD / shares	INF	
15	0000789019 (http://www.sec.gov/CIK)	2017-07-31	Entity [Domain]	Entity Common Stock Shares Outstanding	7702243979	shares	INF	
16	0000789019 (http://www.sec.gov/CIK)	2016-12-31	Entity [Domain]	Entity Public Float	466500000000	USD	-8	
17	0000789019 (http://www.sec.gov/CIK)	2016-07-01 - 2017-06-30	Entity [Domain]	Entity Tax Identification Number	911144442			

You will get a better appreciation of the difference between a fragment and a fact set when we look at the balance sheet. So, switching over to the SEC Interactive Data viewer because with that I can see the entire balance sheet, you see the following:

BALANCE SHEETS - USD ($) $ in Millions	Jun. 30, 2017	Jun. 30, 2016
Current assets:		
Cash and cash equivalents	$ 7,663	$ 6,510
Short-term investments (including securities loaned of $3,694 and $204)	125,318	106,730
Total cash, cash equivalents, and short-term investments	132,981	113,240
Accounts receivable, net of allowance for doubtful accounts of $405 and $426	19,792	18,277
Inventories	2,181	2,251
Other	4,897	5,892
Total current assets	159,851	139,660
Property and equipment, net of accumulated depreciation of $24,179 and $19,800	23,734	18,356
Equity and other investments	6,023	10,431
Goodwill	35,122	17,872
Intangible assets, net	10,106	3,733
Other long-term assets	6,250	3,416
Total assets	241,086	193,468
Current liabilities:		
Accounts payable	7,390	6,898
Short-term debt	9,072	12,904
Current portion of long-term debt	1,049	0
Accrued compensation	5,819	5,264
Income taxes	718	580
Short-term unearned revenue	34,102	27,468
Securities lending payable	97	294
Other	6,280	5,949
Total current liabilities	64,527	59,357
Long-term debt	76,073	40,557
Long-term unearned revenue	10,377	6,441
Deferred income taxes	531	1,476
Other long-term liabilities	17,184	13,640
Total liabilities	168,692	121,471
Commitments and contingencies		
Stockholders' equity:		
Common stock and paid-in capital – shares authorized 24,000; outstanding 7,708 and 7,808	69,315	68,178
Retained earnings	2,648	2,282
Accumulated other comprehensive income	431	1,537
Total stockholders' equity	72,394	71,997
Total liabilities and stockholders' equity	$ 241,086	$ 193,468

The balance sheet fragment is made up of two fact sets. The first fact set is the set of facts that makes up the *Assets [Roll Up]*. The second fact set is the set of facts that makes up the *Liabilities and Equity [Roll Up]*. Now, this may not make a lot of sense. You might ask, "Why would you ever use half of the balance sheet, you need both the assets roll up and the liabilities and equity roll up to work with the balance sheet." And you would be right, you typically work with both the assets and liabilities and equity roll ups when you work with the balance sheet. But, for other report fragments, this is not true.

Further, the facts for the balance sheet all fit into one fact set or fact table. Why would you need to separate those out? Well, in this case that is a good question because we do not need to separate the assets roll up and liabilities and equity roll up facts. Except, when we do. We do want to separate the balance sheet fragment when we only want to work with the assets roll up facts.

#	Reporting Entity	Period	Legal Entity [Axis]	Concept	Fact Value	Unit	Roundi
1	0000789019 (http://www.sec.gov/CIK)	2016-06-30	Entity [Domain]	Cash And Cash Equivalents At Carrying Value	6510000000	USD	-6
2	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Cash And Cash Equivalents At Carrying Value	7663000000	USD	-6
3	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Available For Sale Securities Current	125318000000	USD	-6
4	0000789019 (http://www.sec.gov/CIK)	2016-06-30	Entity [Domain]	Available For Sale Securities Current	106730000000	USD	-6
5	0000789019 (http://www.sec.gov/CIK)	2016-06-30	Entity [Domain]	Cash Cash Equivalents And Short Term Investments	113240000000	USD	-6
6	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Cash Cash Equivalents And Short Term Investments	132981000000	USD	-6
7	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Accounts Receivable Net Current	19792000000	USD	-6
8	0000789019 (http://www.sec.gov/CIK)	2016-06-30	Entity [Domain]	Accounts Receivable Net Current	18277000000	USD	-6
9	0000789019 (http://www.sec.gov/CIK)	2016-06-30	Entity [Domain]	Inventory Net	2251000000	USD	-6
10	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Inventory Net	2181000000	USD	-6
11	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Other Assets Current	4897000000	USD	-6
12	0000789019 (http://www.sec.gov/CIK)	2016-06-30	Entity [Domain]	Other Assets Current	5892000000	USD	-6
13	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Assets Current	159851000000	USD	-6

Let's go back to the first fragment we looked at, the document and entity information. Take a close look at what you see. First, the name is a dead giveaway, "Document and Entity Information". So, this is really two fact sets that you have no way of separating unless you want to separate the "document information" from the "entity information" and you can even say that there are three categories because you also have "entity listing information" in that one fact set.

Document and Entity Information - USD ($) $ / shares in Units, $ in Billions	12 Months Ended		
	Jun. 30, 2017	Jul. 31, 2017	Dec. 31, 2016
Document Type	10-K		
Amendment Flag	false		
Document Period End Date	Jun. 30, 2017		
Document Fiscal Year Focus	2017		
Document Fiscal Period Focus	FY		
Trading Symbol	MSFT		
Entity Registrant Name	MICROSOFT CORPORATION		
Entity Central Index Key	0000789019		
Current Fiscal Year End Date	--06-30		
Entity Well-known Seasoned Issuer	Yes		
Entity Current Reporting Status	Yes		
Entity Voluntary Filers	No		
Entity Filer Category	Large Accelerated Filer		
Entity Common Stock, Par Value Per Share	$ 0.00000625		
Entity Common Stock, Shares Outstanding		7,702,243,979	
Entity Public Float			$ 466.5
I.R.S. Employer Identification No.	911144442		

So, let's walk through all the parts of a fact set by looking at a significantly smaller fact set, components of inventory. Here is the rendering of the components of inventory:

Here is the fact table (fact set) of the components of inventory:

#	Reporting Entity	Period	Legal Entity [Axis]	Concept	Fact Value	Unit	Roundi
1	0000789019 (http://www.sec.gov/CIK)	2016-06-30	Entity [Domain]	Inventory Raw Materials Net Of Reserves	612000000	USD	-6
2	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Inventory Raw Materials Net Of Reserves	797000000	USD	-6
3	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Inventory Work In Process Net Of Reserves	145000000	USD	-6
4	0000789019 (http://www.sec.gov/CIK)	2016-06-30	Entity [Domain]	Inventory Work In Process Net Of Reserves	158000000	USD	-6
5	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Inventory Finished Goods Net Of Reserves	1239000000	USD	-6
6	0000789019 (http://www.sec.gov/CIK)	2016-06-30	Entity [Domain]	Inventory Finished Goods Net Of Reserves	1481000000	USD	-6
7	0000789019 (http://www.sec.gov/CIK)	2016-06-30	Entity [Domain]	Inventory Net	2251000000	USD	-6
8	0000789019 (http://www.sec.gov/CIK)	2017-06-30	Entity [Domain]	Inventory Net	2181000000	USD	-6

And here is the information model definition for the components of inventory disclosure:

Label	Report Element Class	Period	Balance	Name
▼ Inventory, Current [Table]	[Table]			us-gaap:InventoryCurrentTable
▼ Legal Entity [Axis]	[Axis]			dei:LegalEntityAxis
Entity [Domain]	[Member]			dei:EntityDomain
▼ Inventory [Line Items]	[Line Items]			us-gaap:InventoryLineItems
Raw materials	[Concept] Monetary	As Of	debit	us-gaap:InventoryRawMaterialsNetOfReserves
Work in process	[Concept] Monetary	As Of	debit	us-gaap:InventoryWorkInProcessNetOfReserves
Finished goods	[Concept] Monetary	As Of	debit	us-gaap:InventoryFinishedGoodsNetOfReserves
Total	[Concept] Monetary	As Of	debit	us-gaap:InventoryNet

Then you have the business rules that define the roll up of the inventory line items:

Label	Report Element Class	Period	Balance	Name
▼ Inventory	[Concept] Monetary	As Of	debit	us-gaap:InventoryNet
Raw materials	[Concept] Monetary	As Of	debit	us-gaap:InventoryRawMaterialsNetOfReserves
Work in process	[Concept] Monetary	As Of	debit	us-gaap:InventoryWorkInProcessNetOfReserves
Finished goods	[Concept] Monetary	As Of	debit	us-gaap:InventoryFinishedGoodsNetOfReserves

So, all that is straight forward. You have a fragment, components of inventory, which has exactly one fact set. Leveraging the fact set, the information model definition, the concept arrangement pattern, and the XBRL calculation relations, a very nice and readable rendering for the fact set can be created.

But what if a company did what is shown below? What you see is one fragment that has two roll ups; a roll up for the components of property, plant, and equipment and a roll up of the components of inventory. What prevents a public company from

creating this type of fragment? Nothing prevents this and, in fact, it is done all the time.

Reporting Entity [Axis]	SAMP http://www.SampleCompany.com	
Legal Entity [Axis]	Consolidated Entity [Member]	
Unit [Axis]	USD	
	Period [Axis] ▼	
Assets, by Component [Line Items]	2020-12-31	2019-12-31
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
Finished Goods	7,000	7,000
Work in Progress	9,000	9,000
Raw Materials	2,000	2,000
Inventory, Total	18,000	18,000

While the creator if this information might want to put these two roll ups together into one fragment; you might want to work with these two pieces of this one fragment separately; and that is exactly the sort of functionality the fact set provides.

Here is the property, plant, and equipment roll up:

Here is the inventory components roll up:
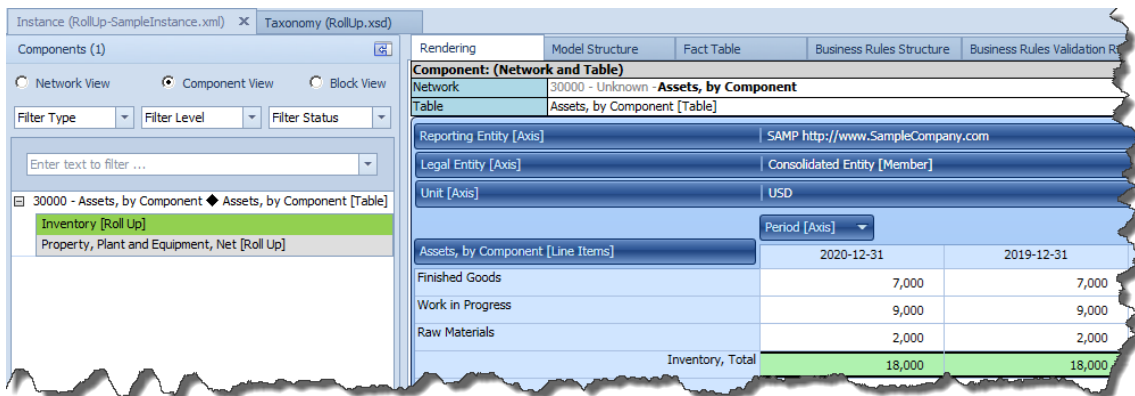
And so, how did the software application separate the two fact sets within the one fragment and be able to work with them individually? (Try this in most software applications and you will not be able to do this.)

The answer to the question is that the software above does understand what a fact set is and it uses information from the model description to break the two fact sets out from the one fragment. What is the information that provides this metadata reliably? The XBRL calculation relations. Each roll up has XBRL calculation relations and each set of XBRL calculation relations has one root element. It is that one root element that (a) tells you the name of the fact set (see on the left) and which facts go into the fact set (or fact table). See:

Property, plant and equipment components fact set:

#	Reporting Entity	Period	Concept	Legal Entity [Axis]	Fact Value	Unit	Rounding
1	SAMP http://www.SampleCompany.com	2020-12-31	Land	Consolidated Entity [Member]	5347000	USD	0
2	SAMP http://www.SampleCompany.com	2019-12-31	Land	Consolidated Entity [Member]	1147000	USD	0
3	SAMP http://www.SampleCompany.com	2020-12-31	Buildings, Net	Consolidated Entity [Member]	244508000	USD	0
4	SAMP http://www.SampleCompany.com	2019-12-31	Buildings, Net	Consolidated Entity [Member]	366375000	USD	0
5	SAMP http://www.SampleCompany.com	2020-12-31	Furniture and Fixtures, Net	Consolidated Entity [Member]	34457000	USD	0
6	SAMP http://www.SampleCompany.com	2019-12-31	Furniture and Fixtures, Net	Consolidated Entity [Member]	34457000	USD	0
7	SAMP http://www.SampleCompany.com	2020-12-31	Computer Equipment, Net	Consolidated Entity [Member]	4169000	USD	0
8	SAMP http://www.SampleCompany.com	2019-12-31	Computer Equipment, Net	Consolidated Entity [Member]	5313000	USD	0
9	SAMP http://www.SampleCompany.com	2020-12-31	Other Property, Plant and Equipment, Net	Consolidated Entity [Member]	6702000	USD	0
10	SAMP http://www.SampleCompany.com	2019-12-31	Other Property, Plant and Equipment, Net	Consolidated Entity [Member]	6149000	USD	0
11	SAMP http://www.SampleCompany.com	2020-12-31	Property, Plant and Equipment, Net	Consolidated Entity [Member]	295183000	USD	0
12	SAMP http://www.SampleCompany.com	2019-12-31	Property, Plant and Equipment, Net	Consolidated Entity [Member]	413441000	USD	0

Inventory components fact set:

#	Reporting Entity	Period	Concept	Legal Entity [Axis]	Fact Value	Unit	Rounding
13	SAMP http://www.SampleCompany.com	2020-12-31	Finished Goods	Consolidated Entity [Member]	7000	USD	0
14	SAMP http://www.SampleCompany.com	2019-12-31	Finished Goods	Consolidated Entity [Member]	7000	USD	0
15	SAMP http://www.SampleCompany.com	2020-12-31	Work in Progress	Consolidated Entity [Member]	9000	USD	0
16	SAMP http://www.SampleCompany.com	2019-12-31	Work in Progress	Consolidated Entity [Member]	9000	USD	0
17	SAMP http://www.SampleCompany.com	2020-12-31	Raw Materials	Consolidated Entity [Member]	2000	USD	0
18	SAMP http://www.SampleCompany.com	2019-12-31	Raw Materials	Consolidated Entity [Member]	2000	USD	0
19	SAMP http://www.SampleCompany.com	2020-12-31	Inventory	Consolidated Entity [Member]	18000	USD	0
20	SAMP http://www.SampleCompany.com	2019-12-31	Inventory	Consolidated Entity [Member]	18000	USD	0

So while the fragment that holds the two fact set contains the property, plant, and equipment components facts and the inventory components facts; you can also separate the facts into the individual fact sets.

1.3. Things you May Not Realize about Representing Information using XBRL

This section gets a little bit technical because I have to explain a few things about how XBRL is employed to represent information. If you want to understand this section, please read through the basic *XBRL Technical Primer*[9].

In XBRL, an information model description is created by creating Networks, putting Tables (hypercubes) in those Networks, and then putting other report elements within those Tables. Alternatively, you might not explicitly define a Table within a Network. And so if you do not explicitly provide a Table and put any report elements within a Network; essentially what you are doing is creating a single implied table that contains each report element that is not represented within a Table within a Network.

And so, Networks and Tables (explicitly defined or implied) are used to represent the information model description of a report.

Sometimes you MUST separate things using Networks to avoid conflicts; other times you get too choose whether to separate things using Networks. Tables work the same way; sometimes you MUST use a Table to separate fact sets and other times you get to choose whether you want to (a) use an existing Table or (b) create a new Table to represent some piece of a report.

A representation of information can have exactly four possible states or features:

1. An information representation is **logically represented** and **easy to comprehend**.

2. An information representation is **logically represented** and **hard to comprehend**.

3. An information representation is **illogically represented** and **easy to comprehend (but illogical)**.

4. An information representation is **illogically represented** and **hard to comprehend (but illogical)**.

States #3 and #4 are incorrect by definition. Information that is defined illogically is simply wrong.

State #2 is not incorrect, but neither is it a best practice. State #1 is the only best practice, information that is logically represented and as easy to read as possible. A **best practice** is a method or technique that has been generally accepted as superior to any other known alternatives because it produces results that are superior to those results achieved by other means or because it has become a standard way of doing something.

And so, let's have another look at the report rendering that I showed earlier where property, plant, and equipment components roll up and the inventory components roll up are combined into one report fragment:

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[9] Charles Hoffman, CPA and Rene van Egmond, XBRL Technical Primer,
http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part00_Chapter01.2_XBRLPrimer.pdf

Reporting Entity [Axis]	SAMP http://www.SampleCompany.com	
Legal Entity [Axis]	Consolidated Entity [Member]	
Unit [Axis]	USD	
	Period [Axis] ▾	
Assets, by Component [Line Items]	2020-12-31	2019-12-31
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
Finished Goods	7,000	7,000
Work in Progress	9,000	9,000
Raw Materials	2,000	2,000
Inventory, Total	18,000	18,000

Now, look at this almost identical representation of the same information and note the slight difference. In the report above, a root presentation relation which is an [Abstract] concept that holds all of the other concepts from the property, plant, and equipment [Roll up] and distinguishes those concepts from the inventory [Roll Up].

Reporting Entity [Axis]	SAMP http://www.SampleCompany.com	
Legal Entity [Axis]	Consolidated Entity [Member]	
Unit [Axis]	USD	
	Period [Axis] ▾	
Assets, by Component [Line Items]	2020-12-31	2019-12-31
Property, Plant and Equipment [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
Inventory [Roll Up]		
Finished Goods	7,000	7,000
Work in Progress	9,000	9,000
Raw Materials	2,000	2,000
Inventory, Total	18,000	18,000

So, is the first rendering at the top of the page without those two [Abstract] concepts wrong and the second rendering at the bottom right? No, that is not what I am saying. Both the top and the bottom representations are logically correct. But at the same time, I point out that if the second representation is easier to read than the first, then the second is a better practice that the first.

You might think that this discussion is silly and that as long as the representation is logical, you can represent XBRL-based information however you want. And yes, it is true that you can do that, represent information however you want as long as the information is not illogical.

However, if you are a software engineer that is constructing software that helps business professionals do things right or to automatically follow best practices or to not let software users to things wrong; this is incredibly helpful information.

Further, have a look at this fragment from an XBRL-based financial report of a public company submitted to the SEC:

Commitments (Details) (USD $) In Millions, unless otherwise specified	12 Months Ended		
	Oct. 31, 2012	Oct. 31, 2011	Oct. 31, 2010
Commitments			
Rent expense	$ 1,012	$ 1,042	$ 1,062
Sublease rental income	37	38	46
Property under capital lease	882	577	
Accumulated depreciation on property under capital lease	453	454	
Minimum lease payments, sublease rental income			
Minimum lease payments, 2013	780		
Minimum lease payments, 2014	665		
Minimum lease payments, 2015	517		
Minimum lease payments, 2016	351		
Minimum lease payments, 2017	218		
Minimum lease payments, thereafter	805		
Minimum lease payments, total	3,336		
Less: Sublease rental income, 2013	(28)		
Less: Sublease rental income, 2014	(23)		
Less: Sublease rental income, 2015	(18)		
Less: Sublease rental income, 2016	(9)		
Less: Sublease rental income, 2017	(4)		
Less: Sublease rental income, thereafter	(12)		
Sublease rental income, total	(94)		
Minimum lease payments net of sublease rental income, 2013	752		
Minimum lease payments net of sublease rental income, 2014	642		
Minimum lease payments net of sublease rental income, 2015	499		
Minimum lease payments net of sublease rental income, 2016	342		
Minimum lease payments net of sublease rental income, 2017	214		
Minimum lease payments net of sublease rental income, thereafter	793		
Minimum lease payments net of sublease rental income, total	3,242		
Capital lease commitments			
Capital lease commitments, 2013	59		
Capital lease commitments, 2014	240		
Capital lease commitments, 2015	11		
Capital lease commitments, 2016	7		
Capital lease commitments, 2017	4		
Capital lease commitments, thereafter	33		
Capital lease commitments, total	354		
Less: Interest payments, 2013	(8)		
Less: Interest payments, 2014	(6)		
Less: Interest payments, 2015	(3)		
Less: Interest payments, 2016	(2)		
Less: Interest payments, 2017	(2)		
Less Interest payments, thereafter	(12)		
Interest payments, total	(33)		

That representation you see above is from an actual XBRL-based report created by a public company to the U.S. Securities and Exchange Commission. While logically, the information is 100% correct, the rendering of the information is hideous and downright ugly.

I have provided you with one simple, basic use of fact sets. This basic explanation is useful in that it helps you get a true sense of what a fact set really is. But it is only a basic example; there are many other uses for the notion of fact sets.

So, one use of fact sets is to avoid hideous, ugly, and unreadable information representations such as these two examples:

There are two strong arguments for not creating ugly, hideous renderings. First, for every one bad example of a rendering, there are 50 or 100 or good examples. The good examples are best practices, the bad examples are not. Second, if you can help software engineers the problems you are having representing information using XBRL and making it right; the software engineers can help you be more successful.

1.4.   Better Understanding the Utility of a Fact Set and a Slot

It is pretty clear that a financial report is made up of lots of smaller pieces and those pieces interact with one another in specific ways. If you give those pieces names, you can use the pieces to perform useful work.

A **fact set** is a part of a fragment that participates in the same *concept arrangement pattern*[10]. By definition, all the concepts participate in the same Member Arrangement Pattern of a component (Network + Table) simply because they exist in the same Table. A roll up, roll forward, adjustment, and set (hierarchy) are all types of concept arrangement patterns. Every XBRL-based public company financial report is essentially a set of fact sets. I estimate that there are about 754,430 fact sets in the set of approximately 6,000 public company reports that I analyzed. 16% are roll ups, 5% are roll forwards, 24% are sets (hierarchies), and 54% are text blocks[11]. I know this because I measured the reports that I analyzed to figure out that fact sets exist.

An **information model** definition is the combined *concept arrangement pattern* and *member arrangement pattern* of a fact set.

Fact sets have something called a "slot"[12]. A **slot** is simply the idea of an allotted place where something can be logically and sensibly placed in a fact set. For example, a roll up has exactly *one* total and so *a second total* could never logically be added to a roll up.

Fact sets and slots are in no way random. Fact sets are used to represent information that is disclosed in a financial report in consistent patterns. Balance sheets and the other primary financial statements are made up of fact sets, long-term debt maturities disclosure and other disclosures are made up of fact sets. Every fragment of a financial report is a set of one or many fact sets. As I pointed out, fact sets have very specific *concept arrangement patterns*: roll up, roll forward, text block, adjustment, variance, set (hierarchy). Fact sets are related to other fact sets in very specific ways.

Basic fact set

Here is an example of a fact set that represents a roll up (the concept arrangement pattern) which has no non-core [Axis] added and therefore the most basic member arrangement pattern:

Property, Plant and Equipment, by Component [Line Items]	Period [Axis]	
	2010-12-31	2009-12-31
Property, Plant and Equipment, by Component [Roll Up]		
Land	1,000,000	1,000,000
Machinery and equipment, gross	2,000,000	2,000,000
Furniture and fixtures, gross	6,000,000	6,000,000
Accumulated depreciation	(1,000,000)	(1,000,000)
Property, plant and equipment, net	8,000,000	8,000,000

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[10] See page 11,
http://www.xbrlsite.com/2015/Analysis/AnalysisSummary2014_PiecesOfReoprt.pdf#page=11

[11] I have a document that summarizes this information.

[12] See section 5.5. Understanding the notion of slot or opening,
http://www.xbrlsite.com/DigitalFinancialReporting/Book2015/DigitalFinancialReporting-2015-04-29-C05.pdf#page=3

You cannot add a second total to a roll up as a roll up has only one total. It would not make logical sense to add a second total to a roll up. Therefore, adding second totals to a roll up should be (could be) disallowed within a software application.

It does make sense to add another concept to the set of line items which aggregate to the total. It also does make sense to add an entirely new period characteristic. A slot is simply a logical location where something can be added to a fact set. Exactly where slots exist in a fact set depends on the *concept arrangement pattern* and *member arrangement pattern* of the fact set. Every fact set in every report fragment in every report works in exactly this same way.

If you are a professional accountant you innately understand how information is related in a set of information such as what is represented in the example shown above. And there are many, many other such report fragments within a financial report. But professional accountants don't call these pieces of information "fact set" because they never needed to explain the mechanics and dynamics that are at work to a computer before. But to represent a financial report digitally and to interact with software applications that provide these digital representations of a financial report describing these mechanics and dynamics is necessary.

Slightly more complex fact set

Below is a slightly more complex fact set. The fact set below is made up of two roll ups and has a whole-part relation which semantically is similar to a roll up. Professional accountants understand that the disclosure below both "foots" and "cross casts". However, the software vendor creating this application does not provide the single underscores and double underscores that explicitly show the mathematical relations. I have added green arrows to show the mathematical relations and green check marks to show that all the information does in fact foot and cross cast as expected:

	0000000001			
	31-Dec-2011			
	All Available-for-Sale Debt and Equity Securities [Domain]	Treasury bills [Member]	Corporate bonds [Member]	Sovereign debt securities [Member]
Available-for-sale Securities, Contractual Maturities [Table]				
Available-for-sale Securities, Contractual Maturities [Line Items]				
Available-for-sale securities at amortized cost [Roll Up]				
Due in one year or less	$300,000,000	$100,000,000	$100,000,000	$100,000,000
Due after one year through five years	$300,000,000	$100,000,000	$100,000,000	$100,000,000
Due after five years through ten years	$300,000,000	$100,000,000	$100,000,000	$100,000,000
Due after ten years	$300,000,000	$100,000,000	$100,000,000	$100,000,000
No contractual maturity dates	$300,000,000	$100,000,000	$100,000,000	$100,000,000
Available-for-sale securities at amortized cost	$1,500,000,000	$500,000,000	$500,000,000	$500,000,000
Available-for-sale securities at estimated fair value [Roll Up]				
Due in one year or less	$300,000,000	$100,000,000	$100,000,000	$100,000,000
Due after one year through five years	$300,000,000	$100,000,000	$100,000,000	$100,000,000
Due after five years through ten years	$300,000,000	$100,000,000	$100,000,000	$100,000,000
Due after ten years	$300,000,000	$100,000,000	$100,000,000	$100,000,000
No contractual maturity dates	$300,000,000	$100,000,000	$100,000,000	$100,000,000
Available-for-sale securities at estimated fair value	$1,500,000,000	$500,000,000	$500,000,000	$500,000,000

The fragment above has two fact sets. Each fact set has a roll up concept arrangement pattern. Each fact set shares the same member arrangement pattern which happens to be a whole-part relation. Logically, the whole-part member arrangement pattern relation is identical to the roll up concept arrangement pattern. It still makes sense to add concepts to the roll up. It still makes sense to add a new period. It also makes sense to add an additional [Member] to the [Axis]. (NOTE that this software does not

show the name of the [Axis] "Period", the "Reporting Entity" or the other [Axis] which contains the [Member]s shown above.)

Imagine articulating all the things that are going on unconsciously in the mind of a professional accountant to a machine such as a computer in a manner that is explicitly understandable to the computer. That is why we are providing explicit names such as "fact set" and "slot" and "concept arrangement pattern" and "member arrangement pattern".

1.5. Disclosure Mechanics

Consider the two disclosures that I showed you before again. Think about the following questions:

- How often would the property, plant, and equipment components roll up be a roll up? Clearly 100% of the time. If you wanted to represent a roll forward, that is a different disclosure.

- How often would the total of the roll up of the components of property, plant, and equipment be the concept such as "us-gaap:PropertyPlantAndEquipmentNet" or some similar alternative concept? Clearly 100% of the time.

- How often would concepts such as Land, Buildings, Furniture and Fixtures, Computer Equipment and such be included within the total? Well, that actually depends on what subcategories of property, plant, and equipment an economic entity actually has. But often those concepts would be used. How often would these subclasses of PPE be used to represent the subcategories of inventory? Never.

- If the line item property plant and equipment was reported on the balance sheet, what is the probably that the subcategories would be de disclosed?

- If property, plant and equipment is disclosed, what is the probably that the estimated useful lives of the subclasses of property, plant and equipment were also disclosed? Pretty high.

Reporting Entity [Axis]		SAMP http://www.SampleCompany.com	
Legal Entity [Axis]		Consolidated Entity [Member]	
Unit [Axis]		USD	
		Period [Axis] ▼	
Assets, by Component [Line Items]		2020-12-31	2019-12-31
Property, Plant and Equipment [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

Consider the same questions above and the inventory components roll up disclosure. Consider the same question and the many other disclosures that exist within a financial report. Consider the prototype below[13]:

These patterns are not unique to US GAAP, they also exist for IFRS and other reporting schemes. These patterns can be represented in machine-readable rules. For example, here are machine-readable rules that relate to the inventory components disclosure required under US GAAP.

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[13] *Disclosure Best Practices*, http://xbrlsite-app.azurewebsites.net/DisclosureBestPractices/DisclosureBestPractices.aspx?DisclosureName=PropertyPlantAndEquipmentNetByTypeRollUp

Apply the same ideas that we are discussing for the property, plant and equipment components disclosure and the inventory components disclosure to other disclosures represented within a report:

These techniques can be applied to each and every fact set that exists within an XBRL-based financial report. Report creation workflows can take advantages of the ability to identify and work with specific fact sets that exist.

1.6. What's in a Name?

If you think about what it takes to make the sorts of things I am discussing in this document you recognize that if you cannot refer to something, you cannot work with that thing. The object "fact set" is given a name. The disclosures that are represented by such a fact set are given a name. The templates and exemplars (examples) that are used to represent a disclosure are associated with that name. As I laid out in the document *Computer Empathy*[14], if you know how to lay out information in machine-readable form you can make a computer seemingly perform magic.

1.7. Fact Set only Part of Larger Conceptual Model

The fact set is only a small but important piece of a much larger conceptual model[15]. That conceptual is leveraged to work with the pieces of an XBRL-based financial report

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[14] Charles Hoffman, CPA, *Computer Empathy*,
http://xbrlsite.azurewebsites.net/2018/Library/ComputerEmpathy.pdf

[15] Charles Hoffman, CPA and Rene van Egmond, *Introduction to the Conceptual Model of a Digital Financial Report*,
http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.1_IntroductionToTheConceptualModelOfDigitalFinancialReport.pdf

to effectively work with the report at a logical level rather than at a technical level. Once the technical aspects are buried deep within software, business users working with software only have to deal with logic, which then innately understand.
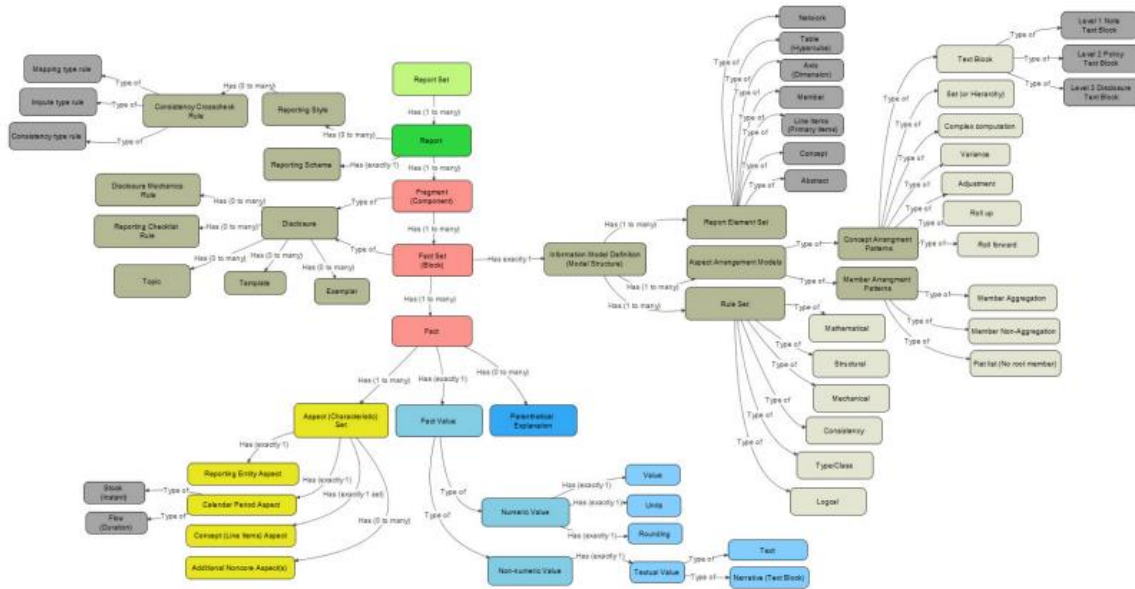
1.8. Human and Computer Collaboration

Today's software for creating XBRL-based financial reports knows very little about the financial report, the disclosures that go into a financial report, etc. This will change. Just like a calculator is used by a professional accountant to do math, software in the future will be as easy to use as a calculator and will serve the needs of professional accountants.

1.9. Conclusion

Deloitte created the notion of that they call *The Finance Factory[16]* to "package" these ideas of digital accounting, reporting, auditing, and analysis. One type of practical knowledge is **know-how**; how to accomplish something. Fact sets are a technique which can be leveraged to build pieces of *The Finance Factory*. While some of the ideas of The Finance Factor seem far-fetched; they really are not as far-fetched as they might seem if you have the know-how to actually make technology work to serve you.

1.10. Prototypes

A basic prototype business report provides a very basic example which helps you get your head around the notion that a financial report is a set of fact sets.

Raw XBRL: http://xbrlsite.azurewebsites.net/2018/Prototypes/LoremIpsum/basic-SampleInstance_WithFormulas.xml

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[16] *Deloitte's Vision: The Finance Factory*, http://xbrl.squarespace.com/journal/2019/2/20/deloittes-vision-the-finance-factory.html

Inline XBRL: http://xbrlsite.azurewebsites.net/2018/Prototypes/LoremIpsum/basic-SampleInstance_WithFormulas.html

Human Readable Validation Report:
http://xbrlsite.azurewebsites.net/2018/Prototypes/LoremIpsum/evidence-package/

A more advance prototype provides insight into the more sophisticated business rules that are used to control the variability of a report. This prototype was created using the *Method of Implementing a Standard Digital Financial Report Using the XBRL Syntax*[17]. Step-by-step documentation is provided for creating this XBRL taxonomy and the related XBRL instance[18].

Raw XBRL: http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/ipsas/taxonomy/company-instance-TestDynamic.xml

Human Readable Validation Report:
http://xbrlsite.azurewebsites.net/2019/Library/Core/evidence-package/

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[17] Charles Hoffman, CPA and Rene van Egmond, *Method of Implementing a Standard Digital Financial Report Using the XBRL Syntax*,
http://xbrlsite.azurewebsites.net/2019/Library/MethodForImplementingStandardFinancialReportUsingXBRL.pdf
[18] *International Public Sector Accounting Standards XBRL Taxonomy Prototype Project*,
http://xbrl.squarespace.com/journal/2019/1/16/international-public-sector-accounting-standards-xbrl-taxono.html

2. Understanding Fact Set Semantics

Irreducible complexity[19] is explained as follows: a single system which is composed of several interacting parts that contribute to the basic function, and where the removal of any one of the parts causes the system to effectively cease functioning.

So for example, consider a simple mechanism such as a mousetrap. That mousetrap is composed of several different parts each of which is essential to the proper functioning of the mousetrap: a flat wooden base, a spring, a horizontal bar, a catch bar, the catch, and staples that hold the parts to the wooden base. If you have all the parts and the parts are assembled together properly, the mousetrap works as it was designed to work.

But say you remove one of the parts of the mousetrap. The mousetrap will no longer function as it was designed, it simply will not work. That is irreducible complexity: the complexity of the design requires that it can't be reduced any farther without losing functionality.

Similarly, an XBRL-based digital financial report has irreducible complexity, certain pieces that if missing cause errors, problems using the information, and other quality issues. Errors and quality issues in financial reports causes the entire report to be considered untrustworthy.

Blocks are designed to prevent such errors, problems using information, and other quality issues. Further, Blocks enable increased functionality to be provided to software users by software engineers.

You have used a conceptual model if you are an accountant and probably don't even realize it. *Electronic spreadsheets* are broken down into the rows, columns, cells, sheets, and workbooks that make up the pieces of an electronic version of a spreadsheet.

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[19] Understanding the Law of Conservation of Complexity,
http://xbrl.squarespace.com/journal/2015/5/24/understanding-the-law-of-conservation-of-complexity.html
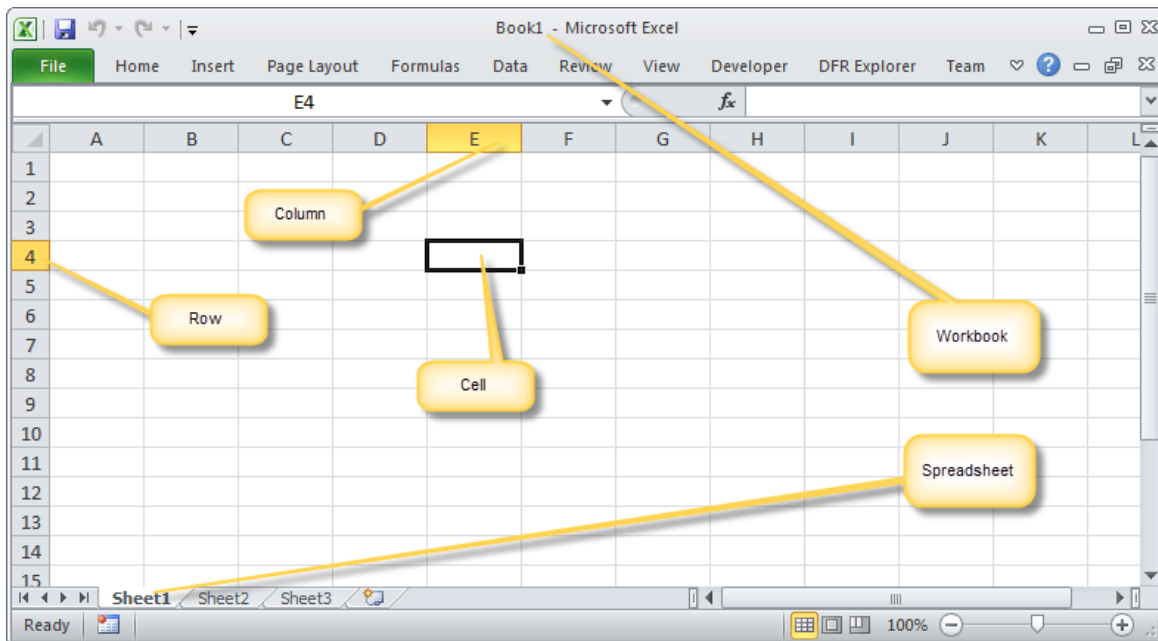
Those ideas came from the paper-based spreadsheet that likewise had rows, columns, cells, and sheets.
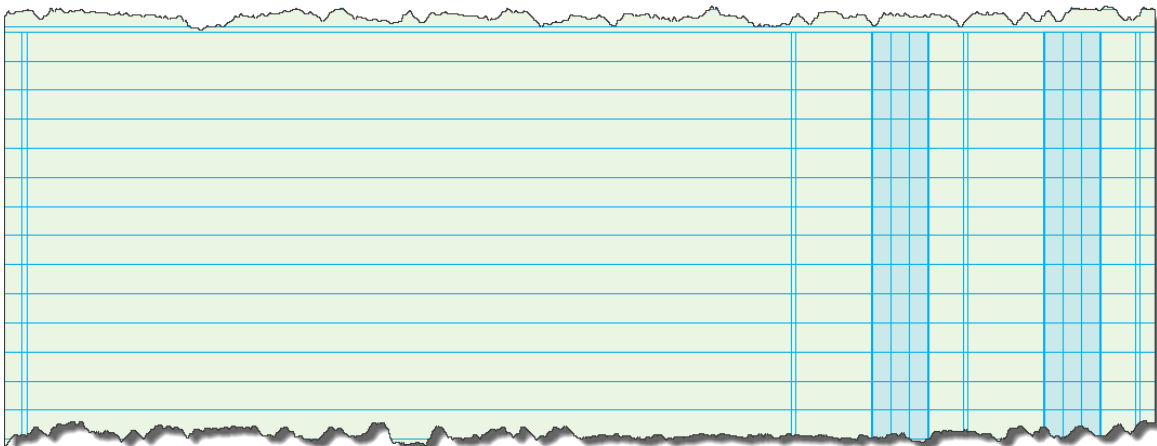
Similarly, a financial report has a conceptual model. There is one very important difference to understand between the spreadsheet model and the financial report conceptual model. The spreadsheet model is presentation oriented. You can put anything into the rows, columns, cells, and sheets of a spreadsheet. But you only understand that there are rows, columns, cells, and spreadsheets; you do not know anything about what is contained in the spreadsheets.

The financial report conceptual model is different in that the financial report conceptual model (a) includes a layer that relates to the general business report model and (b) includes a layer that relates to the accounting items reported within a financial report. While you can present information contained within a financial report by leveraging the information in the report; the actual focus on the conceptual model of a financial report is on the representation of information within the report, not presentation of the information.

As Barnet Sherman points out in his Forbes article, *The Four Letters Transforming The Municipal Bond Market And Government Finance*[20]:

> "**With accurate data comes extensive data functionality**. There are nearly an endless number of applications for data to be used in. Software engineers can develop automated, repeatable processes so data can be analyzed, measured, ranked, benchmarked, managed, modeled, tested, shared, exchanged, outlined, mapped, sorted, templatized, searched, queried, predicted, charted, animated, mined, validated, machine-read, machine-learned, compared, reused, verified, categorized, structured, tracked, screened, referenced, stored and retrieved. Just for starters."

The objective of Blocks is simple: The creation of accurate data so that this extensive functionality can be released by software engineers to those using XBRL-based digital financial reports. The notion of a Block and the functionality that having Blocks enables is explained in this document.

2.1. Primitive Objects

As was explained in the document *Putting the Expertise into an XBRL-based Knowledge Based System for Creating Financial Reports[21]*, compound objects are created from a set of primitive objects. For example a line is a primitive object and a square, which is made up of four lines, is a compound object:
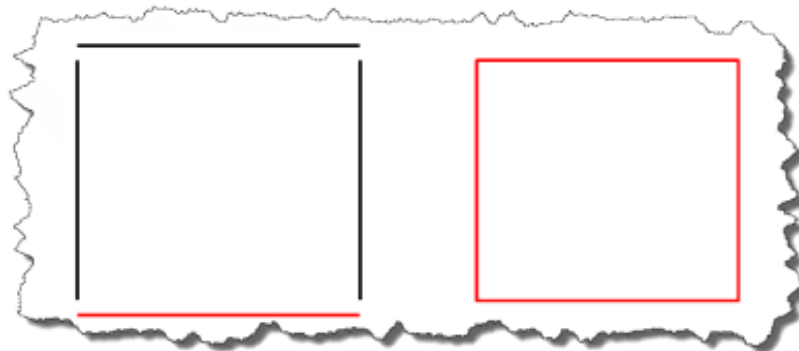
2.2. Implementation Layer

An XBRL-based financial report has two layers of primitive objects. The first set of primitive objects relates to XBRL modeling or **implementation layer**. Those primitive objects include:

- **Network**: A Network is a technical artifact that really has no meaning by itself because those creating XBRL-based digital financial reports use networks in different ways.

- **Table (Hypercube)**: A Table is the same thing that XBRL calls a hypercube. A Table or hypercube simply groups some set of Axes, Members, Line Items,

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[20] Barnet Sherman, *The Four Letters Transforming The Municipal Bond Market And Government Finance*, https://www.forbes.com/sites/investor/2018/12/04/the-four-letters-transforming-the-municipal-bond-market-and-government-finance/#cbdc07979948

[21] *Putting the Expertise into an XBRL-based Knowledge Based System for Creating Financial Reports*, http://pesseract.azurewebsites.net/PuttingTheExpertiseIntoKnowledgeBasedSystem.pdf

Abstracts, and Concepts together. Again, because Table's are used inconsistently, they really have no meaning by themselves.

- **Axis (Dimension)**: An Axis is one approach to representing a characteristic or aspect. Entity and period core aspects[22] are also in essence axes.

- **Member**: A Member is a value of a Characteristic.

- **Line Items (Primary items)**: A Line Items is in essence a type of dimension or Axis.

- **Abstract**: An Abstract is simply used to organize, they provide no real meaning.

- **Concept**: A Concept is a type of Member. A Concept is special in that it can be used to represent a Fact Value. Therefore, Concepts have data types.

The implementation model primitive objects can be related in very specific ways. The following table shows the allowed relationships between the different categories of primitive objects within an XBRL taxonomy:

		Parent						
		Network	Table	Axis	Member	LineItems	Abstract	Concept
Child	Network	Illegal XBRL	Illegal XBRL	Illegal XBRL	Illegal XBRL	Illegal XBRL	Illegal XBRL	Illegal XBRL
	Table	OK	Disallowed	Disallowed	Disallowed	Disallowed	OK	Disallowed
	Axis	Disallowed	OK	Disallowed	Disallowed	Disallowed	Disallowed	Disallowed
	Member	Disallowed	Disallowed	OK	OK	Disallowed	Disallowed	Disallowed
	LineItems	Disallowed	OK	Disallowed	Disallowed	Disallowed	Disallowed	Disallowed
	Abstract	OK	Disallowed	Disallowed	Disallowed	OK	OK	OK
	Concept	Disallowed	Disallowed	Disallowed	Disallowed	OK	OK	Not advised

2.3. Business Report Logical Layer

The second set of primitive objects is related to the meaning of the objects that comprise a business report. Because a financial report is a type of business report, financial reports are likewise comprised of the following primitive objects:

- **Report**: Report[23] which communicates financial and nonfinancial information about an economic or accounting entity to users of that report. Financial reports contain facts, characteristics which describe those facts, parenthetical explanations of facts, relations between facts.

- **Component**: A component (or report fragment) is a set of facts which go together (tend to be cohesive and share a certain common nature) for some specific purpose within a financial report. For example, a "balance sheet" is a report component. The "Maturities of long-term debt" disclosure is a report component.

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[22] XBRL International, *Open Information Model 1.0*, http://www.xbrl.org/Specification/oim/CR-2017-05-02/oim-CR-2017-05-02.html

[23] A report as defined in this model is a combination of a set of one or more XBRL instances, the XBRL taxonomy schemas associated with the XBRL instance(s), the XBRL linkbase(s) associated with the XBRL instance(s) or XBRL taxonomy schemas; in the XBRL International Open Information Model 1.0, a report is essentially the set of facts in an XBRL instance, http://www.xbrl.org/Specification/oim/CR-2017-05-02/oim-CR-2017-05-02.html#component-report

- **Fact**: A fact is a piece of information that is reported[24]. A fact defines a single, observable, reportable piece of information contained within a financial report, or fact value, contextualized for unambiguous interpretation or analysis by one or more distinguishing characteristics[25]. A fact value is one property of a fact; every fact has exactly one fact value. The set of characteristics of a fact is a property of the fact. For example, *Cash and cash equivalents* of 100,000 for the *consolidated entity* for the current balance sheet date of *December 31, 2014* which is *reported in US Dollars* is a fact.

- **Characteristic**: A characteristic describes a fact. A characteristic or distinguishing aspect provides information necessary to describe a fact or distinguish one fact from another fact. A fact may have one or many distinguishing characteristics. For example, line item concept *Cash and cash equivalents* is a characteristic and the calendar period *December 31, 2014* are characteristics which describe a fact.

- **Parenthetical explanation**: Facts may have parenthetical explanations[26] which provide additional descriptive information about the fact.

- **Relation**: A relation[27] is some interaction between the pieces which make up a financial report. Report components can be related to other report components. Reported facts can be related to other reported facts. Characteristics can be related to other characteristics. Business rules are a type of relation which describes computation type and logic-based relations. Classes or sets of concepts are relations.

- **Property**: A property is a trait, quality, feature, attribute, or peculiarity which is used to define its possessor and is therefore dependent on the possessor. A property belongs to something. For example, the color of a ball belongs to and is therefore is dependent on (is a property of) the ball. Financial reports have a set of properties. Components have a set of properties. Facts have a set of properties. Characteristics have a set of properties. Blocks have a set of properties. Parenthetical explanations have a set of properties. Relations have a set of properties. Exemplars and Templates have a set of properties. A Topic has a set of properties. A Disclosure has a set of properties.

- **Block**: A block[28] is a part of a component that participates in the same concept arrangement pattern. A Block is a set of facts which go together (tend to be cohesive and share a certain common nature) for some specific purpose within a financial report. Simply think about a block as a useful fragment used for referencing a fragment of a financial report.

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[24] A fact is identical to the simple fact in the XBRL International Open Information Model 1.0, http://www.xbrl.org/Specification/oim/CR-2017-05-02/oim-CR-2017-05-02.html#component-simple-fact

[25] A characteristic in this model is identical to an aspect in the XBRL International Open Information Model 1.0; http://www.xbrl.org/Specification/oim/CR-2017-05-02/oim-CR-2017-05-02.html#term-aspect; an aspect could be a core aspect or a non-core aspect. Entity and period are core aspects. Units is defined as an aspect by the OIM, but we are defining units as a property of a numeric fact.

[26] A parenthetical explanation is the same as a footnote in the XBRL International Open Information Model 1.0, http://www.xbrl.org/Specification/oim/CR-2017-05-02/oim-CR-2017-05-02.html#component-footnote

[27] *A Taxonomy of Part-Whole Relations*: http://csjarchive.cogsci.rpi.edu/1987v11/i04/p0417p0444/MAIN.PDF

[28] *Understanding Blocks, Slots, Templates and Exemplars*, http://xbrl.squarespace.com/journal/2015/5/11/understanding-blocks-slots-templates-and-exemplars.html

- **Slot**: A slot is simply the idea of an allotted place where something can be logically and sensibly placed in a fragment of a financial report, or Block.

- **Disclosure**: A Disclosure is simply a set of facts that is disclosed. A Disclosure is comprised of one to many Blocks.

- **Topic**: A Topic is simply a set of Disclosures that are grouped together for some specific reason. A Disclosure could belong to one or many Topics. (Best practice is for a Disclosure to be associated with only one Topic.)

- **Exemplar**: An Exemplar is an example of a Disclosure from some other existing financial report. A Disclosure may have zero to many exemplars. An Exemplar is a fragment of an existing Report.

- **Template**: A Template is a starting point or sample used to create a complete Disclosure. A Templated may have zero to many Templates. A Template is an XBRL instance and all related XBRL taxonomy schemas and XBRL linkbases.

Note that the business report logical layer is both consistent with the *XBRL International Open Information Model 1.0*[29] and the *XBRL International Abstract Model 2.0*[30] and builds upon those two efforts to clearly articulate the semantics or logic of a business report. The business report semantics layer is actually very well understood by those who created XBRL; however, this information is not particularly well articulated by XBRL International or by those creating reporting schemes which leverage the XBRL technical syntax.

Finally, the model represented in this document supplements the business report model specifically for metadata necessary and useful for financial reporting.

2.4. *Poka-yoke (Mistake proofing)*

Poka-yoke is a technique used to prevent mistakes through smarter design. Poka-yoke[31] is a Japanese term that means "mistake-proofing". A poka-yoke is any mechanism consciously added to a process that helps an equipment operator avoid mistakes. Its purpose is to eliminate defects by preventing, correcting, or drawing attention to human errors as the errors occur.

For example, consider the graphic[32] below. You want someone to plug the plug into the receptacle such that positive and negative match up; inadvertently reversing this would have catastrophic consequences. In the top graphic notice that it is possible to make a mistake but in the bottom a mistake would be impossible because of the size differences in the positive and negative receptacle and plug.

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[29] XBRL International, *Open Information Model 1.0*, http://www.xbrl.org/Specification/oim/CR-2017-05-02/oim-CR-2017-05-02.html

[30] XBRL International, *XBRL Abstract Model 2.0*, http://www.xbrl.org/specification/abstractmodel-primary/pwd-2012-06-06/abstractmodel-primary-pwd-2012-06-06.html

[31] Wikipedia, *Poka-yoke*, https://en.wikipedia.org/wiki/Poka-yoke

[32] Process Exam, *Six Sigma Tools - Poka Yoke*, http://www.processexam.com/six-sigma-tools-poka-yoke
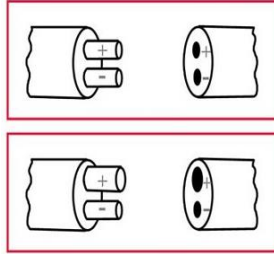
Smart design means less user errors. Blocks are a mechanism for implementing poka-yoke, or mistake proofing XBRL-based information. Primitive object structure, mechanical relations, mathematical relations, logical relations, and even some accounting relations must make sense relative to other primitive objects. Blocks and the structured nature of XBRL make implementing these mistake proofing techniques possible with financial report creation software.

2.5. Compound or Composite Objects

A compound or composite object is and object that has some set of primitive objects. Using the previous example of a square; the square is a compound object made up of the primitive object line. An example of leveraging a compound object would be to, say, resize the object which is a square. If you know the rule "all sides of a square are equal" and "all angles in a square are always 90 degrees"; then resizing the square can be made easier for the user if the user can interact with the compound object square rather than have to interact with each primitive object line.

Further, categorizing compound objects makes working with them even easier. For example, if you distinguish four sided objects from three sided objects you can interact with the objects in a richer way.
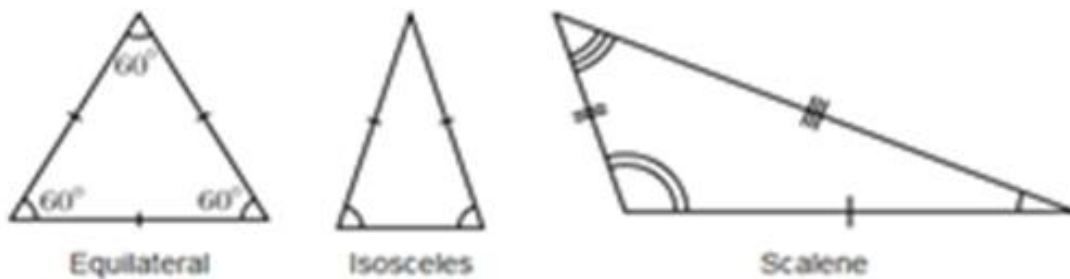
Further, within the category of four sides objects which we give the name quadrilateral, we name the different objects you can also refer to each different object by its name if given a name or by the characteristics of the object using prototype theory.
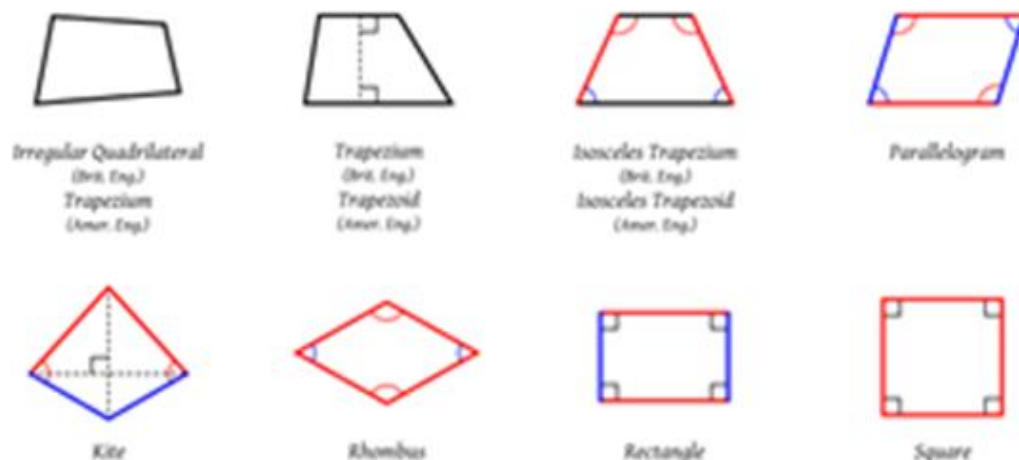
Basically, consistency causes patterns and patterns are leveragable.

The two most confusing and therefore challenging objects to understand in an XBRL-based report are the Network and the Component[33].   The Block was created to mitigate this inconsistency, creating consistency. There are two primary reasons for the inconsistency and resulting confusion.

First, base taxonomies such as the US GAAP and IFRS XBRL Taxonomies can be confusing to understand because of the ways the taxonomies are created. Both the US GAAP and IFRS XBRL Taxonomies are essentially modeled as "picklists". Additional confusion is caused by important relations are not represented and the cumbersome size of the Networks used to represent information. At a technical syntax lever, the Network is very consistent within the US GAAP and IFRS XBRL taxonomies. But, within a Network, the things that are represented are irregular and therefore impossible to address and use consistently. Some information is represented within a Table, other information is not. Some Tables share names, some Tables have unique names. Neither the US GAAP nor the IFRS XBRL taxonomies follow XBRL International best practices which specifies that dimensional and non-dimensional models should not be mixed[34]. Both mix dimensional and non-dimensional models. This make is literally impossible for a software application to work effectively with the US GAAP or IFRS XBRL taxonomies to perform higher-level tasks such as identify a Disclosure and in particular identify and work with specific Disclosures.

Second, XBRL-based reports are represented favoring some notion of presentation of report information rather than representation of the meaning which the report information coveys. Further, little though is put into representing disclosures by some reporting entities. As such, an untrained observer can be very confused as to the meaning of different XBRL representations of information and the meaning that information conveys.

However, if you consider the group of approximately 500,000 report fragments of approximately 6,000 economic entities which report using US GAAP to the SEC and

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[33] Understanding Networks, Components, and Blocks; http://xbrlsite.azurewebsites.net/2018/Pesseract/12-NetworksComponentsAndBlocks.pdf

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

approximately 40,000 report fragments of approximately 400 entities which report using IFRS to the SEC for annual financial reports (i.e. 10-K, 20-F, 40-F); patterns are very apparent to humans and can be discovered by machines provided with the right information. Further, if a knowledgeable observer leverages the consistent patterns and avoids the obviously incorrect (i.e. illogical) patterns, inconsistent representations of the same information, and other irregularities; then useful information emerges.

Blocks contribute to unraveling information, identifying what that information is, and leveraging known structural, mechanical, mathematical, logical, and accounting relations within each Block. Knowing and leveraging that information enables the creation of high-quality, mathematically and logically rock-solid Blocks[35]. This feature has use to those both creating financial report information and consuming that same information.

2.6. Understanding Blocks

A Block[36] is a unit of a report that was created in order to make interacting with and otherwise working with a report easier. Individual facts are many times too small working sets to be useful. Networks tend to be too large to work with. A Block is a useful unit of a report that makes doing certain things significantly easier and other things which were simply impossible; possible.

Essentially, a Block is a fragment of a report that has the same *concept arrangement pattern*[37]. For example, there is a simple basic Block[38]:

Inventory [Line Items]	Period [Axis]	
	2017-06-30	2016-06-30
Raw materials	797,000,000	612,000,000
Work in process	145,000,000	158,000,000
Finished goods	1,239,000,000	1,481,000,000
Total	2,181,000,000	2,251,000,000

The Block above has the concept arrangement pattern "roll up". I will explain more of the traits of a Block as we go along. Blocks are very consistent structures and makes working with an XBRL-based report at a logical level possible as contrast to working at the XBRL technical syntax level. Blocks make many, many things possible.

Blocks are driven by the information represented by a Disclosure itself, not by how someone might choose to present that Disclosure information. For example, if you

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[35] Blocks (Advanced), http://xbrlsite.azurewebsites.net/2018/Pesseract/13-BlocksAdvanced.pdf

[36] Charles Hoffman and Hamed Mousavi, *Putting the Expertise into an XBRL-based Knowledge Based System for Creating Financial Reports*, http://pesseract.azurewebsites.net/PuttingTheExpertiseIntoKnowledgeBasedSystem.pdf

[37] Charles Hoffman and Rene van Egmond, *Understanding Concept Arrangement Patterns, Member Arrangement Patterns, and Report Fragment Arrangement Patterns*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.7_UnderstandingConceptArrangementPatternsMemberArrangementPatterns.pdf

[38] Microsoft, http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureComponentsOfInventoriesDetail-us_gaap_InventoryCurrentTable.html

look at a set of 339[39] Disclosures of the components of property, plant, and equipment there are similarities between each of those Disclosures.

A Block is a part of a Component whose line items all participates in the same *concept arrangement pattern*[40]. A roll up, roll forward, adjustment, and hierarchy are all types of concept arrangement patterns. Every XBRL-based public company financial report is essentially a set of Blocks. I estimate that there are about 754,430 blocks in the set of 5,734 public company reports that I analyzed. Of that total, 16% are roll ups, 5% are roll forwards, 24% are hierarchies, and 54% are text blocks[41].

2.7.   Blocks and Extensibility

XBRL has a predictable shape. What you put into that predictable shape is up to you. However, what you represent using that predictable shape must be logical by some definition. But how do you define what is logical per your definition of logical? How do you explain to creators of XBRL-based reports what is allowed and what is not allowed via an extension XBRL taxonomy so that reports based on that extension and its base XBRL taxonomy are logical?

Here is a simple case to help you understand the issue. The accounting equation establishes that "Assets = Liabilities and Equity"[42]. That rule is nowhere to be found in either the US GAAP XBRL Taxonomy. Per my last measurement, there were 53 economic entities out of about 5,734 where their reported assets did not equal liabilities and equity. Per investigation, all 53 inconsistencies with the accounting equation were verified to be errors in the XBRL-based report of the economic entity.

As was pointed out in the document *Leveraging XBRL Extensibility Effectively*[43], when XBRL's extensibility feature is employed, the flexibility introduced in terms of extensibility means responsibility to control that extensibility using rules. Rules prevent anarchy[44]. The judicious use of rules is necessary to control the structure, mechanics, mathematical relations, logical relations, and general consistency of the information provided within a report.

Blocks help you control mechanisms that assure that extensibility is used how the extensibility is intended to be used. Things like the US GAAP and IFRS XBRL Taxonomy architecture guidelines provide some guidance as does the Edger Filer Manual or the European Single Electronic Format. But, while this guidance is necessary, it is not sufficient. Proof that the guidance is not sufficient is the clearly identifiable filer errors

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[39] Disclosure Best Practices, Property, plant and equipment components, http://xbrlsite-app.azurewebsites.net/DisclosureBestPractices/DisclosureBestPractices.aspx?DisclosureName=PropertyPlantAndEquipmentNetByTypeRollUp

[40] See page 11, http://www.xbrlsite.com/2015/Analysis/AnalysisSummary2014_PiecesOfReoprt.pdf#page=11

[41] I have a document that summarizes this information.

[42] Wikipedia, *Accounting Equation*, https://en.wikipedia.org/wiki/Accounting_equation

[43] *Leveraging XBRL Extensibility Effectively*, http://xbrlsite.azurewebsites.net/2018/Library/LeveragingXBRLExtensibilityEffectively.pdf

[44] *Comprehensive Introduction to Business Rules*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part01_Chapter02.4_ComprehensiveIntroductionToBusinessRules.pdf

in the XBRL-based reports of public companies[45] financial reports. Again, rules prevent anarchy. But exactly what rules?

2.8. *Universally Applicable Automatable Rules*

There are two types of logical rules that are enforced within Blocks. The first category is **universally applicable rules** that apply to every Block of every report.   For example, consider the figure on page 5 which I will repeat here except rather than simply indicating allowed and disallowed relations between the parent and child report elements I am showing the count of the number of relations for each relation in addition to the color coding of what is allowed and what is not allowed.   This information is from a set of 5,734 reports that were analyzed to examine the nature of these relations between different categories of report elements:

		Parent						
		Network 477,041	Table 232,230	Axis 386,912	Member 1,216,391	LineItems 232,690	Abstract 732,409	Concept 3,165,249
Child	Network	0	0	0	0	0	0	0
	Table	1,261	1	0	0	45	230,899	24
	Axis	1	386,888	0	0	3	20	0
	Member	3	0	450,091	766,221	4	72	0
	LineItems	183	232,181	0	0	107	217	2
	Abstract	474,310	22	0	1	113,059	144,471	546
	Concept	46	26	11	137	1,222,427	1,929,257	13,346

These rules are universally applicable to every report.   While XBRL validation is required to enforce certain relations related to expressing XBRL calculation relations and XBRL definition relations; financial report creators are free, per the XBRL technical specification, to represent XBRL presentation relations pretty much however they might want. For example, there is nothing that says you cannot have an "Axis" as part of a set of "Line Items" in the set a set of presentation relations. Even more pathological representations could be created. While most software does not let you do things like this, other software does. Blocks enforce these rules without you having to provide any metadata what-so-ever. These sorts of rules are hard coded into the business report processor.

Another universally applicable rule is the requirement for XBRL calculation relations when a roll up mathematical computation in a Block of information.

Another universally applicable rule is the XBRL technical syntax rules. There is no need for accounting professionals to provide universally applicable rules; software can, and should, enforce all of these rules.

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[45] Quarterly XBRL-based Public Company Financial Report Quality Measurement (September 2018), http://xbrl.squarespace.com/journal/2018/9/29/quarterly-xbrl-based-public-company-financial-report-quality.html

2.9. Other Automatable Logical Rules (i.e. not universally applicable)

If a rule is not universally applicable, then the rule must be enforced using metadata provided by someone, generally a business professional who understands these reports and the information conveyed by the reports.

For example, the SEC does not require XBRL formula rules to be provided for roll forward type mathematical relations in an XBRL-based report. Does this mean that roll forwards don't need to roll forward? Certainly not. What it means is that professional accountants need to be very careful and either (a) make sure they are using other automated processes to be sure this type of mathematical relation is checked by their software, or (b) check roll forward computations manually. The second alternative, manually checking roll forward computations, is proving not to work very well in XBRL-based reports submitted to the SEC. This is provable by simply observing all the errors that exist in those reports.

There are other types of mathematical computations which the SEC does not mandate that business rules be provided: adjustments, variance, member aggregations to name a few.

However, a tool that enforces Block structural, mechanical, mathematical, and other logical rules frees the user of the application from the burden of having to prove that the basic math of a financial report is working correctly.

2.10. Class or Type Relations Rules

Consider the balance sheet fragment below. What would prevent someone creating an XBRL-based report from using the concept "us-gaap:DeferredTaxLiabilitiesNoncurrent" as part of the line item "Total current liabilities"?

Liabilities and stockholders' equity		
Current liabilities:		
Accounts payable	7,390,000,000	6,898,000,000
Short-term debt	9,072,000,000	12,904,000,000
Current portion of long-term debt	1,049,000,000	0
Accrued compensation	5,819,000,000	5,264,000,000
Income taxes	718,000,000	580,000,000
Short-term unearned revenue	34,102,000,000	27,468,000,000
Securities lending payable	97,000,000	294,000,000
Other	6,280,000,000	5,949,000,000
Total current liabilities	64,527,000,000	59,357,000,000
Long-term debt	76,073,000,000	40,557,000,000
Long-term unearned revenue	10,377,000,000	6,441,000,000
Deferred income taxes	531,000,000	1,476,000,000
Other long-term liabilities	17,184,000,000	13,640,000,000
Total liabilities	168,692,000,000	121,471,000,000
Commitments and contingencies	xsi:nil	xsi:nil

us-gaap:DeferredTaxLiabilitiesNoncurrent

Based on the concept name, it is rather obvious that the concept relates to noncurrent liabilities and not to current liabilities. But errors such as this occur all the time in the XBRL-based financial reports submitted to the SEC by public companies.

Again, I will point out, that hundreds and sometimes even thousands of concepts are used to create XBRL-based financial reports. It is not effective to manually check each and every concept used to make sure the financial report has been represented correctly. While manual effort is required, minimizing that effort will maximize quality.

If rules exist which explicitly state that the concept "us-gaap:DeferredTaxLiabilitiesNoncurrent" should be a part of noncurrent liabilities and never be part of current liabilities, then that task can be automated. This is the role of class or type relations rules.

2.11. Reporting Checklist Rules

Financial reports have certain disclosures that are always required. For example, a balance sheet is always required. Same for an income statement, cash flow statement, and statement of changes in equity. A statement of comprehensive income might be required. Certain disclosures are always required such as the nature of operations, basis of reporting, significant accounting policies, and revenue recognition policy.

If certain line items are reported; then certain disclosures are required. For example, if the line item "Inventories" appears on the balance sheet, the a disclosure of inventory components and the inventory policy is required.

These statements and disclosures are instantiated within a report in the form of a Block. If machine-readable metadata is provided, then automated machine-based

processes can augment the manual effort of professional accountants to check to be sure statutory and regulatory disclosure rules are being complied with.

2.12. Disclosure Mechanics Rules

Blocks have rules that must be followed depending on the nature of the Block. If a Block is a roll up; you would certainly expect XBRL calculation relations to exist.

If you know what a Block of information is representing, you would understand even more about the character that the Block must take. For example, if you knew that a Block represented an inventory components disclosure; then you would know that:

- The Block is s roll up because an inventory components disclosure is a roll up.

- That roll up should, in fact, roll up correctly.

- The Block, being a roll up, has a total concept and that total concept is most probably going to be the concept "us-gaap:InventoryNet" should you be reporting using US GAAP or "ifrs-full:Inventories" if you are reporting using IFRS. There may be other alternative concepts but those alternatives should be knowable to you.

- The Block, being an inventory components disclosure, will likely be accompanied by an inventory policy disclosure, a Level 2 Policy Text Block. Further, it is highly likely, but not necessarily the case, that a Level 1 Note Text Block for the full inventory disclosure will be somewhere in the report.

It is these sorts of relations that disclosure mechanics rules automatically verifies to be correct or incorrect based on the machine-readable rules that are available to assist the software application.

2.13. Consistency Cross Check Rules

Consider the following situation. A report was created and the concept "us-gaap:OperatingExpenses" which relates to indirect operating expenses was used erroneously to represent the line item "Total cost of revenues". How would an automated software process find that error?

Revenue			
Product	57,190,000,000	61,502,000,000	75,956,000,000
Service and other	32,760,000,000	23,818,000,000	17,624,000,000
Total revenue	89,950,000,000 [2,3]	85,320,000,000 [1]	93,580,000,000
Cost of revenue			
Product	15,175,000,000	17,880,000,000	21,410,000,000
Service and other	19,086,000,000	14,900,000,000	11,628,000,000
Total cost of revenue	34,261,000,000	32,780,000,000	33,038,000,000
Gross margin	55,689,000,000 [2]	52,540,000,000	60,542,000,000
Research and development	13,037,000,000	11,988,000,000	12,046,000,000
Sales and marketing	15,539,000,000	14,697,000,000	15,713,000,000
General and administrative	4,481,000,000	4,563,000,000	4,611,000,000
Impairment, integration, and restructuring	306,000,000	1,110,000,000	10,011,000,000
Operating income	22,326,000,000 [2]	20,182,000,000	18,161,000,000
Other income (expense), net	23,000,000	(431,000,000)	16,000,000

us-gaap:OperatingExpenses

If consistency cross check rules are implemented by software applications and the metadata is provided that states what the consistency rules are; then automated software processes can find this inconsistency. This is in essence how the quarterly quality checks[46] that I run work.

Relying on manual checks to make sure this sort error does not exist in a report is obviously not going to work. Today, about 10% of all reports have such an error.

A similar type of error[47] is when a concept is use within one Block to represent a line item and then that concept contradicts or conflicts with another Block of a report that contains information.

2.14. Complex Structures are Really Groups of Simple Structures

Consider the set of three Blocks below which make up an income statement[48]:

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[46] Quarterly XBRL-based Public Company Financial Report Quality Measurement (September 2018), http://xbrl.squarespace.com/journal/2018/9/29/quarterly-xbrl-based-public-company-financial-report-quality.html

[47] If you want to better understand these types of errors, see these high-quality examples of errors that exist in XBRL-based reports submitted to the SEC, http://xbrl.squarespace.com/journal/2017/4/29/high-quality-examples-of-errors-in-xbrl-based-financial-repo.html

[48] Microsoft, Income statement, http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-StatementINCOMESTATEMENTS-us_gaap_StatementTable.html

	Period [Axis]		
Statement [Line Items]	2016-07-01 - 2017-06-30	2015-07-01 - 2016-06-30	2014-07-01 - 2015-06-30
Revenue			
Product	57,190,000,000	61,502,000,000	75,956,000,000
Service and other	32,760,000,000	23,818,000,000	17,624,000,000
Total revenue	89,950,000,000 [2,3]	85,320,000,000 [1]	93,580,000,000
Cost of revenue			
Product	15,175,000,000	17,880,000,000	21,410,000,000
Service and other	19,086,000,000	14,900,000,000	11,628,000,000
Total cost of revenue	34,261,000,000	32,780,000,000	33,038,000,000
Gross margin	55,689,000,000 [2]	52,540,000,000	60,542,000,000
Research and development	13,037,000,000	11,988,000,000	12,046,000,000
Sales and marketing	15,539,000,000	14,697,000,000	15,713,000,000
General and administrative	4,481,000,000	4,563,000,000	4,611,000,000
Impairment, integration, and restructuring	306,000,000	1,110,000,000	10,011,000,000
Operating income	22,326,000,000 [2]	20,182,000,000	18,161,000,000
Other income (expense), net	823,000,000	(431,000,000)	346,000,000
Income before income taxes	23,149,000,000	19,751,000,000	18,507,000,000
Provision for income taxes	1,945,000,000	2,953,000,000	6,314,000,000
Net income	21,204,000,000 [2,5]	16,798,000,000 [4]	12,193,000,000
Earnings per share:			
Basic	2.74 [2]	2.12	1.49
Diluted	2.71 [2,5]	2.10 [4]	1.48
Weighted average shares outstanding:			
Basic	7,746,000,000	7,925,000,000	8,177,000,000
Diluted	7,832,000,000	8,013,000,000	8,254,000,000
Cash dividends declared per common share	1.56	1.44	1.24

There are three Blocks. The first Block is a roll up of "Net income". The second Block is a hierarchy (or set) that represents a summary of earnings per share. The third Block is a hierarchy (or set) that represents a summary of weighted average shares outstanding.

Could have this information been presented in different manners? Sure. Could this information been represented in a different manner? Could the meaning of the information have been different simply based on the preferences of the creator of the representation? Certainly not.

Blocks are about the objective representation of information, not about subjective and perhaps even arbitrary presentation choices which are consciously or sometimes even unconsciously made by accountants. Blocks are about structural rules, mechanical rules, mathematical rules, logical rules, and certain accounting rules that are all objective and not open for debate. That leaves the judgement to the professional accountants, hiding the technical details that they do not care about and should not have to concern themselves with to the software application to deal with.

If these ideas are discussed with a professional accountant, care needs to be taken to be sure that you are having the right discussion. The typical professional account will make the statement that everything within a financial report is subject to professional

judgement which is simply not true. Professional accountants get no latitude as to whether a roll up should roll up, if a roll forward should roll forward or if a balance sheet balances. This logic is universal and to which all domains, even the domain of accounting, must subscribe. If explained to professional accountants correctly, the vast majority will concur with these ideas. Proof of this is that the vast majority of information reported within an XBRL-based report subscribes to these ideas.

2.15. Blocks have Slots

Blocks have "slots". A Slot is simply a place in a Block where it makes logical sense for new objects to be added to the Block. Different types of Blocks have different slots. Below you can see one Block, showing two Slots for that Block. One Slot is that a new Line Item can be added within the roll up total. Or, a second Slot is that a new period can be added to the Block.

This is not a comprehensive discussion of Slots, it only provides the general ideas of what a Slot is, and that a financial report can be broken down into a set of Blocks each of which has specific Slots.

2.16. Types of Blocks

The following is a list of commonly occurring Block patterns.

Text Block[49]

The most common form of Block is the Text Block which makes up over half of the reported facts within an XBRL instance. This is a Text Block:

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[49] Level 3 Disclosure Text Block, Microsoft, http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureINVENTORIESTables-us_gaap_StatementTable.html

There are three categories of Text Blocks: Level 1 Note Text Block, Level 2 Policy Text Block, and Level 3 Disclosure Text Block. All Text Blocks are similar in that they contain prose, essentially formatted text[50].

Essentially, a Text Block or any kind is a Block that has exactly one concept, the Text Block concept.

Hierarchy or Set[51]

The Hierarchy[52] or Set is simply some set of one to many concepts, other than Text Blocks, that conveys information that goes together for some reason or other.

Statement [Line Items]	Period [Axis]		
	2016-07-01 - 2017-06-30	2017-07-31	2016-12-31
Document Type	10-K		
Amendment Flag	false		
Document Period End Date	2017-06-30		
Document Fiscal Year Focus	2017		
Document Fiscal Period Focus	FY		
Trading Symbol	MSFT		
Entity Registrant Name	MICROSOFT CORPORATION		
Entity Central Index Key	0000789019		
Current Fiscal Year End Date	--06-30		
Entity Well-known Seasoned Issuer	Yes		
Entity Current Reporting Status	Yes		
Entity Voluntary Filers	No		
Entity Filer Category	Large Accelerated Filer		
Entity Common Stock, Par Value Per Share	0.00000625		
Entity Common Stock, Shares Outstanding		7,702,243,979	
Entity Public Float			466,500,000,000
I.R.S. Employer Identification No.	911144442		

Roll Up[53]

The Roll Up is similar to a Set in that it is a set of concepts. What makes a roll up different is that the Set of concepts participates within a roll up relation that is represented by XBRL calculations relations.

Inventory [Line Items]	Period [Axis]	
	2017-06-30	2016-06-30
Raw materials	797,000,000	612,000,000
Work in process	145,000,000	158,000,000
Finished goods	1,239,000,000	1,481,000,000
Total	2,181,000,000	2,251,000,000

A roll up always has exactly one total. A roll up always has XBRL calculation relations. A roll up always has numeric concepts that are of the same period type (i.e. either all instant or all duration). A roll up could aggregate a set of stocks (i.e. balance sheet accounts) or a set of flows (i.e. income statement, net cash flow, etc.).

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[50] Text Blocks in reports submitted to the SEC are a specifically prescribed form of escaped HTML.

[51] Hierarchy or Set, Microsoft, http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DocumentDocumentAndEntityInformation-us_gaap_StatementTable.html

[52] I don't like the term "Hierarchy", because essentially all of the Block patterns are hierarchies of some sort. The term "Set" is a better term. But, there is a lot of legacy information that uses the term Hierarchy. So, the term Set and Hierarchy are basically interchangeable and mean the same thing.

[53] Roll up, Microsoft, http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureComponentsOfInventoriesDetail-us_gaap_InventoryCurrentTable.html

Roll Up, Nested[54]

A nested roll up is exactly the same as a roll up except that the roll up includes one or more subtotals.

Property, Plant and Equipment [Line Items]	Period [Axis]	
	2016-06-30	2015-06-30
Land	824,000,000	769,000,000
Buildings and improvements	12,393,000,000	10,800,000,000
Leasehold improvements	3,659,000,000	3,577,000,000
Computer equipment and software	17,391,000,000	13,612,000,000
Furniture and equipment	3,889,000,000	3,579,000,000
Total, at cost	38,156,000,000	32,337,000,000
Accumulated depreciation	(19,800,000,000)	(17,606,000,000)
Total, net	18,356,000,000	14,731,000,000

Roll Forward[55]

A roll forward seems similar to a roll up, however they are not the same. A roll forward represents the flows between a stock at two different calendar periods in time. The formula is: Beginning balance + Changes = Ending Balance.

Income Tax Contingency [Line Items]	Period [Axis]		
	2016-07-01 - 2017-06-30	2015-07-01 - 2016-06-30	2014-07-01 - 2015-06-30
Balance, beginning of year	10,164,000,000	9,599,000,000	8,714,000,000
Decreases related to settlements	(4,000,000)	(201,000,000)	(50,000,000)
Increases for tax positions related to the current year	1,277,000,000	1,086,000,000	1,091,000,000
Increases for tax positions related to prior years	397,000,000	115,000,000	94,000,000
Decreases for tax positions related to prior years	(49,000,000)	(317,000,000)	(144,000,000)
Decreases due to lapsed statutes of limitations	(48,000,000)	(118,000,000)	(106,000,000)
Balance, end of year	11,737,000,000	10,164,000,000	9,599,000,000

Roll forwards always have an instant concept with a period start preferred label role, the same instant concept at some future point in time with a period end preferred label role, and then some set of one to many changes. Another term for roll forward is "movements" or "movements analysis".

Member Aggregation[56]

A member aggregation is exactly the same logically as a roll up. However, a member aggregation is different than a roll up in that the syntax used to represent the roll up

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[54] Roll up, Nested, Microsoft, http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureComponentsOfPropertyAndEquipmentDetail-us_gaap_ScheduleOfPropertyPlantAndEquipmentTable.html

[55] Roll Forward, Microsoft, http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureChangesInUnrecognizedTaxBenefitsDetail-us_gaap_IncomeTaxContingencyTable.html

[56] Member aggregation, Microsoft, http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureLongLivedAssetsExcludingFinancialInstrumentsAndTaxAssetsClassifiedByLocationOfControllingStatutoryCompanyDetail-msft_CertainLongLivedAssetsByGeographyTable.html

is different. In a roll up, the line items being rolled up are a set of concepts. In a member aggregation, however, there is one concept that is used to represent all of the members and members are differentiated from one another using an Axis.

	Period [Axis]									
	2017-06-30					2016-06-30				
	Statement, Geographical					Statement, Geographical				
Certain Long-Lived Assets by Geography [Line Items]	United States	Ireland	Luxembourg	Other Countries	Geographical [Domain]	United States	Ireland	Luxembourg	Other Countries	Geographical [Domain]
Long-lived assets	39,118,000,000	12,876,000,000	6,845,000,000	10,123,000,000	68,962,000,000	22,819,000,000	2,078,000,000	6,854,000,000	8,210,000,000	39,961,000,000

Roll Up + Member Aggregation[57]

A roll up can be combined with a member aggregation which then has the roll up + member aggregation pattern as is shown here:

Property, Plant and Equipment [Line Items]	Period [Axis]									
	2016-12-31					2015-12-31				
	Property, Plant and Equipment, Type [Axis]					Property, Plant and Equipment, Type [Axis]				
	Computer equipment	Technical equipment	Facilities	Capital projects in progress	Property, Plant and Equipment, Type [Domain]	Computer equipment	Technical equipment	Facilities	Capital projects in progress	Property, Plant and Equipment, Type [Domain]
Total property and equipment	2,270,000	2,427,000	3,387,000	1,010,000	9,094,000	1,877,000	1,806,000	1,772,000	2,183,000	7,638,000
Accumulated depreciation - other					(4,836,000)					(2,622,000)
Net property and equipment					4,258,000					5,016,000

Roll Forward + Member Aggregation[58]

A roll forward can likewise be combined with a member aggregation which then has a roll forward + member aggregation pattern which is shown here:

Component: (Network and Table)								
Network	100800 - Disclosure -Carrying Amount of Goodwill (Detail)							
Table	Schedule of Goodwill [Table]							
Reporting Entity [Axis]	0000789019 http://www.sec.gov/CIK				Legal Entity [Axis]		Entity [Domain]	
	Period [Axis] Statement Business Segmen...							
	2016-07-01/2017-06-30				2015-07-01/2016-06-30			
Goodwill [Line Items]	Productivity and Business Processes	Intelligent Cloud	More Personal Computing	Segments [Domain]	Productivity and Business Processes	Intelligent Cloud	More Personal Computing	Segments [Domain]
Beginning Balance	6,678,000,000	5,467,000,000	5,727,000,000	17,872,000,000	6,309,000,000	4,917,000,000	5,713,000,000	16,939,000,000
Acquisitions	17,072,000,000 [1]	49,000,000	115,000,000	17,236,000,000	443,000,000	549,000,000	100,000,000	1,092,000,000
Other	(11,000,000)	39,000,000	(14,000,000)	14,000,000	(74,000,000)	1,000,000	(86,000,000)	(159,000,000)
Ending Balance	23,739,000,000	5,555,000,000	5,828,000,000	35,122,000,000	6,678,000,000	5,467,000,000	5,727,000,000	17,872,000,000

Adjustment[59]

An adjustment looks similar to a roll up or a roll forward, however, the logic of the mathematical computation is completely different. An adjustment has the formula logic: Originally stated balance + changes = Restated balance. The following shows an example.

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[57] Roll up + Member aggregation, comparison, http://www.xbrlsite.com/site1/2017/Prototypes/DisclosureAnalysis/All/Index_1271_Consistent.html

[58] Roll forward + member aggregation, comparison, http://www.xbrlsite.com/site1/2017/Prototypes/DisclosureAnalysis/All/Index_225_Consistent.html

[59] Adjustment, XASB reference implementation, http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/xasb/taxonomy/evidence-package/contents/index.html#Rendering-PriorPeriodAdjustments-gaap_StatementChangesInEquityPriorPeriodAdjustmentsTable.html

Reporting Entity [Axis]	0000000001 http://www.sec.gov/CIK	
Legal Entity [Axis]	Consolidated Entity [Domain]	
Period [Axis]	2015-12-31	
		Drop Column Fields Here
Changes in Stockholders' Equity [Line Items]	Report Date [Axis] ▲	Fact Value
Increase (Decrease) in Stockholders' Equity [Adjustment]		
Stockholders' equity, originally stated	Originally Stated Report Date [Member]	30,000,000
Correction of a prior period error	Restated Report Date [Domain]	12,000,000
Effect of mandatory change in accounting policy for adoption of FAS XXX	Restated Report Date [Domain]	(2,000,000)
Stockholders' equity, restated	Restated Report Date [Domain]	40,000,000

Adjustments are relatively rare in financial reports. They can typically occur when there is a correction of an error or a change in equity related to an accounting policy change.

Variance[60]

A variance looks similar to a member aggregation, however the business logic is different. The formula logic for a variance is: Budgeted amount + Variance = Actual. There can be other members used besides budgeted; what is common is the use of a reporting scheme.

Reporting Entity [Axis]	SAMP http://www.SampleCompany.com		
Legal Entity [Axis]	Consolidated Entity [Member]		
Period [Axis]	2010-01-01/2010-12-31		
	Reporting Scenario [Axis] ▲		
Variance Analysis [Line Items]	Budgeted [Member]	Variance [Member]	Actual [Member]
Variance Analysis [Hierarchy]			
Sales	5,000	1,000	6,000
Cost of Goods Sold	3,000	1,000	4,000
Contribution Margin	2,000	(1,000)	1,000
Distribution Costs	1,000	0	1,000

Hierarchy + Members But Without Aggregation[61]

Below you see a disclosure of payments to benefit plans. Members are used to distinguish one category of plans from another however there is no aggregation involved in the representation.

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[60] Variance, XASB reference implementation, http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/xasb/taxonomy/evidence-package/contents/index.html#Rendering-VarianceAnalysis-company_VarianceAnalysisGrossProfitTable.html

[61] Hierarchy + Members but without aggregation, comparison, http://www.xbrlsite.com/site1/2017/Prototypes/DisclosureAnalysis/All/Index_285_Consistent.html

Defined Benefit Plan Disclosure [Line Items]	Period [Axis]		
	2016-08-31		
	Defined Benefit Plans and Other Postretirement Benefit Plans [Axis]		
	U.S. Plans	Non-U.S. Plans	Other Postretirement Benefit Plan [Member]
2017	46,881,000 [1]	44,537,000	10,259,000
2018	49,865,000 [1]	50,094,000	11,469,000
2019	53,277,000 [1]	55,964,000	12,598,000
2020	56,950,000 [1]	66,225,000	13,942,000
2021	61,361,000 [1]	75,166,000	15,830,000
2022-2026	373,921,000 [1]	416,507,000	110,756,000

Roll Forward Info[62]

A roll forward info might look similar to a roll forward, but there is a difference. A roll forward actually has a roll forward computation. A roll forward info has no roll forward computation, it only conveys information about a roll forward. A good example is the roll forward of shares for a share based payment award with supplemental information provided for the weighted average stock price for each flow.

Reporting Entity [Axis]	SAMP http://www.SampleCompany.com	
Legal Entity [Axis]	Consolidated Entity [Member]	
	Period [Axis] ▼	
Weighted Average Grant Date Fair Value [Line Items]	2010-01-01/2010-12-31	
Weighted Average Grant Date Fair Value [Roll Forward Info]		
Nonvested Fair Value, Beginning Balance	32.72	
Granted	41.51	
Vested	30.92	
Forfeited	35.93	
Nonvested Failr Value, Ending Balance	36.92	

Other Block Patterns

As mentioned, testing of the approximately 754,430 Blocks in the set of 5,734 public company financial reports that have been submitted to the SEC, 100% of those Blocks fit into this model. However, errors could exist in the model. The error that could be occurring is that there is some other identifiable pattern or patterns which are not listed in this set of identified Block patterns. The resolution to this error would simply be to add a new Block pattern or patterns.

This is not a matter of opinion, this is 100% provable using the evidence of the financial reports themselves. When the new Block patterns are added, then the model becomes 100% correct once again.

2.17. Disclosures

A disclosure is simply some set of information that is disclosed within a report. A disclosure is made up of one or many Blocks.

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[62] Roll forward info, Microsoft, http://www.xbrlsite.com/2017/Prototypes/Microsoft/evidence-package/#Rendering-DisclosureStockPlanActivityDetail-us_gaap_ScheduleOfShareBasedCompensationArrangementsByShareBasedPaymentAwardTable.html

For example, a balance sheet is made up of two blocks:

1. A roll up of "Assets"
2. A roll up of "Liabilities and Equity"

Similarly, every other disclosure can be explained using that idea that disclosures are made up of sets of Blocks. The document *Disclosure Best Practices*[63] provides detailed information related to about 65 disclosures.

Note that an important idea here is that each Disclosure is given a name[64]. Providing names allows for specific disclosures to be referred to, things to be connected to disclosures, and other such benefits.

2.18. Templates

A Template is an instance of a Disclosure that can be used for creating a report. Similar to how a template might be used in PowerPoint to create a presentation; Templates can be used to create financial reports[65].
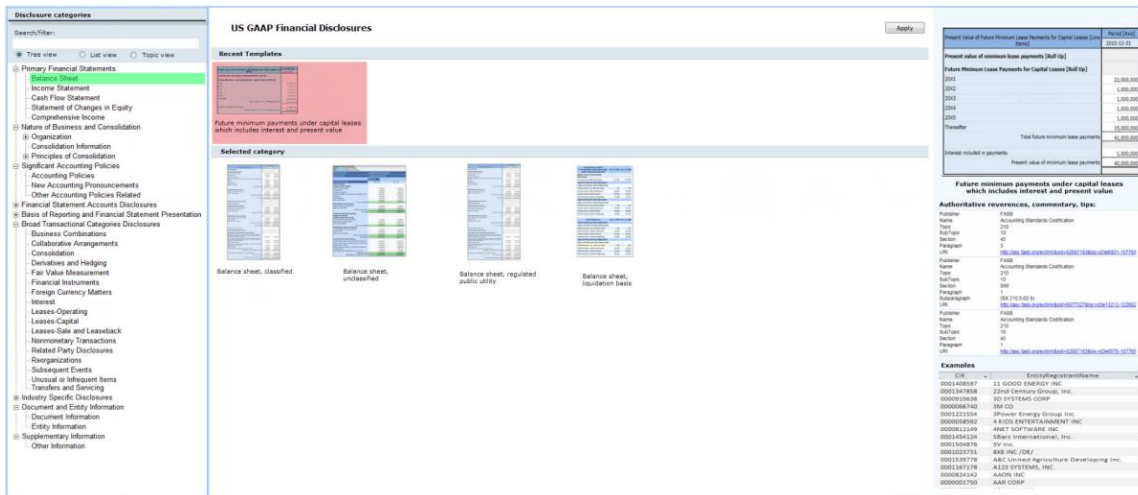
2.19. Exemplars

What does the term CPA stand for? Some say that the term stands for "Copy, Paste, Adjust" meaning that the way an accountant creates a report is by taking a piece from another report that is similar, adjusting that report, essentially using that existing report as a template or model for a disclosure which you might need to create.

Given that XBRL-based reports are machine readable, that means that any of the, say, approximately 6,000 10-Ks submitted by companies to the SEC can be automatically read, you find the disclosure that you want to borrow (i.e. use as a starting point for your disclosure), and then automatically imported into your software application that is used to create financial reports.

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[63] Disclosure Best Practices,
http://www.xbrlsite.com/site1/2017/Prototypes/DisclosureAnalysis/DisclosureBestPractices.pdf
[64] Understanding the Power of Naming Disclosures,
http://xbrl.squarespace.com/journal/2018/11/26/understanding-the-power-of-naming-disclosures.html
[65] Leveraging Templates and Exemplars, http://xbrl.squarespace.com/journal/2018/11/8/leveraging-templates-and-exemplars.html

I created a prototype of breaking the Microsoft 10-K for 2017 into the approximately 127 Networks that made up that report[66]. I used the same software code to extract information across reports, grabbing about 38 balance sheets[67].

Exemplars provide both human readable versions[68] that can be scanned to help you find the disclosure that you desire manually; or using machine readable[69] versions of pointers to the Exemplars and the Exemplar itself so that it can be imported into your software application.


2.20. Topics

Because there are lots and lots of possible disclosures, probably between 1,000 and maybe up to perhaps 5,000, you will want a way of organizing the Disclosures. That is where Topics come in. You can organize disclosures into whatever hierarchy you might find desirable. Every company could have their own organization, including or excluding whatever disclosures they want or including/excluding entire libraries of disclosures.

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[66] Microsoft Report Components, http://xbrlsite.azurewebsites.net/2016/Prototype/msft/rss.xml

[67] Balance sheet Components, http://xbrlsite.azurewebsites.net/2016/Prototype/BalanceSheet/rss.xml

[68] IFRS Exemplars, Human readable format, http://xbrlsite-app.azurewebsites.net/DisclosureBestPractices_IFRS/DisclosureBestPractices.aspx?BalanceSheet

[69] US GAAP Exemplars, Machine readable format, http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/us-gaap/Disclosures/disclosures-exemplarsList-ref.xml
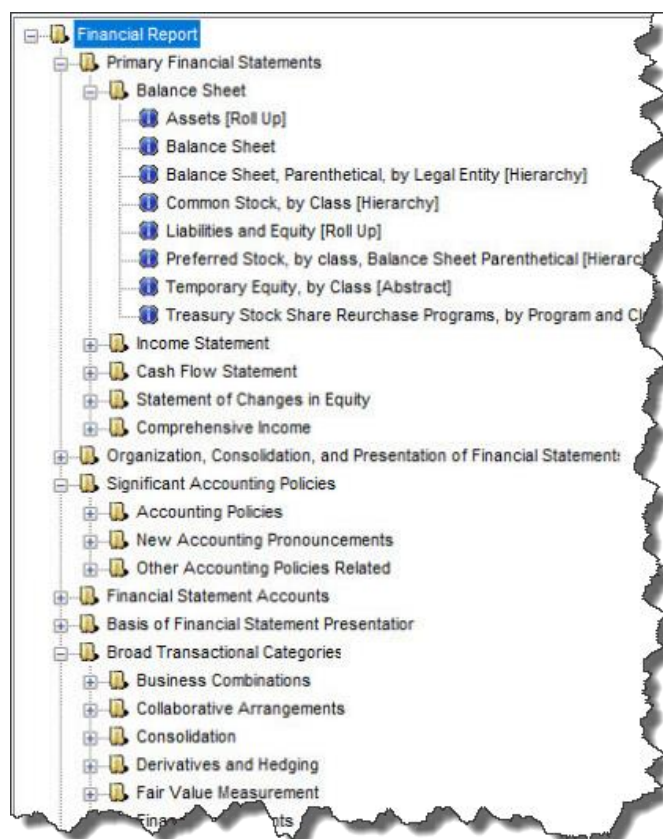
2.21. Framework for Creating Metadata for Any Reporting Scheme

While it may be interesting to see the human-readable and machine-readable organizations for US GAAP[70], IFRS[71], and what I call the XASB[72] reporting scheme even though the entire set of disclosures is not provided as of yet; what is more interesting is to recognize that this is really a framework for organizing information to make automating work possible. To get a fuller appreciation for what you see, try the human-readable examples[73] for most all of what can be done with this metadata. Or,

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[70] US GAAP machine readable metadata,
http://xbrlsite.azurewebsites.net/2018/Prototypes/ModernFinancePlatform/ModernFinancePlatform_Web.pdf

[71] IFRS machine readable metadata,
http://xbrlsite.azurewebsites.net/2018/Prototypes/ModernFinancePlatform/ModernFinancePlatform_Web_IFRS.pdf

[72] XASB machine readable metadata,
http://xbrlsite.azurewebsites.net/2018/Prototypes/ModernFinancePlatform/ModernFinancePlatform_Web_XASB.pdf

[73] US GAAP, human readable,
http://xbrlsite.azurewebsites.net/2018/Prototypes/ModernFinancePlatform/ModernFinancePlatform_Human.pdf

even better, try and write some code against the machine-readable metadata[74] and see what you can create!
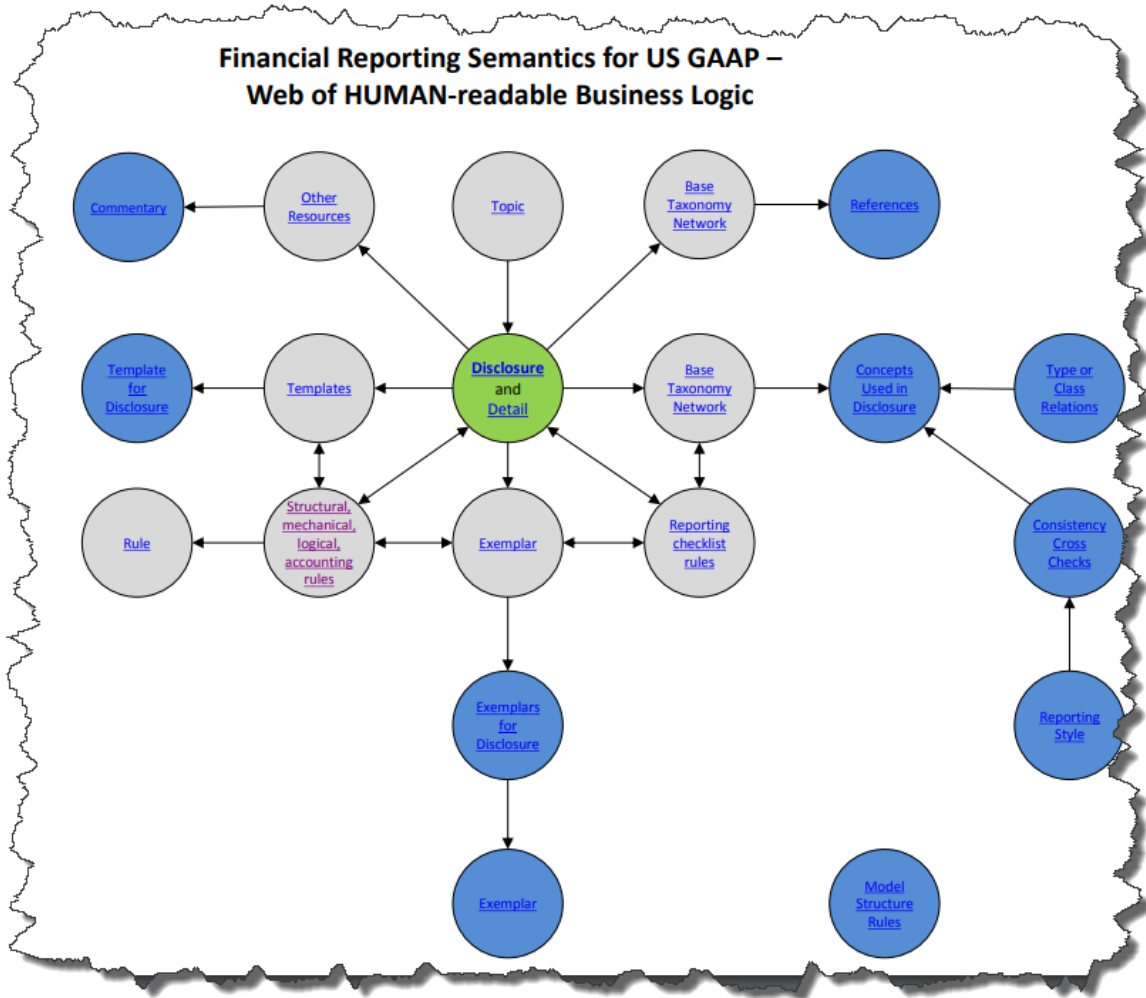
2.22. Quality

Engineer and statistician W. Edwards Deming defined quality as "predictability," and called variance "the enemy of quality." To achieve an intended outcome, Deming thought it was important to plan for common-cause variation, which can be predicted, and special-cause variation, which cannot be predicted.

Harold F. Dodge, one of the principal architects of the science of statistical quality control, said, "You cannot inspect quality into a product." In other words, once the inspection takes place, it's too late. Rather, data from the quality inspection needs to be utilized to continually improve the process.

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[74] Working Proof of Concept Template Selector, http://xbrl.squarespace.com/journal/2018/12/1/working-proof-of-concept-template-selector.html

Management consultant Joseph Juran, who focused on management training and the human element of quality control for a variety of businesses, stated that quality is "a fitness for use."

Businessman Philip B. Crosby, who developed the concept of Zero Defects while working as senior quality engineer at aircraft manufacturer The Martin Company, defined quality as "a conformance to requirements." He warned against the high cost of nonconformance and said that the desired performance standard of zero defects could only be achieved through the proper management system.

The philosophies, processes, and techniques of Lean Six Sigma[75] can be effectively applied to controlling the quality of XBRL-based financial reports. Lean Six Sigma is a discipline that combines the problem solving methodologies and quality enhancement techniques of Six Sigma with the process improvement tools and efficiency concepts of Lean Manufacturing. Born in the manufacturing sector, Lean Six Sigma works to produce products and services in a way that meets consumer demand without creating wasted time, money and resources.

2.23. Conclusion

Microsoft Word, supplemented by Microsoft Excel, is used to create 85% of all financial reports as I understand it. That is a problem because neither of those applications understands anything about financial reports. This is part of the reason that the last mile of finance is so inefficient[76].

There are alternatives. The painful, gruesome, grueling, barbaric practices, processes, and procedures that are used to create financial reports can be modernized[77].

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[75] Comprehensive Introduction to Lean Six Sigma for Accountants, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part01_Chapter02.72_LeanSixSigma.pdf

[76] Changing Old School Financial Report Creation Processes, http://xbrl.squarespace.com/journal/2017/2/14/changing-old-school-financial-report-creation-processes.html

[77] Financial Transformation and the Modern Finance Platform, http://xbrl.squarespace.com/journal/2018/11/2/financial-transformation-and-the-modern-finance-platform.html

3.   Recognizing and Identifying Fact Sets

An XBRL-based report, such as a financial report, is composed of many fragments which make up the structure of the report. Each structural piece, or fragment, category has pros and cons depending on the nature of the structural piece.

The lowest level category of report fragment is the **Fact**. Facts provide individual pieces of information. As explained by the multidimensional model of an XBRL-based report[78], one Fact is differentiated from another Fact by the Characteristics of the Fact. Individual Facts is generally the most detailed level of interaction with the information that makes up a report.

The highest level category of a report fragment is the **Network**. Networks provide individual fragments of the technical structure of a report. The Network tends to be a technical oriented structure that are quite large and that have some business meaning but generally not enough precision in terms of meaning to be useful.   Further, Networks often offer information in terms of the personal preference of how someone tends to want to organize information which could be well organize or poorly organized.

The second-highest level category of a report fragment is the **Hypercube** or often times called the [Table] in US GAAP or IFRS based financial reports. The Hypercube tends to be correlated to the Network on a one-to-one basis in the vast majority of US GAAP and IFRS based financial reports because each Network tends to contain only one explicitly defined Hypercube or one implied Hypercube (i.e. while no Hypercube is defined, all Concepts in the Network are grouped into one dynamically defined implied Hypercube). And so, the utility of the Hypercube tends to be comparable to the utility of the Network.

If there is more than one Hypercube in a Network, then that report fragment can be identified by combining the Network plus each Hypercube into what I refer to as a **Component**. But again, Components tend to have the same utility as a Network.

Enter the notion of what I call the **Block**. The Block is a fragment of a report that was created in order to make it possible to enable software applications to interact with the fragments of an XBRL-based report at a level that enables software engineers to create functionality that is useful to the professional accountants interacting with such reports.

This document explains what Blocks are and why they are so useful in solving two significant problems when working with an XBRL-based report: (2) working at a logical as contrast to a technical level and (2) identifying the fragment that you are working with.

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[78] *Introduction to the Multidimensional Model for Professional Accountants*, http://xbrl.squarespace.com/journal/2016/3/18/introduction-to-the-multidimensional-model-for-professional.html

3.1. Understanding the Block

The notion of a Block[79] is one of the harder ideas to explain and understand in the conceptual model of a digital financial report[80]. Blocks are explained in detail in the document *Putting the Expertise into an XBRL-based Knowledge Based System for Creating Financial Reports* [81] and explained how they are used in the document *Guide to Building an Expert System for Creating Financial Reports* [82].

A Block is a unit of a report that was created in order to make interacting with and otherwise working with a report easier. Individual facts are many times too small working sets to be useful. Networks tend to be too large to work with. A Block is a useful unit of a report that makes doing certain things significantly easier.

Essentially, a Block is a fragment of a report that has the same *concept arrangement pattern*[83]. For example, there is a simple basic block:

Inventory Disclosure [Abstract]	Period [Axis]	
	2016-03-31	2015-03-31
Inventory Disclosure [Abstract]		
Raw materials and supplies	7,993,000	7,417,000
Work-in-progress	13,147,000	6,466,000
Finished goods	5,600,000	2,891,000
Inventories	26,740,000	16,774,000

The Block above has the concept arrangement pattern "roll up". I will explain more of the traits of a Block as we go along. Blocks are very consistent structures and makes working with an XBRL-based report at a logical level possible as contrast to working at the XBRL technical syntax level. Blocks make many, many things possible.

Note that then notion of blocks was inspired by MIT's Scratch application[84] and Blockly[85].

A Block is a part of a Component whose line items all participates in the same *concept arrangement pattern*[86]. A roll up, roll forward, adjustment, and hierarchy are all types of concept arrangement patterns. Every XBRL-based public company financial report

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[79] YouTube.com, *Understanding Blocks*, https://www.youtube.com/watch?v=yI9yjD_T78I

[80] Charles Hoffman and Rene van Egmond, *Introduction to Conceptual Model of a Digital Financial Report*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.1_IntroductionToTheConceptualModelOfDigitalFinancialReport.pdf

[81] Charles Hoffman and Hamed Mousavi, *Putting the Expertise into an XBRL-based Knowledge Based System for Creating Financial Reports*, http://pesseract.azurewebsites.net/PuttingTheExpertiseIntoKnowledgeBasedSystem.pdf

[82] Charles Hoffman, *Guide to Building an Expert System for Creating Financial Reports*, http://xbrlsite.azurewebsites.net/2018/Library/GuideToBuildingAnExpertSystemForCreatingFinancialReports.pdf

[83] Charles Hoffman and Rene van Egmond, *Understanding Concept Arrangement Patterns, Member Arrangement Patterns, and Report Fragment Arrangement Patterns*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.7_UnderstandingConceptArrangementPatternsMemberArrangementPatterns.pdf

[84] MIT, Scratch, https://scratch.mit.edu/

[85] Blockly, http://xbrl.squarespace.com/journal/2014/7/14/blockly.html

[86] See page 11, http://www.xbrlsite.com/2015/Analysis/AnalysisSummary2014_PiecesOfReoprt.pdf#page=11

is essentially a set of Blocks. I estimate that there are about 754,430 blocks in the set of 5,734 public company reports that I analyzed. Of that total, 16% are roll ups, 5% are roll forwards, 24% are hierarchies, and 54% are text blocks[87].

If you do not understand what a Block is, I would encourage you to read the documents referenced thus far in this document. If you want some hands on experience with Blocks, download the Pesseract software application and work through the documentation related to Networks, Components and Blocks[88].

3.2. Examples Used in This Document

In the remainder of this document I am going to use examples from the document *General Ledger Trial Balance to External Financial Report*[89]. In that document you will see a rather small example, a larger example, and an XBRL-based report that was submitted to the SEC referred to. You can get to working commercial quality tools provided by XBRL Cloud for the examples I will reference.

Alternatively, you can download and install the Pesseract working proof of concept[90] and load the examples for yourself. I will try and provide direct references to examples as best that I can.

It may be the case that I reference XBRL-based financial reports submitted to the SEC and show those reports in the XBRL Cloud Viewer. You can get to pretty much any XBRL-based financial report submitted to the SEC from the XBRL Cloud EDGAR Dashboard[91]. Just press the blue button that says "Viewer" in the column marked "Interactive Reviewer".

It can be hard to understand information if you cannot see things for yourself. At the same time, different software applications provide different functionality. Because of the differences in functionality, it can be hard to explain extremely detailed ideas. I will use the XBRL Cloud and Pesseract software tools.

3.3. Perspective

Why are Networks necessary? There are exactly two answers to that question: (1) because you WANT to represent a report fragment in separate Networks or (2) because you HAVE to represent a report fragment in a different Network.

So the "WANT to" is easy to understand. For example, you choose to put two fragments of information into two different Networks. Why would you do that? Because you can. Not much of a discussion is necessary here, this is simply a matter of preference. But what about the "HAVE to". Why would you have to construct two different report fragments within different Networks? The answer is conflicts.

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[87] I have a document that summarizes this information.

[88] Networks, Components, and Blocks, http://xbrlsite.azurewebsites.net/2018/Pesseract/12-NetworksComponentsAndBlocks.pdf

[89] General Ledger Trial Balance to External Financial Report, http://xbrlsite.azurewebsites.net/2018/RoboticFinance/TrialBalanceToReport.pdf

[90] Pesseract, http://pesseract.azurewebsites.net/

[91] EDGAR Dashboard, https://edgardashboard.xbrlcloud.com/edgar-dashboard/

Say, for example, that you wanted to represent the three computations[92] below within an XBRL-based report:

	2010	2009
TRADE AND OTHER RECEIVABLES		
Trade and Other Receivables, Net, by Component		
Trade Receivables, Net	8,790	6,431
Financing Lease Receivables, Net	2,498	1,263
Other Receivables, Net	1,305	1,096
Trade and Other Receivables, Net	12,593	8,790
Trade and Other Receivables, Net, by Net/Gross		
Trade and Other Receivables, Gross	18,280	13,472
Allowance for Doubtfull Accounts	-5,687	-4,682
Trade and Other Receivables, Net	12,593	8,790
Trade and Other Receivables, Net, by Current/Noncurrent		
Trade Receivables, Net, Current	6,340	5,701
Trade Receivables, Net, Noncurrent	6,253	3,089
Trade and Other Receivables, Net	12,593	8,790

To do that, you would need to use three different Networks. Why? Because there are three different sets of roll up computations and if you represented all three roll ups within one Network the three sets of computations would conflict with one another. And so, to avoid conflicts such as this (i.e. there are other types of conflicts) you use Networks.

The point here is to highlight the difference between a preference where you could do something and a requirement where you must do something. It is important to be able to distinguish between what is a preference and something that is required.

Next, the following might not be familiar to you. What you see is a list of the Blocks within a straight forward XBRL document[93]:

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[92] Business Use Case: Multiple Rollups, http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/BusinessUseCases/2017-05-07/BUC06-MultipleRollUps/Index.html

[93] You can grab the ZIP archive with the XBRL instance and XBRL taxonomy here, http://xbrlsite.azurewebsites.net/2018/Pesseract/Basic.zip
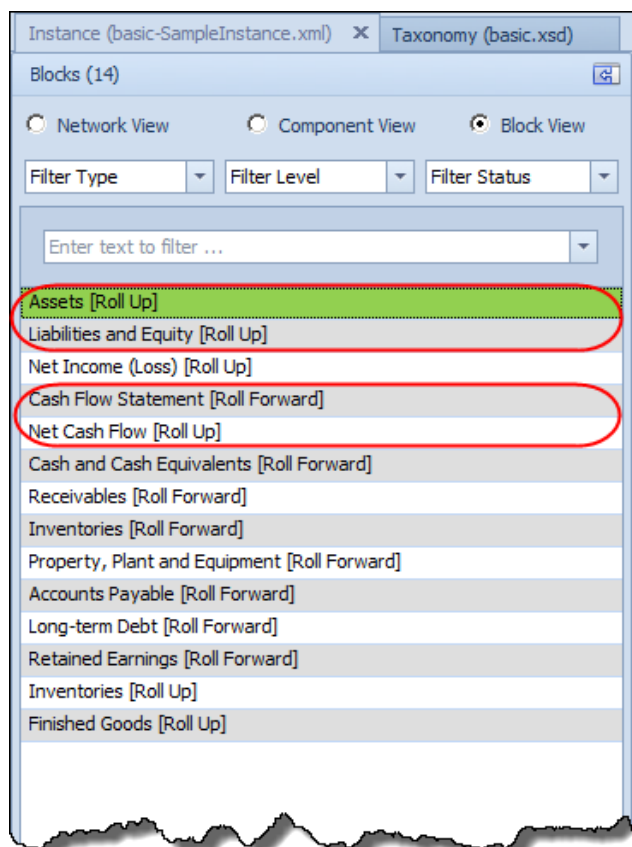
In that report there are 12 Networks, there are 12 Hypercubes, there are 12 Components because there is one Hypercube per Network, and there are 14 Blocks. Why are there 14 Blocks? The reason there are 14 Blocks is because there are two Components that contain two Blocks, all the other Components have only one Block.

In this representation the balance sheet is in one Network, but that Network contains two Blocks; "Assets [Roll Up]" and "Liabilities and Equity [Roll Up]". And that makes sense; that is exactly what a balance sheet is: two roll ups and the totals for the roll ups are the same amount, the balance sheet balances.

In this representation the cash flow statement is likewise in one Network, but again there are two Blocks: "Net Cash Flow [Roll Up]" and the "Cash Flow Statement [Roll Forward]". That likewise makes sense, a cash flow statement is a roll up of the net cash flows from operating, financing, and investing activities to the total net cash flow. Then, the beginning balance is rolled forward to the ending balance using that total net cash flow and perhaps some other reconciling items.

So why couldn't this report be represented so that there is a one-to-one correlation between Networks and Blocks? There is no reason that could not be done. How this information is represented is purely a matter of preference.

Where information occurs in the report is a matter of preference, habit, norms in many cases, best practices, and other such reasons. The meaning of the information contained in the report would not change if Blocks were represented in different Network combinations. The only imitation that you have is that you cannot create

relations where you have physical conflicts between things like the different totals of receivables which we showed earlier in this section.

3.4. Disclosure Mechanics

Disclosure mechanics is the idea that each disclosure follows specific structural, mathematical, logical, accounting, and maybe even other rules.

So, for example, consider this inventory components disclosure:

Component: (Network and Table)			
Network	2101 - Disclosure - **Inventories Detail**		
Table	Implied [Table]		
Reporting Entity [Axis]		30810137d58f76b84afd http://standards.iso.org/iso/17442	
Unit [Axis]		USD	
		Period [Axis]	
Implied [Line Items]		2018-12-31	2017-12-31
Inventories [Roll Up]			
Finished Goods		600	700
Work in Progress		200	100
Raw Material		200	200
Inventories		1,000	1,000

Notice that this disclosure is a roll up. Would an inventory components disclosure ever be a roll forward? The answer is no. An inventory roll forward is a different disclosure. Here is what an inventory roll forward looks like:

Component: (Network and Table)		
Network	1230 - Disclosure - **Inventories**	
Table	Implied [Table]	
Reporting Entity [Axis]		30810137d58f76b84afd http://st
Unit [Axis]		USD
		Period [Axis]
Inventories [Roll Forward]		2018-01-01/2018-12-31
Inventories [Roll Forward]		
Inventories, Beginning Balance		1,000
Purchases of Inventory for Sale		2,000
Costs of Sales 2		(2,000)
Inventory Written Off		0
Inventories, Ending Balance		1,000

You may say, "Well, that looks like it has a total also." But that is not what is going on. Note the first line item "Inventories, Beginning Balance" and then the last line item "Inventories, Ending Balance".

A roll forward reconciles the same concept between two points in time. A roll up aggregates a concept, in this case, at a point in time[94].

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[94] To understand the difference between a roll up and a roll forward, see the document *Leveraging the Theoretical and Mathematical Underpinnings of a Financial Report*, page 4, Legers and Journals, Stocks and Flows,
http://xbrlsite.azurewebsites.net/2018/Library/TheoreticalAndMathematicalUnderpinningsOfFinancialReport.pdf

So ask yourself a question: "How may roll ups have a total?" The answer is that 100% of roll ups have a total. And then ask yourself, "How many roll ups have to actually mathematically add up?" Well, clearly 100% of roll ups should add up mathematically.

You can ask yourself the same type of questions about roll forwards. These commonalities between roll ups and roll forwards are patterns. Software engineers love patterns. Why? Because patterns allow them to absorb some of the complexity of a task, have the software perform that task, and then provide useful functionality within software applications.

OK, so we say we identified a pattern for inventory components roll up. How can we check to see if that pattern holds? Empirical evidence. Look at the inventory components disclosure of financial reports of public companies. Well, I did exactly that. Here are the results[95]:

	July 3, 2016		June 28, 2015
	(in thousands)		
Finished goods	$ 44,264	$	43,254
Work-in-process	24,573		16,020
Raw materials	34,491		33,889
	$ 103,328	$	93,163

What about other patterns? Well, OK; so if there is an inventory components roll up disclosure[96]; I know that there would also be an inventory note[97]. You would also expect that there would be an inventory policy[98].

Once you start noticing patterns you start noticing more patterns. You start documenting relationships[99]. You begin to automate the testing process using that information and you can analyze 100% of the population:

DisclosureFound	DisclosureConsistent	RepresentationConcept_TextBlock	RepresentationConcept_Detail	Count	Percent
FALSE	CONSISTENT	NOT-FOUND	NOT-FOUND	3,612	56%
TRUE	CONSISTENT	us-gaap:ScheduleOfInventoryCurrentTableTextBlock	us-gaap:InventoryNet	1,721	27%
TRUE	INCONSISTENT	NOT-FOUND	us-gaap:InventoryNet	1,061	16%
TRUE	INCONSISTENT	us-gaap:ScheduleOfInventoryCurrentTableTextBlock	NOT-FOUND	46	1%
TRUE	CONSISTENT	us-gaap:ScheduleOfUtilityInventoryTextBlock	us-gaap:InventoryNet	19	0%
TRUE	INCONSISTENT	us-gaap:ScheduleOfUtilityInventoryTextBlock	NOT-FOUND	7	0%
				6,466	100%
			Consistent with expectation	5,352	83%
			Inconsistent with expectation	1,114	17%
			Total	6,466	100%

Then you document these observations in pseudo code, for example:

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[95] Inventory Components Roll Up, http://xbrlsite-app.azurewebsites.net/DisclosureBestPractices/DisclosureBestPractices.aspx?DisclosureName=InventoryNetRollUp

[96] Inventory disclosure, http://www.xbrlsite.com/2018/10K/Notes/Compare_813.html

[97] Inventory note, http://www.xbrlsite.com/2018/10K/Notes/Compare_91.html

[98] Inventory policy, http://www.xbrlsite.com/2018/10K/Notes/Compare_347.html

[99] Understanding Disclosure Mechanics, http://xbrlsite.azurewebsites.net/2016/Analysis/UnderstandingDisclosureMechanics.pdf
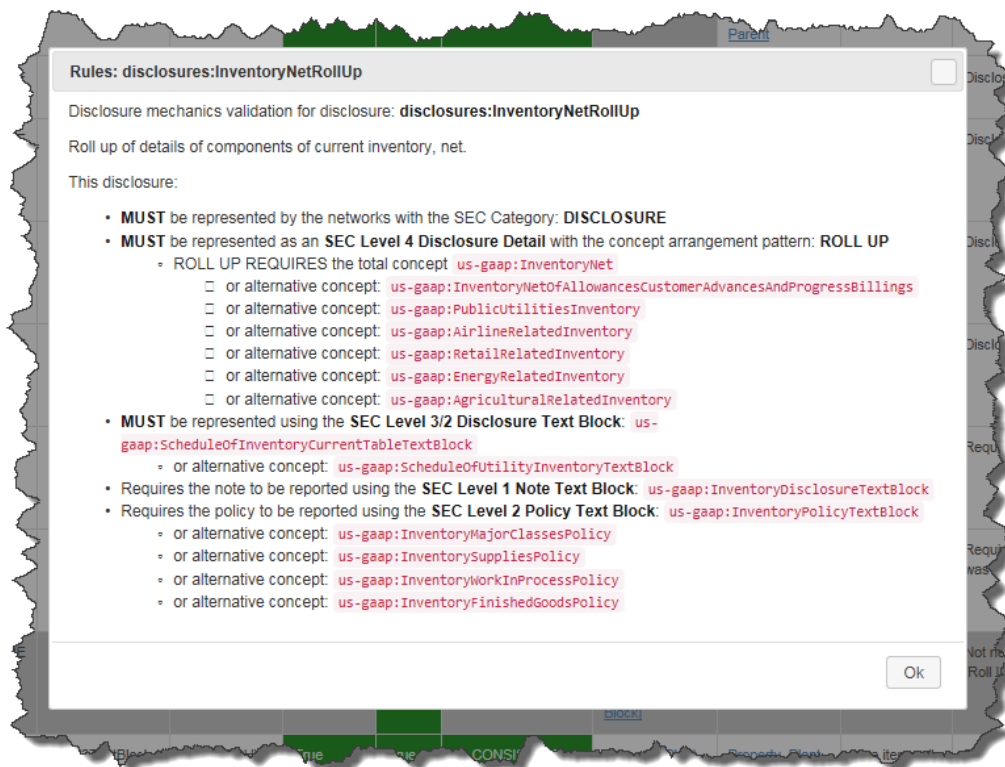
Then, you figure out a scheme to represent those rules in machine-readable form. I tried numerous alternatives and settled on the XBRL syntax, specifically using XBRL definition relations[100].

I repeated this process for approximately 65 disclosures, summarizing the information in a document called *Disclosure Best Practices*[101]. I created rules for each of the approximately 65 rules. Then, I organized the individual rules linkbases with an XBRL taxonomy schema[102].

I then talked to two different software engineers about what I had put together and which I knew worked because I could get most of this to work using some Microsoft Access database applications that I created. But clearly, what I had was not commercial quality.

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[100] XBRL definition relations rules for inventory components roll up, http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/us-gaap/disclosure-mechanics/517-rules-def.xml

[101] Disclosure Best Practices, http://www.xbrlsite.com/site1/2017/Prototypes/DisclosureAnalysis/DisclosureBestPractices.pdf

[102] XBRL taxonomy schema for 65 rules, http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/us-gaap/disclosure-mechanics/Disclosures_BASE2.xsd

But, I convinced XBRL Cloud to implement these disclosure mechanics rules. I could run this for individual companies, for example here is the Microsoft 10-K checked against the approximately 65 disclosure mechanics rules[103].

I implemented the same thing in Pesseract[104], comparing the XBRL Cloud results with the Pesseract results[105] to make sure the implementations were consistent.

Note that while these rules are specifically created for US GAAP, the framework is independent of any profile[106].

IFRS works also, but I have not created a lot of rules yet. I created another example for the XASB reporting schema[107] that I create and maintain for testing. There is a specific thing that I will get back to with regard to this.

3.5. *Reporting Checklist*

I organized the disclosure mechanics rules with another set of helpful rules which I call the reporting checklist. The disclosure checklist rules were likewise represented using XBRL definition relations[108].

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[103] Microsoft Disclosure Mechanics Validation Results, http://xbrlsite.azurewebsites.net/2017/Prototypes/Microsoft2017/Disclosure%20Mechanics%20and%20Reporting%20Checklist.html

[104] Microsoft Results in Pesseract, video, https://www.youtube.com/watch?v=V9bElBR7iFg

[105] Microsoft Results in Pesseract results screenshot, http://xbrlsite.azurewebsites.net/2017/Prototypes/DisclosureMechanicsExample/DisclosureMechanicsSummary.jpg

[106] XBRL-based Digital Financial Reporting Profiles and General Business Reporting Profile, http://xbrlsite.azurewebsites.net/2018/Library/Profiles-2018-10-22.pdf

[107] XASB reporting schema, Disclosure Mechanics Results, http://xbrlsite.azurewebsites.net/2017/Prototypes/XASB/Disclosure%20Mechanics%20and%20Reporting%20Checklist.html

[108] Reporting checklist, XBRL definition relations rules, http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/us-gaap/reporting-checklist/ReportingChecklist-us-gaap-strict-rules-def.xml

#	Disclosure	Category	Level	Pattern	Applicable	Found	Disclosure Consistent	Representation Concept [TEXT BLOCK]	Representation Concept [DETAIL]	Checklist Category	Reason
1	Entity Information		Level4Detail	HIERARCHY	True	True	CONSISTENT	NOT-EXPECTED	Economic Entity Name	Required disclosure	Disclosure always required
2	Document Information		Level4Detail	HIERARCHY	True	True	CONSISTENT	NOT-EXPECTED	Document Title	Required disclosure	Disclosure always required
3	Financial Highlights		Level3TextBlock / Level4Detail	HIERARCHY	True	True	CONSISTENT	Financial Highlights [HTML]	Revenues, Net	Required disclosure	Disclosure always required
4	Balance Sheet		Level4Detail	COMPONENT	True	True	CONSISTENT	NOT-EXPECTED	NOT-EXPECTED	Required disclosure	Disclosure always required, satisfied by Assets [Roll Up] and Liabilities and Equity [Roll Up]
5	Assets [Roll Up]		Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Assets	Part of disclosure	Disclosure always required
6	Liabilities and Equity [Roll Up]		Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Liabilities and Equity	Part of disclosure	Disclosure always required
7	Income Statement		Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Net Income (Loss)	Required disclosure	Disclosure always required
8	Cash Flow Statement, Direct Method		Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Cash Flow, Net	Required disclosure	Disclosure always required
9	Statement of Changes in Equity		Level4Detail	ROLL FORWARD	True	True	CONSISTENT	NOT-EXPECTED	Equity	Required disclosure	Disclosure always required
10	Significant Accounting Policies		Level1TextBlock	LEVEL 1 TEXT BLOCK	True	True	CONSISTENT	Significant Accounting Policies [Note]	NOT-EXPECTED	Required disclosure	Disclosure always required
11	Basis of Reporting		Level1TextBlock	LEVEL 1 TEXT BLOCK	True	True	CONSISTENT	Overall Financial Report Presentation and Display [HTML]	NOT-EXPECTED	Required disclosure	Disclosure always required
12	Nature of Operations		Level1TextBlock	LEVEL 1 TEXT BLOCK	True	True	CONSISTENT	Nature of Business [HTML]	NOT-EXPECTED	Required disclosure	Disclosure always required
13	Cash and Cash Equivalents Components		Level3TextBlock / Level4Detail	ROLL UP	True	True	CONSISTENT	Cash and Cash Equivalents Components [Schedule]	Cash and Cash Equivalents	Line item exists, then disclosure required	Required because line item gaap:CashAndCashEquivalents was reported
14	Reconciliation of Cash Summary		Level3TextBlock / Level4Detail	ROLL UP	True	True	CONSISTENT	Reconciliation of to Cash Flow Statement, Summary [Schedule]	Cash and Cash Equivalents, per Cash Flow Statement	Line item exists, then disclosure required	Required because line item gaap:CashAndCashEquivalents was reported
15	Reconciling Item of Cash and Cash Equivalents		Level3TextBlock / Level4Detail	HIERARCHY	True	True	CONSISTENT	Reconciliation of to Cash Flow Statement, Detail [Schedule]	Reconciling Item, Amount	Disclosure 'Reconciliation of Cash Summary' exists, then disclosure required	Required because disclosure 'Reconciliation of Cash Summary' was found and is consistent.
16	Receivables Details, Current and Noncurrent		Level3TextBlock / Level4Detail	ROLL UP	True	True	CONSISTENT	Receivables, Current and Noncurrent [Schedule]	Receivables, Net	Line item exists, then disclosure required	Required because line item gaap:ReceivablesNet was reported
17	Receivables Details, Gross, Net		Level3TextBlock / Level4Detail	ROLL UP	True	True	CONSISTENT	Receivables, Net and Gross [Schedule]	Receivables, Net	Line item exists, then disclosure required	Required because line item gaap:Rec...

What the reporting checklist does is organize the disclosures into a checklist which articulates whether a disclosure is always required, required if some line item is reported, required if some other disclosure is required, etc. The disclosures in the reporting checklist are the disclosures for which the disclosure mechanics rules are provided. So, the reporting checklist and the disclosure mechanics work together.

3.6. Disclosures

Key to making all of this work is inventorying 100% of disclosures which will be provided within a financial report and assigning each of these disclosures a unique identifier. Below is that inventory of disclosures, each of which has been uniquely identified[109]. Currently there are 959 disclosures within this library. Additional libraries exist for IFRS and for the XASB testing reporting scheme which helps make sure that this functionality works for any reporting scheme which has a profile which is supported.

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[109] Disclosures, http://www.xbrlsite.com/2015/fro/us-gaap/html/Disclosures/Detail/index.html

Again, these disclosures and all related information are provided in the form of an XBRL taxonomy schema[110].

3.7. Topics

Less important but still useful is the notion of topics. Topics are used to organize disclosures into a hierarchy[111]. Because a flat list of 959 disclosures can be overwhelming to work with, an XBRL taxonomy schema was created to define topics[112]. Topics enable disclosures to be organized within sets. Topics exist for each reporting scheme or profile supported.

3.8. Arcroles

The disclosure mechanics rules and the reporting checklist rules are expressed using XBRL definition relations. XBRL definition relations is general functionality to represent a relation between two things. Arcroles are used to define the type of relationship.

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[110] Disclosures XBRL taxonomy schema, http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/us-gaap/Disclosures/disclosures.xsd

[111] PWC, *FASB accounting standards codification quick reference guide*, https://www.pwc.com/us/en/cfodirect/assets/pdf/accounting-guides/pwc_codification_quick_reference_guide.pdf

[112] Topics XBRL taxonomy schema, http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/us-gaap/Disclosures/topics.xsd

To articulate the disclosure mechanics and reporting checklist rules, arcroles[113] are used. Currently, the arcroles defined are proprietary. There are two sets of arcroles. The first set is general arcroles[114]. The second set is a set of arcroles that are specifically used for articulating the reporting checklist and disclosure mechanics rules[115].

Rather than using arcroles that are proprietary; a better approach is to have XBRL International create the arcroles, put them into the XBRL International Link Role Registry[116], and have a global standard reporting checklist and disclosure mechanics scheme.

3.9. Back to Blocks

So, you might be asking how all of this relates to Blocks. Here is the connection.

Blocks have nothing to do with personal preferences. Blocks have to do with mechanical, structural, mathematical, logical, and other rules that are universally the same for all economic entities that might create a financial report. Blocks factor out personal preferences. Blocks are purely mechanical; they are objective rather than subjective.

Yes, it is true that an economic entity can chose between disclosure alternatives. What goes into a Block can be different for different economic entities. However, once they choose; they MUST follow the rules related to representing that specific disclosures. Yes, it is true that an economic entity can organize the presentation of information to their liking. However, no economic entity can change the statutory or regulatory disclosure rules of the reporting schema to which they must comply.

The Block is the least common denominator that enables thousands of economic entities to consistently[117] represent information such that the information is usable by analysts.

3.10. Prototype Theory

There are two approaches to identify something. The first approach is to use a unique identifier[118] that is guaranteed to be unique to some set of objects. This approach works great if the objects you are working with provide unique identifiers. What do you do if you don't have unique identifiers within the set of objects you are working with?

The second approach to identifying something is prototype theory[119]. According to prototype theory, objects can be defined by their resemblance to a unique prototype that is a best or most typical example of the object, sharing the maximum number of

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[113] XBRL International, XBRL 2.1 Specification, http://www.xbrl.org/Specification/XBRL-2.1/REC-2003-12-31/XBRL-2.1-REC-2003-12-31+corrected-errata-2013-02-20.html#_3.5.3.9

[114] General arcroles, http://xbrlsite.azurewebsites.net/2016/conceptual-model/cm-arcroles.xsd

[115] Reporting checklist and disclosure mechanics arcroles, http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles.xsd

[116] XBRL International Link Role Registry, https://specifications.xbrl.org/registries/lrr-2.0/

[117] Comparing Reporting Styles, Notes on Comparability, http://xbrl.squarespace.com/journal/2015/11/11/comparing-reporting-styles-notes-on-comparability.html

[118] Wikipedia, *Unique Identifier*, https://en.wikipedia.org/wiki/Unique_identifier

[119] Understanding Prototype Theory, http://xbrl.squarespace.com/journal/2013/12/21/understanding-prototype-theory.html

features or traits with that prototype. A prototype[120] consists of characteristic features.

As an example, one can understand that something is a "chair" by understanding as many traits as possible about the thing you are looking at, looking at the traits of a chair as defined by a prototype (the undisputed example), and then predicting whether the thing you are looking at is in fact a "chair" by comparing the traits you are observing with the traits of a chair.

This is important because neither the US GAAP XBRL Taxonomy, the IFRS XBRL Taxonomy, nor XBRL-based reports submitted to the SEC by public companies provide identifiers that explicitly and uniquely identify specific disclosures.

Essentially, the logical rules defined in machine-readable form[121] for and used in the process of checking disclosure mechanics also defines a prototype which can be used to identify disclosures within a report. Those rules are prototypes that can be used to query a report for a specific disclosure.

3.11. Block Detection and Identification

There are two distinct phases in the process of detecting and identifying a Block within a report:

1. Determining that some fragment of a report is an identifiable Block.
2. Determining the information that is being represented, the disclosure being provided, by that Block.

The first phase where you simply identify THAT some fragment of a report is a Block is straight forward and are applied Network by Network until all the Blocks in a Network are identified; and then all the Networks within a report have been identifies meaning that all the Blocks of a report have been identified.

The second phase, understanding the information that is being conveyed by a Block of information, requires that additional metadata be created which is then used in that process of understanding what the Block represents.

Remember that we are discussing machine-based processes here. A professional accountant would generally have no problem identifying what information is being conveyed by a Block of information. We are trying to get a machine to understand the nature of the Block of information so that the machine can perform work for its human operator.

3.12. All Report Blocks

So a report can be broken down to some set of Blocks. That complete set of Blocks is the report. For example, the Microsoft 2017 10-K financial report can be broken down into 192 distinct Blocks. Each of the 192 Blocks must be verified to be correct. If you

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[120] YouTube.com, *Semantics #4 - Prototype Theory*, https://www.youtube.com/watch?v=mff_sPnz_gs

[121] Disclosure mechanics rule, http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/us-gaap/disclosure-mechanics/517-rules-def.xml

go look at the validation results of the Microsoft report[122]; you will notice that there are 70 lines in the validation results report.

Why are there only 70 lines and not 192, one report line per Block? There are four specific reasons:

1. Information is conveyed three times generally in a report: (1) the Level 1 Note Text Block which contains an HTML representation for an entire disclosure; (2) the Level 3 Disclosure Text Block which contains an HTML representation for a specific disclosure; and (3) the Level 4 Disclosure Detail which provided individual Facts for a disclosure or statement. Level 1 Note Text Blocks other than the one for the significant accounting policies is not considered in the validation process because where disclosures are presented is a matter of preference and is subjective therefore the validation process ignores the vast majority of Blocks that are Level 1 Note Text Blocks.

2. The validation report puts the Level 3 Disclosure Text Block and the Level 4 Disclosure Detail side-by-side on the report; and therefore many lines show two Blocks that make up both the Level 3 and Level 4 versions of the same disclosure.

3. The validation report lines that are completely gray in color are disclosures for which there are rules provided but the economic entity does not report that disclosure; so those lines can be ignored. (It is possible to turn those disclosures that are not applicable to the economic entity off using the radio buttons on the top of the report).

4. Rules do not exist for 100% of the Blocks that are provided in the report. If rules are not provided, then the second phase of determining what information the Block is conveying cannot be performed. Missing rules means parts of the report are not being verified as being correct.

This is a critically important point to understand. The prototype reporting checklist and disclosure mechanics rules that I provide number about 65 or 70 disclosures depending upon how you count them (i.e. how disclosure alternatives are counted). There is not 100% coverage of US GAAP currently provided. What I am showing is a prototype.

But what if you did provide 100% coverage for a reporting scheme and what if 100% of the Blocks were covered by rules? That is exactly what is done with the XASB reporting scheme prototype[123].

The XASB report has 133 Blocks and the verification report has 133 blocks that are being verified to be correct. This is important to understand because it means that there is 100% coverage of the XBRL-based report by the verification rules.

Further, the XASB report prototype exercises all concept arrangement patterns found in US GAAP or IFRS based reports. That proves the capabilities of the system.

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[122] Microsoft Disclosure Mechanics Validation Results, http://xbrlsite.azurewebsites.net/2017/Prototypes/Microsoft2017/Disclosure%20Mechanics%20and%20Reporting%20Checklist.html

[123] XASB reporting schema, Disclosure Mechanics Results, http://xbrlsite.azurewebsites.net/2017/Prototypes/XASB/Disclosure%20Mechanics%20and%20Reporting%20Checklist.html

An easier report where 100% coverage can be better seen is to use what I call the basic example[124]. There are no text blocks used and the representation of the report is straight forward. Here is the Block view of the report where you see that there are 12 Blocks shown with the Pesseract software application:
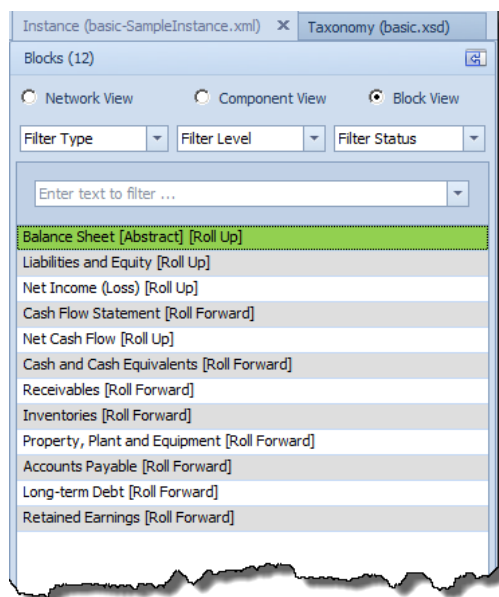
Here is the XBRL Cloud evidence package that helps you see the Blocks in the report[125] if you don't have software where you can load the report:

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[124] Basic example, XBRL instance, http://xbrlsite.azurewebsites.net/2018/Prototypes/Basic/Basic-XASB-ConsistentRF/basic-SampleInstance.xml

[125] Basic example, XBRL Cloud Evidence Package, http://xbrlsite.azurewebsites.net/2018/Prototypes/Basic/Basic-XASB-ConsistentRF/evidence-package/contents/index.html#Rendering-N0-Implied.html

The XBRL Cloud view of this information shows 10 Components, that software understands Blocks, but does not provide a separate listing for Blocks in this interface. Two of the Components have two Blocks (balance sheet and cash flow statement) while all the Components have one Block so there are a total of 12 Blocks the same as the Pesseract software's count of Blocks.

Here is the XBRL Cloud reporting checklist and disclosure mechanics validation report[126]. You can see a list of 12 Blocks here. Note that 100% of the Blocks are represented correctly per the rules used to evaluate the report:

#	Disclosure	Category	Level	Pattern	Applicable	Found	Disclosure Consistent	Representation Concept [TEXT BLOCK]	Representation Concept [DETAIL]	Checklist Category	Reason
1	Balance Sheet		Level4Detail	COMPONENT	True	True	CONSISTENT	NOT-EXPECTED	NOT-EXPECTED	Required disclosure	Disclosure always required, satisfied by Assets [Roll Up] and Liabilities and Equity [Roll Up]
2	Assets [Roll Up]		Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Assets	Part of disclosure	Disclosure always required
3	Liabilities and Equity [Roll Up]		Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Liabilities and Equity	Part of disclosure	Disclosure always required
4	Income Statement		Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Net Income (Loss)	Required disclosure	Disclosure always required
5	Cash Flow Statement, Direct Method		Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Net Cash Flow	Required disclosure	Disclosure always required
6	Receivables [Roll Forward]		Level4Detail	ROLL FORWARD	True	True	CONSISTENT	NOT-EXPECTED	Receivables	Required disclosure	Disclosure always required
7	Cash and Cash Equivalents [Roll Forward]		Level4Detail	ROLL FORWARD	True	True	CONSISTENT	NOT-EXPECTED	Cash and Cash Equivalents	Line item exists, then disclosure required	Required because line item basic:CashAndCashEquivalents was reported
8	Inventories [Roll Forward]		Level4Detail	ROLL FORWARD	True	True	CONSISTENT	NOT-EXPECTED	Inventories	Line item exists, then disclosure required	Required because line item basic:Inventories was reported
9	Accounts Payable [Roll Forward]		Level4Detail	ROLL FORWARD	True	True	CONSISTENT	NOT-EXPECTED	Accounts Payable	Line item exists, then disclosure required	Required because line item basic:AccountsPayable was reported
10	Property, Plant, and Equipment [Roll Forward]		Level4Detail	ROLL FORWARD	True	True	CONSISTENT	NOT-EXPECTED	Property, Plant and Equipment	Line item exists, then disclosure required	Required because line item basic:PropertyPlantAndEquipment was reported
11	Long-Term Debt [Roll Forward]		Level4Detail	ROLL FORWARD	True	True	CONSISTENT	NOT-EXPECTED	Long-term Debt	Line item exists, then disclosure required	Required because line item basic:LongtermDebt was reported
12	Retained Earnings [Roll Forward]		Level4Detail	ROLL FORWARD	True	True	CONSISTENT	NOT-EXPECTED	Retained Earnings	Line item exists, then disclosure required	Required because line item basic:RetainedEarnings was reported

The Pesseract application provides the same results, again using a slightly different interface. Note the count of 12 Blocks:

Primary Information

#	Disclosure	Category	Level	Pattern	Disclosure Found	Disclosure Consis...	Applicable	Representation Concept [TEXT BLOCK]	Representation Concept DETAIL
	1 Accounts Payable [Roll For...	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Accounts Payable
	2 Assets [Roll Up]	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Assets
	3 Balance Sheet	Statement	UNKNOWN	Component	True	CONSISTENT	True	-	-
	4 Cash and Cash Equivalents...	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	NOT-FOUND
	5 Cash Flow Statement, Dire...	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Net Cash Flow
	6 Income Statement	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Net Income (Loss)
	7 Inventories [Roll Forward]	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Inventories
	8 Liabilities and Equity [Roll Up]	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Liabilities and Equity
	9 Long-Term Debt [Roll Forw...	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Long-term Debt
	10 Property, Plant, and Equip...	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Property, Plant and Equipment
	11 Receivables [Roll Forward]	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Receivables
	12 Retained Earnings [Roll For...	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Retained Earnings

In summary, what is being shown is that if a complete set of rules is provided the covers 100% of the Blocks being represented; then 100% of the report can be verified to be consistent with the expectations which are articulated within the machine-readable rules.

All this is enabled by the ability to break down an XBRL-based report into fragments that you can work with; we call these fragments Blocks.

3.13. Complete System

This document focused on the notion of Blocks. These Blocks empower the reporting checklist and disclosure mechanics functionality which is discussed within in this document.   But, to verify an XBRL-based report completely you need additional capabilities. These additional capabilities are explained in detail in the document *Chain of Capabilities Necessary to Automate Accounting Processes*[127]. The following is a summary of the chain of capabilities necessary to make sure that an XBRL-based report has been created correctly. Please refer to the other document for details:

- XBRL technical syntax consistency

- Model structure consistency

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[127] Charles Hoffman, *Chain of Capabilities Necessary to Automate Accounting Processes*, http://xbrlsite.azurewebsites.net/2018/Library/ChainOfCapabilities.pdf

- Reporting styles
- Continuity cross-checks
- Types
- Reporting checklist
- Disclosure mechanics
- Manual review of non-automatable tasks

As you can see the reporting checklist and disclosure mechanics functionality is included in the necessary chain of capabilities.

As is explained in the document *Leveraging the Theoretical and Mathematical Underpinnings of a Financial Report*[128]; a financial report can be explained using mathematics and logic.

If you think beyond individual financial reports and the need to exchange information, while I understand less about ideas such as digital distributed ledgers, smart contracts, triple-entry accounting[129]; those ideas will certainly play a major role in a complete system which leverages these technologies of a digital environment.

Part of this system must, most likely, include the independent audit. Visionaries such as Jun Dai and Miklos Vasarhelyi of Rutgers University in their papers *Imagineering Audit 4.0*[130] and *Toward Blockchain-Based Accounting and Assurance*[131], foresee new techniques that leverage technology to make audits better, faster, and cheaper.

Techniques for managing quality by manufacturing companies exist and have been effectively used to control quality. These same techniques can be used in accounting, reporting, auditing, and analysis in a digital environment.

Lean Six Sigma[132] is a discipline that combines the problem solving methodologies and quality enhancement techniques of Six Sigma with the process improvement tools and efficiency concepts of Lean Manufacturing. Born in the manufacturing sector, Lean Six Sigma works to produce products and services in a way that meets consumer demand without creating wasted time, money and resources.

Specifically, Lean is 'the purposeful elimination of wasteful activities.' It focuses on making process throughout an organization faster, which effects production over a period of time. Six Sigma works to develop a measurable process that is nearly flawless in terms of defects, while improving quality and removing as much variation as possible from the system.

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[128] Charles Hoffman, *Leveraging the Theoretical and Mathematical Underpinnings of a Financial Report*, http://xbrlsite.azurewebsites.net/2018/Library/TheoreticalAndMathematicalUnderpinningsOfFinancialRepor t.pdf

[129] Charles Hoffman, *Digital Distributed Ledgers+Smart Contracts+XBRL*, http://xbrlsite.azurewebsites.net/2018/Library/DistributedLedgersSmartContractsXBRL.pdf

[130] Jun Dai and Miklos Vasarhelyi, *Imagineering Audit 4.0*, http://aaajournals.org/doi/abs/10.2308/jeta-10494

[131] Jun Dai and Miklos Vasarhelyi, *Toward Blockchain-Based Accounting and Assurance*, http://aaajournals.org/doi/10.2308/isys-51804

[132] *Comprehensive Introduction to Lean Six Sigma for Professional Accountants*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part01_C hapter02.72_LeanSixSigma.pdf

While financial report quality control is generally extremely high, it is also extremely manual in nature. The modern finance platform[133] will use the techniques of Lean Six Sigma to measure and automate accounting, reporting, auditing, and analysis processes.

Putting all these pieces together will make the old-school approaches to creating and auditing a financial report look barbaric.

3.14. Conclusion

The Block is a notion that is used as a matter of convenience. Employed correctly, Blocks can be used to enable functionality which can be achieved in no other way. While the technique of employing Blocks was shown in the narrow context of creating XBRL-based financial reports; these same ideas are applicable to the broader arena of accounting process automation.

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[133] *The Modern Finance Platform*,
http://xbrl.squarespace.com/journal/2018/7/15/the-modern-finance-platform.html