

# Digital Financial Reporting Proof of Semantics

## *Understanding representations of financial information represented using the XBRL technical syntax*

By Charles Hoffman, CPA ([Charles.Hoffman@me.com](mailto:Charles.Hoffman@me.com))

Last Revised – February 28, 2020 (DRAFT)

“The things that we should do are: the things that need to be done, the things you see that need to be done, and the things no one else thinks need to be done.” *Richard Buckminster Fuller*<sup>1</sup>

### **Executive summary:**

- This document proves another layer of conceptual meaning of XBRL-based financial information, building on the accounting equation example representation, the SFA6 *Elements of Financial Statements* example representation, and the concept arrangement patterns found in financial reports.
- Four XBRL processors and XBRL formula processors reach the same conclusions as to the semantics represented in the provided XBRL-based representation.
- All known concept arrangement patterns tested work as expected individually but more importantly work together as a holistic unit within one report.

---

<sup>1</sup> WikiQuotes, Richard Buckminster Fuller, [https://simple.wikiquote.org/wiki/Richard\\_Buckminster\\_Fuller](https://simple.wikiquote.org/wiki/Richard_Buckminster_Fuller)

### **Copyright (full and complete release of copyright)**

All content of this document is placed in the public domain. I hereby waive all claim of copyright in this work. This work may be used, altered or unaltered, in any manner by anyone without attribution or notice to me. To be clear, I am granting full permission to use any content in this work in any way you like. I fully and completely release all my rights to any copyright on this content. If you feel like distributing a copy of this work, you may do so without attribution or payment of any kind. All that said, attribution is appreciated should one feel so compelled. The copyrights of other works referenced by this document are established by the referenced work.

This document builds on the base created by the accounting equation represented in XBRL<sup>2</sup> and the FASB's SFAC 6 *Elements of Financial Statements* represented in XBRL<sup>3</sup>. This example which I am referring to as the **Proof** example expands the significantly simpler logical systems represented by the accounting equation and SFAC 6, expanding the simple example enough to include 100% of the known information patterns which I refer to as concept arrangement patterns<sup>4</sup>, testing the set together in one report for the purpose to both test and demonstrate the logic at play within a financial report.

You can download a zip file<sup>5</sup> that contains all of the XBRL examples or the human-readable representation of the example<sup>6</sup>. The home page for this information can be found here<sup>7</sup>. You can download the tool used to generate this prototype here<sup>8</sup>.

## Concept Arrangement Patterns

The *US GAAP Financial Reporting Taxonomy Architecture*<sup>9</sup> decomposes a report into "fragments" and "schedules" and finally into "facts". 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 Architecture Term
A <b>report</b> is information published by a reporting entity at some point in time for some purpose.	Report	Financial Report
A <b>fragment</b> is a set of one to many fact sets which go together for some specific purpose within a report.	Fragment	Report Fragment
A <b>fact set</b> 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

<sup>2</sup> Accounting Equation represented in XBRL, <http://xbrlsite.azurewebsites.net/2020/core/master-ae/>

<sup>3</sup> FASB's SFAC 6 *Elements of Financial Statements* represented in XBRL, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/>

<sup>4</sup> Concept Arrangement Patterns, [http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02\\_Chapter05.7a\\_ConceptArrangementPatterns.pdf](http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.7a_ConceptArrangementPatterns.pdf)

<sup>5</sup> Proof, ZIP file download, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/proof.zip>

<sup>6</sup> Proof, Human readable representation, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package.zip>

<sup>7</sup> Proof, Index page, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/index.html>

<sup>8</sup> Download database application, <http://xbrlsite-app.azurewebsites.net/Proof/Download.aspx>

<sup>9</sup> FASB, *US GAAP Financial Reporting Taxonomy Architecture*, Figure 6. Many-to-Many Relationship Between Fragments and Facts, page 13, [https://www.fasb.org/cs/ContentServer?c=Document\\_C&cid=1176163689810&d=&pagename=FASB%2FDocument\\_C%2FDocumentPage](https://www.fasb.org/cs/ContentServer?c=Document_C&cid=1176163689810&d=&pagename=FASB%2FDocument_C%2FDocumentPage)

A <b>fact</b> 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
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------	------

The analysis of a set of 6,023 XBRL-based financial reports submitted to the SEC by public companies revealed:

- Total reports: 6,023
- Total facts reported: 8,532,275
- Average number of facts per report: 1,416
- Total number of networks in all reports: 462,786
- Average number of networks per report: 77
- Total number of fact sets in all reports: **754,430**
- Average number of fact sets per report: 125
- Average number of fact sets per network: 1.6
- Average facts per network: 18
- Average facts per fact set: 11

So, the actual average size of the pieces of a report are quite small. Information is skewed a bit by the relatively large number of Level 1, Level 2, and Level 3 text blocks.

Networks are too big to work with because they can contain multiple hypercubes (a.k.a. [Table]s). Even hypercubes are too big to work with because those creating reports tend to construct the hypercubes in arbitrary ways. Facts themselves are too small to work with.

But there is a magical fragment “unit” that is just right. I call this magical unit of a financial report the “Block” or the “Fact Set”. I will use the term Fact Set in this document. Each Fact Set can be described by what I call a concept arrangement pattern.

Of the **754,430** Fact Sets found in the 6,023 reports that I interrogated using automated machine-based processes, there were:

- **Text Blocks:** 407,392 (54%) are text blocks (Level 1 Notes, Level 2 Policies, Level 3 Disclosures)
- **Sets:** 181,063 (24%) are sets (or hierarchies, no mathematical computations)
- **Roll Ups:** 120,708 (16%) are roll ups
- **Roll Forwards:** 37,721 (5%) are roll forwards
- **Other (including Roll Forward Info, Adjustment, Variance):** 7,546 (1%) are Roll Forward Infos or something else

But every fragment of every XBRL-based financial report can be described by its concept arrangement pattern of the Fact Set which makes up the fragment. The concept arrangement

pattern is simply the pattern of the arrangement of the contents of the [Line Items] (a.k.a. primary items) of the report. Only Concepts or [Abstract]s can exist within a set of [Line Items].

What the **Proof** does is put all of those possible concept arrangement patterns into one XBRL taxonomy schema, set of XBRL linkbases, set of XBRL formulas, and XBRL instance and constructs a provably properly functioning logical system. The purpose of this is to verify that each of the concept arrangement patterns have been created logically and interact with all other concept arrangement patterns within an XBRL-based digital financial report.

## Proof Built on Accounting Equation and SFAC 6

The FASB's SFAC 6 *Elements of Financial Statements* is part of the conceptual framework<sup>10</sup> which defines the US GAAP financial reporting scheme<sup>11</sup> and has the accounting equation model at its core. The accounting equation is:

$$\text{“Assets = Liabilities + Equity”}$$

SFAC 6 defines 10 interrelated elements of US GAAP financial statements (**terms**) that are directly related to measuring performance and status of an economic entity and used in the preparation of a general purpose financial report: Assets, Liabilities, Equity, Comprehensive income, Investments by Owners, Distributions to Owners, Revenues, Expenses, Gains, Losses.

SFAC 6 defines additional assertions (a.k.a. rules). The FASB explicitly states the components of comprehensive income which include: Revenues, Expenses, Gains, and Losses<sup>12</sup>.

$$\text{“Comprehensive Income = Revenues - Expenses + Gains - Losses”}$$

The equation above defines the relationship between comprehensive income and its components. The equation below defines the relations between the other concepts and uses the components of “Comprehensive Income” as defined above.

$$0 = (\text{Equity}^{\text{T0}} + \text{Revenue}^{\text{P1}} - \text{Expenses}^{\text{P1}} + \text{Gains}^{\text{P1}} - \text{Losses}^{\text{P1}} + \text{InvestmentsByOwners}^{\text{P1}} - \text{DistributionsToOwners}^{\text{P1}}) + \text{Liabilities}^{\text{T1}} - \text{Assets}^{\text{T1}}$$

The above rule can be condensed down to a basic roll forward of Equity as follows (the rule above is not really necessary and is replaced by this equation):

---

<sup>10</sup> FASB, *Conceptual Framework*, <https://www.fasb.org/jsp/FASB/Page/BridgePage&cid=1176168367774>

<sup>11</sup> Charles Hoffman, CPA, *Comparison of Financial Reporting Schemes High Level Concepts*, <http://xbrlsite.azurewebsites.net/2018/Library/ReportingSchemes-2018-12-30.pdf>

<sup>12</sup> FASB, SFAC 6, page 21, paragraph 20

$$\text{Equity}^{T1} = \text{Equity}^{T0} + \text{ComprehensiveIncome}^{P1} + \text{InvestmentsByOwners}^{P1} - \text{DistributionsToOwners}^{P1}$$

Finally, while not explicitly defined in SFAC 6, the FASB is certainly strongly implying the existence of “financial statements” that provide information about the “status” and “performance” of an economic entity and as we pointed out before that the status and performance are intertwined per the notion of articulation. This at least implies the structures:

- Balance sheet (i.e. status as of a point in time)
- Income statement (i.e. performance over a period of time)
- Changes in equity (i.e. connects the balance sheet to the income statement per the roll forward of the “Equity” account)

With that information, an economic entity can create a financial statement that communicate **facts** about that economic entity. For example, I will use the imaginary economic entity “ABC Company” and represent their facts as follows:

- Assets= \$0 as of December 31, 2019; \$3,500 as of December 31, 2020
- Liabilities= \$0 as of December 31, 2019; \$0 as of December 31, 2020
- Equity= \$0 as of December 31, 2019; \$3,500 as of December 31, 2020
- Comprehensive income = \$3,000 for the period January 1, 2020 to December 31, 2020
- Investments by Owners = \$1,000 for the period January 1, 2020 to December 31, 2020
- Distributions to Owners = \$500 for the period January 1, 2020 to December 31, 2020
- Revenues = \$7,000 for the period January 1, 2020 to December 31, 2020
- Expenses = \$3,000 for the period January 1, 2020 to December 31, 2020
- Gains = \$1,000 for the period January 1, 2020 to December 31, 2020
- Losses = \$2,000 for the period January 1, 2020 to December 31, 2020

As such, in more visual terms and adding **facts** to instantiate these terms, **associations** of the terms to form **structures**, and **assertions** (a.k.a. rules) to be sure everything connects mathematically as expected into something that might represent the core of a set of financial statements you have the following:

Shell of a **balance sheet**<sup>13</sup> which measures status:

---

<sup>13</sup> Human readable rendering of balance sheet, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-NO-RE5.html>

**CC0 1.0 Universal (CC0 1.0)  
Public Domain Dedication**

CC0 1.0 Universal (CC0 1.0) Public Domain Dedication <https://creativecommons.org/publicdomain/zero/1.0/>

<b>Component: (Network and Table)</b>	
Network	<b>01-Balance Sheet</b> ( <a href="http://www.xbrlsite.com/sfac6/role/BalanceSheet">http://www.xbrlsite.com/sfac6/role/BalanceSheet</a> )
Table	Balance Sheet [Hypercube]

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

Reporting Entity [Axis]	GH259400TOMPUOLS65II ( <a href="http://standards.iso.org/iso/17442">http://standards.iso.org/iso/17442</a> )
-------------------------	--------------------------------------------------------------------------------------------------------------

Balance Sheet [Line Items]	Period [Axis]	
	2020-12-31	2019-12-31
<b>Balance Sheet [Arithmetic Expression]</b>		
Assets	3,500	0
Liabilities	0	0
Equity	3,500	0

Shell of a **comprehensive income** statement<sup>14</sup> which measures performance:

<b>Component: (Network and Table)</b>	
Network	<b>02-Comprehensive Income</b> ( <a href="http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome">http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome</a> )
Table	Comprehensive Income Statement [Hypercube]

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

Reporting Entity [Axis]	GH259400TOMPUOLS65II ( <a href="http://standards.iso.org/iso/17442">http://standards.iso.org/iso/17442</a> )
-------------------------	--------------------------------------------------------------------------------------------------------------

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

Shell of **changes in equity**<sup>15</sup> which connects the income statement to the balance sheet:

<sup>14</sup> Human readable rendering of comprehensive income statement, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-proof\\_ComprehensiveIncomeStatementHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-proof_ComprehensiveIncomeStatementHypercube.html)

<sup>15</sup> Human readable rendering of changes in equity, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ChangesInEquity-proof\\_ChangesInEquityHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ChangesInEquity-proof_ChangesInEquityHypercube.html)

Component: (Network and Table)	
Network	<b>03-Changes in Equity</b> ( <a href="http://www.xbrlsite.com/sfac6/role/ChangesInEquity">http://www.xbrlsite.com/sfac6/role/ChangesInEquity</a> )
Table	Changes in Equity [Hypercube]

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

Reporting Entity [Axis]	GH259400TOMPUOLS65II ( <a href="http://standards.iso.org/iso/17442">http://standards.iso.org/iso/17442</a> )
-------------------------	--------------------------------------------------------------------------------------------------------------

Changes in Equity [Line Items]	Period [Axis]
	2020-01-01 - 2020-12-31
<b>Changes in Equity [Roll Forward]</b>	
Equity, Beginning Balance	0
Comprehensive Income	3,000
Investments by Owners	1,000
(Distributions to Owners)	(500)
Equity, Ending Balance	3,500

The rules (a.k.a. assertions) that show that everything ticks and ties numerically per the four rules represented. (Note that the balance sheet rule is executed twice, once for the beginning and again for the ending balance.)

id	satisfied	message
CONSISTENCY_5 (evaluation 1)	satisfied	$\$Assets=3500 = (\$Liabilities=0 + \$Equity=3500)$
CONSISTENCY_5 (evaluation 2)	satisfied	$\$Assets=0 = (\$Liabilities=0 + \$Equity=0)$
CONSISTENCY_6 (evaluation 1)	satisfied	$\$ComprehensiveIncome=3000 = (\$Revenues=7000 - \$Expenses=3000 + \$Gains=1000 - \$Losses=2000)$
RollForward_1 (evaluation 1)	satisfied	$\$Equity\_BalanceStart=0 + \$ComprehensiveIncome=3000 + \$InvestmentsByOwners=1000 - \$DistributionsToOwners=500 = \$Equity\_BalanceEnd=3500$
ASSERTION_SFAC6_CONCEPTUAL_FRAMEWORK_RECONCILIATION (evaluation 1)	satisfied	$0 = ((\$Equity\_BalanceStart=0 + ((\$Revenues=7000 - \$Expenses=3000) + (\$Gains=1000 - \$Losses=2000))) + (\$InvestmentsByOwners=1000 - \$DistributionsToOwners=500)) + (\$Liabilities\_BalanceEnd=0 - \$Assets\_BalanceEnd=3500))$

I am not going to provide a cash flow statement yet because SFAC 6 does not discuss the cash flow statement but we all know there are four primary financial statements rather than three. See the next iteration, *Common Elements of Financial Statements*<sup>16</sup>, which will include the cash flow statement.

The four statement (we are using three of the four) model shows the explicitly created **articulation** or the interrelationships between the three primary financial statements defined by the FASB in SFAC 6. However, since net cash flow is not defined by SFAC 6 we can only represent the interrelationships of three of the four statements: balance sheet, income

<sup>16</sup> Common Elements of Financial Statements, <http://xbrlsite.azurewebsites.net/2019/core/master-elements/>





statements for capturing meaning or representing a shared understanding of and knowledge in some universe of discourse.

As I have explained, a logical system or logical theory is made up of a sets of logical statements that describe the **models, structures, terms, associations, assertions, and facts** of the logical system. In very simple terms,

- **Logical theory:** A logical theory is a set of *models* that are consistent with that logical theory.
- **Model:** A model is a set of *structures*. A model is a permissible interpretation of a theory.
- **Structure:** A structure is a set of *statements* which describe the structure.
- **Statement:** A statement is a proposition, claim, assertion, belief, idea, or fact about or related to the universe of discourse. There are four broad categories of statements:
  - **Terms:** (a.k.a. report elements) Terms are statements that define ideas used by the logical theory such as the ideas “assets”, “liabilities”, and “equity”.
  - **Associations:** (a.k.a. relations) Associations are statements that describe permissible interrelationships between the terms such as “assets is part-of the balance sheet” or “assets = liabilities + equity” or “an asset is a ‘debit’ and is ‘as of’ a specific point in time and is always a monetary numeric value”.
  - **Assertions:** (a.k.a. rules) Assertions are statements that describe what tend to be IF...THEN...ELSE types of relationships such as “IF the economic entity is a not-for-profit THEN net assets = assets - liabilities; ELSE assets = liabilities + equity”
  - **Facts:** (a.k.a. items) Facts are statements about the numbers and words that are provided by an economic entity within their financial report. For example, “assets for the consolidated legal entity Microsoft as of June 20, 2017 was \$241,086,000,000 expressed in US dollars and rounded to the nearest millions of dollars.

The statements of a logical system which describes a logical system can be **consistent** or inconsistent (i.e. they can contradict one another). A logical system can have high to low **precision** and high to low **coverage**. *Precision* is a measure of how precisely the information within a logical system has been represented as contrast to reality for the universe of discourse. *Coverage* is a measure of how completely information in a logical system has been represented relative to the reality for a universe of discourse. If a logical system is consistent, has high precision, and has high coverage it is said to be a properly functioning logical system.

Finally, nothing about this logical system is a “black box”. The innerworkings are logical, they are clear, and humans can understand what is being expressed because they understand the rules of the logic and they understand the terminology being used to explain the logical system.

Information about the logical system in machine-readable form is knowable. And so, if any of this is explained in machine-readable terms it must be done so using auditable algorithms that are explainable to humans. Algorithms, including artificial intelligence, used by the enterprise or for accounting, reporting, auditing, and analysis needs to be explainable artificial intelligence. Explainable AI<sup>21</sup> (XAI) provides insight into how the software algorithms reached its conclusions, an understandable “line of reasoning” so to speak.

And so, SFAC 6 is a logical system that can be represented in machine-readable terms and tested using machine-based algorithms. The FASB’s SFAC 6 *Elements of Financial Statements* provides key information that enables the exchange of complex financial information<sup>22</sup>. This SFAC 6 logical system is a demonstration of how XBRL-based digital financial reporting works<sup>23</sup>. The Proof logical system makes incremental additions to the base SFAC 6 logical system which no professional accountant would likely disagree are necessary to represent a complete financial report. We are not holding that all possible additions have been added at this point; we are simply asserting that what we are adding is necessary.

## PROPERLY FUNCTIONING: CONSISTENT, PRECISE, AND COMPLETE:

The logical system can be called **properly functioning** because all of the statements within the logical system are **consistent** with one another (i.e. there are no contradictions, there are no inconsistencies), it can be established that the logical system created **precisely** reflects the reality of the SFAC 6 logical system (remember, we just made the numbers up for ABC Company), and a **complete** set of statements seem to be included within the logical system per the logical information provided by the FASB within SFAC 6 (i.e. the terms, associations, assertions, structures defined in SFAC 6).

A software application can take all of the logical statements made within the machine-readable version of this logical system and perform work.

The logical system of SFAC 6 is therefore *consistent*, *precise*, and *complete* because all the statements are consistent with one another within the logical system, the logical system

---

<sup>21</sup> ACCA, Narayanan Vaidyanathan, *Explainable AI: Putting the user at the core*,

[https://www.accaglobal.com/uk/en/professional-insights/technology/Explainable\\_AI.html](https://www.accaglobal.com/uk/en/professional-insights/technology/Explainable_AI.html)

<sup>22</sup> Charles Hoffman, CPA, *Special Theory of Machine-based Automated Communication of Semantic Information of Financial Statements*,

<http://xbrl.azurewebsites.net/2019/Library/SpecialTheoryOfSemanticCommunicationOfFinancialInformation.pdf>

<sup>23</sup> *Digital Financial Reporting: The Big Picture in Pictures*, <http://xbrl.squarespace.com/journal/2020/2/21/digital-financial-reporting-the-big-picture-in-pictures.html>

reflects the formal truths we wish to convey precisely, and a complete set of statements describe the logical system.

This graphic below shows a synopsis of the information and we can look at this synopsis and see that the logical system appears to be properly functioning because this is a relatively simple logical system with a limited amount of information being communicated:

**Consistent**

**Complete**

**Precise**

Assets = 3,500<sup>T1</sup>; 0<sup>T0</sup>

Liabilities = 0<sup>T1</sup>; 0<sup>T0</sup>

Equity = 3,500<sup>T1</sup>; 0<sup>T0</sup>

Revenues = 7,000

Expenses = 3,000

Gains = 1,000

Losses = 2,000

Comprehensive income = 3,000

Investments by Owners = 1,000

Distributions to Owners = 500

Assets = Liabilities + Equity

Comprehensive Income =  
Revenues - Expenses + Gains - Losses

Equity<sup>T1</sup> = Equity<sup>T0</sup> + Comprehensive  
Income<sup>P1</sup> + Investments by Owners<sup>P1</sup> -  
Distributions to Owners<sup>P1</sup>

Balance Sheet (Abstract)	Period (Axis)	
	2020-12-31	2019-12-31
Assets	3,500	0
Liabilities	0	0
Equity	3,500	0

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

Changes in Equity (Abstract)	Period (Axis)	
	2020-01-01 - 2020-12-31	
Equity (Roll Forward)		
Equity, Beginning	0	
Comprehensive Income	3,000	
Investments by Owners	1,000	
(Distributions to Owners)	(500)	
Equity, Ending	3,500	

Balance Sheet (Abstract)	Period (Axis)	
	2020-12-31	2019-12-31
Assets	3,500	0
Liabilities	0	0
Equity	3,500	0

Changes in Equity (Abstract)	Period (Axis)	
	2020-01-01 - 2020-12-31	
Equity (Roll Forward)		
Equity, Beginning	0	
Comprehensive Income	3,000	
Investments by Owners	1,000	
(Distributions to Owners)	(500)	
Equity, Ending	3,500	

And so, above we have shown one permissible interpretation or model of the SFAC 6 logical system that is consistent with our logical theory. This logical theory can be proven by representing the information in XBRL and then processing that machine-readable system using software applications that understand that XBRL-based representation.

The Proof logical system uses the SFAC 6 logical system as its base and expands that base incrementally to add necessary functionality required to represent financial reports effectively.

## Keeping the Logical System Properly Functioning

So, we have proven that the accounting equation logical system is properly functioning and that the SFAC 6 logical system is properly functioning; however, there is much more to a financial report than exist within those two small, tiny really, logical systems.

In the next section we are going to add important and necessary pieces to the provably properly functioning logical system and keep that system consistent, complete, and precise and provably properly functioning.

Prior to adding additional pieces, the mathematical relations were all reported to be consistent. After adding all the additional pieces, the XBRL Formula results should likewise be consistent.

Below you can see the XBRL Formula validation results provided by four different XBRL Formula processors, each of which reports 11 assertions having been defined, 14 assertions have then executed, and of the 14 executed all 14 are reported to be satisfied per each of the four XBRL Formula processors.

Those results are summarized below:

### UBmatrix XPE 4.0:

Thu Feb 27 15:49:50 PST 2020

XBRL Processor Version:4.0.0.2125

Report name: Detailed Output

#### Summary

Formulas Compiled	Formula Fired	Assertions Compiled	Assertions Fired	Assertions Satisfied	Assertions Not Satisfied
0	0	11	14	14	0

#### Assertion Report

##### Value Assertions

id	satisfied	message
CONSISTENCY_AccountingEquation (evaluation 1)	satisfied	\$Assets=0 = (\$Liabilities=0 + \$Equity=0)
CONSISTENCY_AccountingEquation (evaluation 2)	satisfied	\$Assets=3500 = (\$Liabilities=0 + \$Equity=3500)
CONSISTENCY_ComprehensiveIncome (evaluation 1)	satisfied	\$ComprehensiveIncome=3000 = (\$Revenues=7000 - \$Expenses=3000 + \$Gains=1000 - \$Losses=2000)
CONSISTENCY_ComprehensiveIncome (evaluation 2)	satisfied	\$ComprehensiveIncome=3750 = (\$Revenues=6000 - \$Expenses=2000 + \$Gains=750 - \$Losses=1000)
CONSISTENCY_ComprehensiveIncome (evaluation 3)	satisfied	\$ComprehensiveIncome=-750 = (\$Revenues=1000 - \$Expenses=1000 + \$Gains=250 - \$Losses=1000)
RollForward_Equity (evaluation 1)	satisfied	\$Equity_BalanceStart=0 + \$ComprehensiveIncome=3000 + \$InvestmentsByOwners=1000 - \$DistributionsToOwners=500 = \$Equity_BalanceEnd=3500
CONSISTENCY_SFAC6_Conceptual_Framework_Reconciliation (evaluation 1)	satisfied	0 = ((\$Equity_BalanceStart=0 + ((\$Revenues=7000 - \$Expenses=3000) + (\$Gains=1000 - \$Losses=2000)) + (\$InvestmentsByOwners=1000 - \$DistributionsToOwners=500)) + (\$Liabilities_BalanceEnd=0 - \$Assets_BalanceEnd=3500))
VARIANCE_Revenues (evaluation 1)	satisfied	\$Actual=7000 = (\$Budget=6000 + \$Variance=1000)
VARIANCE_Expenses (evaluation 1)	satisfied	\$Actual=3000 = (\$Budget=2000 + \$Variance=1000)
VARIANCE_Gains (evaluation 1)	satisfied	\$Actual=1000 = (\$Budget=750 + \$Variance=250)
VARIANCE_Losses (evaluation 1)	satisfied	\$Actual=2000 = (\$Budget=1000 + \$Variance=1000)
VARIANCE_ComprehensiveIncome (evaluation 1)	satisfied	\$Actual=3000 = (\$Budget=3750 + \$Variance=-750)
MemberAggregation_SegmentRevenues (evaluation 1)	satisfied	SATISFIED: (OK) The reported total 7000 for the concept proof: Revenues agrees to the aggregate of each reported member.
Adjustment_Reconciles_EquityPriorPeriodAdjustments (evaluation 1)	satisfied	\$Restated=0 = (\$OriginallyStated=2000 + \$CorrectionOfError=-1500 + \$MandatoryAccountingChange=-500)

## XBRL Cloud Evidence Package:

### Assertions Summary

	Defined	Executed	Pass	Fail
Existence assertions	0	0	0	0
Value assertions	11	14	14	0
Consistency assertions	0	0	0	0
<b>Total all assertions</b>	<b>11</b>	<b>14</b>	<b>14</b>	<b>0</b>

#	Label	Result	Rule
1	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$ (CONSISTENCY_ComprehensiveIncome)	Pass	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$
2	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$ (CONSISTENCY_ComprehensiveIncome)	Pass	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$
3	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$ (CONSISTENCY_ComprehensiveIncome)	Pass	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$
4	$\$Actual = (\$Budget + \$Variance)$ (VARIANCE_Expenses)	Pass	$\$Actual = (\$Budget + \$Variance)$
5	$\$Actual = (\$Budget + \$Variance)$ (VARIANCE_ComprehensiveIncome)	Pass	$\$Actual = (\$Budget + \$Variance)$
6	$\$Actual = (\$Budget + \$Variance)$ (VARIANCE_Revenues)	Pass	$\$Actual = (\$Budget + \$Variance)$
7	Adjustment reconciles: originally stated balance + adjustments restated balance across the Report Date [Axis] (Adjustment_Reconciles_EquityPriorPeriodAdjustments)	Pass	$\$Restated = (\$OriginallyStated + \$CorrectionOfError + \$MandatoryAccountingChange)$
8	$\$Equity\_BalanceStart + \$ComprehensiveIncome + \$InvestmentsByOwners - \$DistributionsToOwners = \$Equity\_BalanceEnd$ (RollForward_Equity)	Pass	$\$Equity\_BalanceStart + \$ComprehensiveIncome + \$InvestmentsByOwners - \$DistributionsToOwners = \$Equity\_BalanceEnd$
9	$\$Assets = (\$Liabilities + \$Equity)$ (CONSISTENCY_AccountingEquation)	Pass	$\$Assets = (\$Liabilities + \$Equity)$
10	$\$Assets = (\$Liabilities + \$Equity)$ (CONSISTENCY_AccountingEquation)	Pass	$\$Assets = (\$Liabilities + \$Equity)$
11	SATISFIED: (OK) The reported total 7000 for the concept proof:Revenues agrees to the aggregate of each reported member. (MemberAggregation_SegmentRevenues)	Pass	$\$Total\ eq\ sum(\$Each)$
12	$0 = (\$Equity\_TO) + (\$Revenue(P1) - \$Expenses(P1) + \$Gains(P1) - \$Losses(P1)) + (\$InvestmentsByOwners(P1) - \$DistributionsToOwners(P1))) + \$Liabilities(T1) - \$Assets(T1)$ (CONSISTENCY_SFAC6_Conceptual_Framework_Reconciliation)	Pass	$0 = ((\$Equity\_BalanceStart + (\$Revenues - \$Expenses) + (\$Gains - \$Losses)) + (\$InvestmentsByOwners - \$DistributionsToOwners)) + (\$Liabilities\_BalanceEnd - \$Assets\_BalanceEnd)$
13	$\$Actual = (\$Budget + \$Variance)$ (VARIANCE_Gains)	Pass	$\$Actual = (\$Budget + \$Variance)$
14	$\$Actual = (\$Budget + \$Variance)$ (VARIANCE_Losses)	Pass	$\$Actual = (\$Budget + \$Variance)$

## Fujitsu XWand:

No. ID	Type	Expression	Element	Context	Unit	Value
1	CONSISTENCY_AccountingEquation	$\$Assets = (\$Liabilities + \$Equity)$	-	-	-	true
2	CONSISTENCY_AccountingEquation	$\$Assets = (\$Liabilities + \$Equity)$	-	-	-	true
3	CONSISTENCY_ComprehensiveIncome	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$	-	-	-	true
4	CONSISTENCY_ComprehensiveIncome	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$	-	-	-	true
5	CONSISTENCY_ComprehensiveIncome	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$	-	-	-	true
6	RollForward_Equity	$\$Equity\_BalanceStart + \$ComprehensiveIncome + \$InvestmentsByOwners - \$DistributionsToOwners = \$Equity\_BalanceEnd$	-	-	-	true
7	CONSISTENCY_SFAC6_Conceptual_Framework_Reconciliation	$0 = ((\$Equity\_BalanceStart + (\$Revenues - \$Expenses) + (\$Gains - \$Losses)) + (\$InvestmentsByOwners - \$DistributionsToOwners)) + (\$Liabilities\_BalanceEnd - \$Assets\_BalanceEnd)$	-	-	-	true
8	VARIANCE_Revenues	$\$Actual = (\$Budget + \$Variance)$	-	-	-	true
9	VARIANCE_Expenses	$\$Actual = (\$Budget + \$Variance)$	-	-	-	true
10	VARIANCE_Gains	$\$Actual = (\$Budget + \$Variance)$	-	-	-	true
11	VARIANCE_Losses	$\$Actual = (\$Budget + \$Variance)$	-	-	-	true
12	CONSISTENCY_ComprehensiveIncome	$\$Actual = (\$Budget + \$Variance)$	-	-	-	true
13	MemberAggregation_SegmentRevenues	$\$Total\ eq\ sum(\$Each)$	-	-	-	true
14	Adjustment_Reconciles_EquityPriorPeriodAdjustments	$\$Restated = (\$OriginallyStated + \$CorrectionOfError + \$MandatoryAccountingChange)$	-	-	-	true

## Arelle:

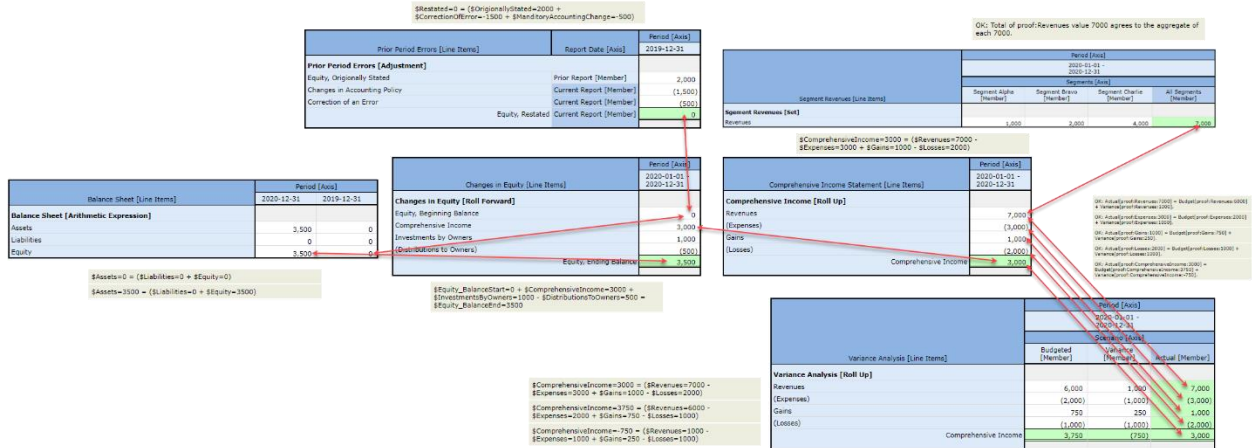
messages	Concepts
(formula:assertionSatisfied)	$\$Actual = (\$Budget + \$Variance)$ , $\$Actual$ : proof:ComprehensiveIncome context D-E2B5-4642-81CA-A478, $\$Budget$ : proof:ComprehensiveIncome context D-E2B5-4642-81CA-A478-Budget, $\$Variance$ : proof:ComprehensiveIncome context D-E2B5-4642-81CA-A478-Variance
(formula:assertionSatisfied)	$\$Actual = (\$Budget + \$Variance)$ , $\$Actual$ : proof:Expenses context D-E2B5-4642-81CA-A478, $\$Budget$ : proof:Expenses context D-E2B5-4642-81CA-A478-Budget, $\$Variance$ : proof:Expenses context D-E2B5-4642-81CA-A478-Variance - Rule-Variance-VAD01-formula.xml
(formula:assertionSatisfied)	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$ , $\$ComprehensiveIncome$ : proof:ComprehensiveIncome context D-E2B5-4642-81CA-A478, $\$Revenues$ : proof:Revenues context D-E2B5-4642-81CA-A478, $\$Expenses$ : proof:Expenses context D-E2B5-4642-81CA-A478, $\$Gains$ : proof:Gains context D-E2B5-4642-81CA-A478, $\$Losses$ : proof:Losses context D-E2B5-4642-81CA-A478
(formula:assertionSatisfied)	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$ , $\$ComprehensiveIncome$ : proof:ComprehensiveIncome context D-E2B5-4642-81CA-A478, $\$Expenses$ : proof:Expenses context D-E2B5-4642-81CA-A478, $\$Gains$ : proof:Gains context D-E2B5-4642-81CA-A478, $\$Losses$ : proof:Losses context D-E2B5-4642-81CA-A478
(formula:assertionSatisfied)	$\$Assets = (\$Liabilities + \$Equity)$ , $\$Assets$ : proof:Assets context I-99F9-4C9C-8C6C-BE7C, $\$Equity$ : proof:Equity context I-99F9-4C9C-8C6C-BE7C, $\$Liabilities$ : proof:Liabilities context I-99F9-4C9C-8C6C-BE7C - Rule-Consistency-B501-formula.xml 77, instance.xml
(formula:assertionSatisfied)	$\$Assets = (\$Liabilities + \$Equity)$ , $\$Assets$ : proof:Assets context I-5251-4725-9160-E873, $\$Equity$ : proof:Equity context I-5251-4725-9160-E873, $\$Liabilities$ : proof:Liabilities context I-5251-4725-9160-E873 - Rule-Consistency-B501-formula.xml 77, instance.xml 142
(formula:assertionSatisfied)	$\$Actual = (\$Budget + \$Variance)$ , $\$Actual$ : proof:Revenues context D-E2B5-4642-81CA-A478, $\$Budget$ : proof:Revenues context D-E2B5-4642-81CA-A478-Budget, $\$Variance$ : proof:Revenues context D-E2B5-4642-81CA-A478-Variance - Rule-Variance-VAD01-formula.xml
(formula:assertionSatisfied)	$\$Actual = (\$Budget + \$Variance)$ , $\$Actual$ : proof:Losses context D-E2B5-4642-81CA-A478, $\$Budget$ : proof:Losses context D-E2B5-4642-81CA-A478-Budget, $\$Variance$ : proof:Losses context D-E2B5-4642-81CA-A478-Variance - Rule-Variance-VAD01-formula.xml 382
(message:MemberAggregation_SegmentRevenues)	SATISFIED: (OK) The reported total 7000 for the concept proof:Revenues agrees to the aggregate of each reported member. - Rule-MemberAggregation-formula.xml 73
(formula:assertionSatisfied)	$\$Revenues$ for each segment member foots to total, $\$Each$ : proof:Revenues context D-E2B5-4642-81CA-A478-Alpha, $\$Total$ : proof:Revenues context D-E2B5-4642-81CA-A478 - Rule-MemberAggregation-formula.xml 73, instance.xml 154, 174, 175
(formula:assertionSatisfied)	$\$Equity\_BalanceStart + \$ComprehensiveIncome + \$InvestmentsByOwners - \$DistributionsToOwners = \$Equity\_BalanceEnd$ , $\$Equity\_BalanceStart$ : proof:Equity context D-E2B5-4642-81CA-A478, $\$ComprehensiveIncome$ : proof:ComprehensiveIncome context D-E2B5-4642-81CA-A478, $\$InvestmentsByOwners$ : proof:InvestmentsByOwners context D-E2B5-4642-81CA-A478, $\$DistributionsToOwners$ : proof:DistributionsToOwners context D-E2B5-4642-81CA-A478
(formula:assertionSatisfied)	$\$Actual = (\$Budget + \$Variance)$ , $\$Actual$ : proof:Gains context D-E2B5-4642-81CA-A478, $\$Budget$ : proof:Gains context D-E2B5-4642-81CA-A478-Budget, $\$Variance$ : proof:Gains context D-E2B5-4642-81CA-A478-Variance - Rule-Variance-VAD01-formula.xml 281, 14
(formula:assertionSatisfied)	Adjustment reconciles: originally stated balance + adjustments restated balance across the Report Date [Axis], $\$CorrectionOfError$ : proof:ChangesInAccountingPolicy context I-5251-4725-9160-E873, $\$MandatoryAccountingChange$ : proof:CorrectionOfError context I-5251-4725-9160-E873

Here you see the interconnections between the facts that have all been verified to be consistent with expectation and mapped to the XBRL Formula validation results that are shown above<sup>24</sup>:

<sup>24</sup> Proof mathematical computations, <http://xbrl.azurewebsites.net/2020/core/master-proof/ProofMathematicalComputations.jpg>

**CCO 1.0 Universal (CCO 1.0)  
Public Domain Dedication**

CCO 1.0 Universal (CCO 1.0) Public Domain Dedication <https://creativecommons.org/publicdomain/zero/1.0/>



And so, this shows that the proof logical system is consistent, complete, and precise and therefore properly functioning.

First, I want to explain the three existing concept arrangement patterns that existed in the accounting equation and SFAC 6 logical systems for completeness. Then, I will explain the additional concept arrangement patterns that have been added in order to have a full set of all concept arrangement patterns represented within one report.

## Existing: Roll Up

One common mathematical association between numeric facts within a financial statement is the roll up. A Roll Up concept arrangement pattern is exemplified by the Comprehensive Income statement structure which looks as follows<sup>25</sup>:

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

A Roll Up is some set of items that aggregates to a total. Above, the items are Revenues, Expenses, Gains, and Losses and the total is Comprehensive Income. Items can be added to the total or subtracted from the total. All Roll Ups follow this pattern. Roll Ups can be nested within other Roll Ups to form subtotals that ultimately aggregate into a grand total. Every Roll

<sup>25</sup> Comprehensive Income, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-proof\\_ComprehensiveIncomeStatementHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-proof_ComprehensiveIncomeStatementHypercube.html)

Up is explained by machine-readable rules represented in the form of either XBRL calculation relations<sup>26</sup> or XBRL Formulas<sup>27</sup> that articulate the mathematical relation in machine-readable form.

## Existing: Roll Forward

A second very common mathematical oriented pattern of relations between numeric concepts is the Roll Forward which reconciles changes between the values of a line item for two points in time. Accounting students learn this fundamental relation by the acronym BASE which means **B**eginning balance + **A**dditions - **S**ubtractions = **E**nding balance. A Roll Forward is exemplified by the Changes in Equity structure<sup>28</sup>:

Changes in Equity [Line Items]	Period [Axis]
	2020-01-01 - 2020-12-31
<b>Changes in Equity [Roll Forward]</b>	
Equity, Beginning Balance	0
Comprehensive Income	3,000
Investments by Owners	1,000
(Distributions to Owners)	(500)
Equity, Ending Balance	3,500

Every Roll Forward can be represented in machine-readable form using XBRL Formulas<sup>29</sup>.

## Existing: Arithmetic Expression

All other mathematical relations can be represented by the Arithmetic Expression concept arrangement pattern. This mathematical pattern can simply think of as containing two parts. The first part is a set of facts. The second set of the pattern is the mathematical relations between the set of facts represented as some XBRL Formula. The Arithmetic Expression concept arrangement pattern can be exemplified by the Balance Sheet structure<sup>30</sup>:

<sup>26</sup> Comprehensive Income XBRL calculation rules for Roll Up, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/proof-cal.xml>

<sup>27</sup> Comprehensive Income XBRL Formula rules for Roll Up, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-Arithmetic-IS01-formula.xml>

<sup>28</sup> Changes in Equity, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ChangesInEquity-proof\\_ChangesInEquityHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ChangesInEquity-proof_ChangesInEquityHypercube.html)

<sup>29</sup> Changes in Equity XBRL Formula rules for Roll Forward, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-RollForward-formula.xml>

<sup>30</sup> Balance Sheet structure, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-BalanceSheet-proof\\_BalanceSheetHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-BalanceSheet-proof_BalanceSheetHypercube.html)



Balance Sheet [Line Items]	Period [Axis]	
	2020-12-31	2019-12-31
<b>Balance Sheet [Arithmetic Expression]</b>		
Assets	3,500	0
Liabilities	0	0
Equity	3,500	0

As with the Roll Forward and Roll Up, the Arithmetic Expression machine-readable rules can be represented using XBRL Formula<sup>31</sup>.

## Add: Adjustment for Correcting Prior Period Accounting Change or Error

Financial statements can be adjusted for accounting changes and/or prior period errors that are discovered and must be corrected in future reports. Generally, all such changes are run through equity in order to adjust a current financial report for a prior period change in accounting policy and/or a correction of an error.

The concept arrangement pattern created for this purpose is called an “Adjustment” and the pattern is described as a reconciliation of an originally stated balance to a restated balance by adding or subtracting specific adjustments to the originally stated balance to the restated balance. You see that example here in the Prior Period Error structure<sup>32</sup>:

Prior Period Errors [Line Items]	Report Date [Axis]	Period [Axis]
		2019-12-31
<b>Prior Period Errors [Adjustment]</b>		
Equity, Originally Stated	Prior Report [Member]	2,000
Changes in Accounting Policy	Current Report [Member]	(1,500)
Correction of an Error	Current Report [Member]	(500)
Equity, Restated	Current Report [Member]	0

What can be tricky to understand about this representation is that the above restated balance is the exact same fact as the beginning balance of equity in the changes in equity fact set<sup>33</sup>:

<sup>31</sup> Balance Sheet XBRL Formula rules, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-Consistency-BS01-formula.xml>

<sup>32</sup> Prior Period Errors, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-PriorPeriodErrors-proof> [PriorPeriodErrorsHypercube.html](#)

<sup>33</sup> Changes in Equity, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ChangesInEquity-proof> [ChangesInEquityHypercube.html](#)

Changes in Equity [Line Items]	Period [Axis]
	2020-01-01 - 2020-12-31
<b>Changes in Equity [Roll Forward]</b>	
Equity, Beginning Balance	0
Comprehensive Income	3,000
Investments by Owners	1,000
(Distributions to Owners)	(500)
Equity, Ending Balance	3,500

Note that in the *Prior Period Errors* structure has the dimension “Report Date [Axis]” and that the *Changes in Equity* structure does not have that dimension. And so, you might ask the question, “How can a fact exist only once but have a dimension in one structure and not have that dimension in a different structure?”

The answer to that question is the XBRL notion of a “dimension-default”. The “Current Report [Member]” is established as the dimension-default within the Prior Period Error structure<sup>34</sup>:

#	Label	Report Element Class	Period Type	Balance	Name
1	<b>Prior Period Errors [Hypercube]</b>	[Table]			proof:PriorPeriodErrorsHypercube
2	<b>Report Date [Axis]</b>	[Axis]			proof:ReportDateAxis
3	Current Report [Member]	[Member]			proof:CurrentReportMember
4	Prior Report [Member]	[Member]			proof:PriorReportMember
5	<b>Prior Period Errors [Line Items]</b>	[Line Items]			proof:PriorPeriodErrorsLineItems
6	<b>Prior Period Errors [Adjustment]</b>	[Abstract]			proof:PriorPeriodErrorsAdjustment
7	Equity, Originally Stated	[Concept] Monetary	As Of	Credit	proof:Equity
8	Changes in Accounting Policy	[Concept] Monetary	As Of	Credit	proof:ChangesInAccountingPolicy
9	Correction of an Error	[Concept] Monetary	As Of	Credit	proof:CorrectionOfAnError
10	Equity, Restated	[Concept] Monetary	As Of	Credit	proof:Equity

A detailed discussion about the “dimension-default” is beyond the scope of this document. If you are familiar with the notion of a dimension-default, you can see this represented in the XBRL definition relations of the Proof XBRL taxonomy schema and its related XBRL linkbases<sup>35</sup>.

<sup>34</sup> Prior Period Error, Model Structure, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#NetworkStructure-PriorPeriodErrors-proof\\_PriorPeriodErrorsHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#NetworkStructure-PriorPeriodErrors-proof_PriorPeriodErrorsHypercube.html)

<sup>35</sup> Proof XBRL taxonomy schema, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/proof.xsd>

	Order	Arctrole
Definition View		
01-Balance Sheet		
02-Comprehensive Income		
03-Changes in Equity		
04-Prior Period Errors		
Prior Period Errors [Line Items]	0	
Equity	67	<a href="http://xbrl.org/int/dim/arctrole/domain-member">http://xbrl.org/int/dim/arctrole/domain-member</a>
Changes in Accounting Policy	68	<a href="http://xbrl.org/int/dim/arctrole/domain-member">http://xbrl.org/int/dim/arctrole/domain-member</a>
Correction of an Error	69	<a href="http://xbrl.org/int/dim/arctrole/domain-member">http://xbrl.org/int/dim/arctrole/domain-member</a>
Prior Period Errors [Hypercube]	70	<a href="http://xbrl.org/int/dim/arctrole/all">http://xbrl.org/int/dim/arctrole/all</a>
Report Date [Axis]	71	<a href="http://xbrl.org/int/dim/arctrole/hypercube-dimension">http://xbrl.org/int/dim/arctrole/hypercube-dimension</a>
Current Report [Member]	72	<a href="http://xbrl.org/int/dim/arctrole/dimension-domain">http://xbrl.org/int/dim/arctrole/dimension-domain</a>
Prior Report [Member]	74	<a href="http://xbrl.org/int/dim/arctrole/domain-member">http://xbrl.org/int/dim/arctrole/domain-member</a>
Current Report [Member]	73	<a href="http://xbrl.org/int/dim/arctrole/dimension-default">http://xbrl.org/int/dim/arctrole/dimension-default</a>

Finally, an XBRL formula is added to verify that the Adjustment concept arrangement pattern is operating correctly per the logic expected from the XBRL Formula processor<sup>36</sup>.

Adjustment_Reconciles_EquityPriorPeriodAdjustments (evaluation 1)	satisfied	$\$Restated=0 = (\$OriginallyStated=2000 + \$CorrectionOfError=-1500 + \$MandatoryAccountingChange=-500)$
-------------------------------------------------------------------	-----------	-----------------------------------------------------------------------------------------------------------

As such, the logical system remains consistent, complete, and precise.

## Add: Actual to Budget Comparison

Financial statements can include an “Actual” to “Budget” comparison with the difference between actual and budget represented by a “Variance”. This can be achieved within an XBRL-based report using the Variance concept arrangement pattern.

A Variance concept arrangement pattern is described as a representation of one or more line items which are differentiated by using a “Scenario [Axis]” dimension. Actual and budget reporting scenarios can be achieved using an Actual [Member], a Budgeted [Member], and a Variance [Member] and is exemplified below<sup>37</sup>:

<sup>36</sup> XBRL Formula for Adjustment, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-Adjustment-formula.xml>

<sup>37</sup> Variance Analysis, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-VarianceAnalysis-proof\\_VarianceAnalysisHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-VarianceAnalysis-proof_VarianceAnalysisHypercube.html)

Variance Analysis [Line Items]	Period [Axis]		
	2020-01-01 - 2020-12-31		
	Scenario [Axis]		
	Budgeted [Member]	Variance [Member]	Actual [Member]
<b>Variance Analysis [Roll Up]</b>			
Revenues	6,000	1,000	7,000
(Expenses)	(2,000)	(1,000)	(3,000)
Gains	750	250	1,000
(Losses)	(1,000)	(1,000)	(2,000)
Comprehensive Income	3,750	(750)	3,000

Again, note that similar to the Prior Period Error representation; the “Actual [Member]” values in the Variance Analysis structure directly tie to the Comprehensive Income structure<sup>38</sup>:

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

Once again, the connection between the Variance Analysis structure and the Comprehensive Income structure is achieved by representing the Actual [Member] as the dimension-default<sup>39</sup>.

#	Label	Report Element Class	Period Type	Balance	Name
1	Variance Analysis [Hypercube]	[Table]			proof:VarianceAnalysisHypercube
2	Scenario [Axis]	[Axis]			proof:ScenarioAxis
3	Actual [Member]	[Member]			proof:ActualMember
4	Budgeted [Member]	[Member]			proof:BudgetedMember
5	Variance [Member]	[Member]			proof:VarianceMember
6	Variance Analysis [Line Items]	[Line Items]			proof:VarianceAnalysisLineItems
7	Variance Analysis [Roll Up]	[Abstract]			proof:VarianceAnalysisRollUp
8	Revenues	[Concept] Monetary	For Period	Credit	proof:Revenues
9	(Expenses)	[Concept] Monetary	For Period	Debit	proof:Expenses
10	Gains	[Concept] Monetary	For Period	Credit	proof:Gains
11	(Losses)	[Concept] Monetary	For Period	Debit	proof:Losses
12	Comprehensive Income	[Concept] Monetary	For Period	Credit	proof:ComprehensiveIncome

Again, this can be seen in the XBRL definition relations.

Finally, the mathematical computation to verify the relationship between actual, budgeted, and variance values are represented using XBRL Formula and are consistent<sup>40</sup>:

<sup>38</sup> Comprehensive Income structure, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-proof\\_ComprehensiveIncomeStatementHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-proof_ComprehensiveIncomeStatementHypercube.html)

<sup>39</sup> Variance Analysis Model Structure, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#NetworkStructure-VarianceAnalysis-proof\\_VarianceAnalysisHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#NetworkStructure-VarianceAnalysis-proof_VarianceAnalysisHypercube.html)

<sup>40</sup> Variance Analysis XBRL Formulas, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-Variance-VA01-formula.xml>

**CC0 1.0 Universal (CC0 1.0)  
Public Domain Dedication**

CC0 1.0 Universal (CC0 1.0) Public Domain Dedication <https://creativecommons.org/publicdomain/zero/1.0/>

VARIANCE_Revenues (evaluation 1)	satisfied	\$Actual=7000 = (\$Budget=6000 + \$Variance=1000)
VARIANCE_Expenses (evaluation 1)	satisfied	\$Actual=3000 = (\$Budget=2000 + \$Variance=1000)
VARIANCE_Gains (evaluation 1)	satisfied	\$Actual=1000 = (\$Budget=750 + \$Variance=250)
VARIANCE_Losses (evaluation 1)	satisfied	\$Actual=2000 = (\$Budget=1000 + \$Variance=1000)
VARIANCE_ComprehensiveIncome (evaluation 1)	satisfied	\$Actual=3000 = (\$Budget=3750 + \$Variance=-750)

As such, the logical system can still be considered consistent, complete, and precise.

## Add: Roll Forward Info

Financial statements can include what at first glance appears to be a Roll Forward but is actually a different concept arrangement pattern referred to as a Roll Forward Info. A Roll Forward Info has a “beginning” and “ending” balance similar to a Roll Forward, but unlike a Roll Forward, there is no mathematical computation. The Roll Forward Info is exemplified by the Stock Activity Plan structure<sup>41</sup>:

Weighted Average Grant Date Fair Value [Line Items]	Period [Axis]
	2020-01-01 - 2020-12-31
<b>Weighted Average Grant Date Fair Value [Roll Forward Info]</b>	
Nonvested Fair Value, Beginning Balance	32.72
Granted	41.51
Vested	30.92
Forfeited	35.93
Nonvested Fair Value, Ending Balance	36.92

While a Roll Forward Info is commonly represented in human-readable presentations with the single underline and double underline similar to a Roll Forward; the Roll Forward Info does not actually foot. Rather, a Roll Forward Info tends to always be provided with a Roll Forward which it explains in additional detail. Finally, the Roll Forward Info while necessary does not logically connect or mathematically connect to any other reported facts within the financial report.

As such, the logical system can still be considered consistent, complete, and precise.

<sup>41</sup> Stock Activity Plan structure, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-StockPlanActivity-proof\\_WeightedAverageGrantDateFairValueHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-StockPlanActivity-proof_WeightedAverageGrantDateFairValueHypercube.html)

## Add: Set

A Set concept arrangement pattern is simply some set of numeric or nonnumeric or a combination of numeric and nonnumeric concepts that have no mathematical relations between the concepts. A Set is exemplified by the Financial Highlights structure<sup>42</sup>:

Financial Highlights [Line Items]	Period [Axis]
	2020-01-01 - 2020-12-31
<b>Financial Highlights [Set]</b>	
Revenues	7,000
Comprehensive Income	3,000
Distributions to Owners	500

Again, while the structure shown above provides three numeric facts described by numeric concepts; there are no mathematical relations between these facts within the context of this structure. As such, there are no mathematical rules needed to explain this structure. Further, this structure does not tie mathematically to any other structure in the report. Rather, each fact ties individually to some structure.

As such, the logical system can still be considered consistent, complete, and precise.

## Add: Text Blocks

A financial report can contain words that do not connect mathematically to other facts represented within a financial report. At times the words are more than simply text, rather than contain structures within the words. For example, the words could include a table, an ordered list, an unordered list, or other sorts of prose. This information is represented within a financial report using the Text Block concept arrangement pattern.

While only one is necessary, three Text Blocks have been created and are exemplified using the Policies structure<sup>43</sup>:

---

<sup>42</sup> Financial Highlights, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-FinancialHighlights-proof\\_FinancialHighlightsHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-FinancialHighlights-proof_FinancialHighlightsHypercube.html)

<sup>43</sup> Policies, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-Policies-proof\\_PoliciesHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-Policies-proof_PoliciesHypercube.html)

**CC0 1.0 Universal (CC0 1.0)  
Public Domain Dedication**

CC0 1.0 Universal (CC0 1.0) Public Domain Dedication <https://creativecommons.org/publicdomain/zero/1.0/>

Policies [Line Items]	Period [Axis]																			
	2020-01-01 - 2020-12-31																			
Basis of Reporting [Text Block]	<p>Duis fermentum. Nullam dui orci, scelerisque porttitor, volutpat a, porttitor a, enim. Sed lobortis. Maecenas scelerisque ullamcorper libero. Aliquam porta leo imperdiet pede. In semper, elit vel elementum auctor, lectus purus rhoncus arcu, lacinia sollicitudin justo odio et nunc. Phasellus sagittis fringilla risus. Curabitur iaculis sagittis orci. Ut malesuada libero nec nulla molestie vestibulum. Suspendisse lectus massa, ullamcorper at, tincidunt eget, bibendum vel, risus. Curabitur imperdiet. Suspendisse accumsan, arcu vel ornare interdum, magna tellus porta mauris, in porta mi lacus sodales felis. Pellentesque dapibus, leo non sollicitudin consequat, lectus orci fringilla felis, non interdum leo libero sed augue. Sed magna. Maecenas ante ipsum, congue ut, sodales a, pulvinar ut, dui. Suspendisse mauris massa, sollicitudin et, hendrerit eget, placerat id, orci. Donec molestie magna.</p> <p>Sed mauris. Nulla facilisi. Fusce tristique posuere ipsum. Nulla facilisi. Aliquam viverra risus vitae ante. Sed rhoncus mi in wisi. Nullam nibh dui, molestie vitae, imperdiet non, ornare at, elit. Aenean nec justo. Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Duis sodales.</p>																			
Nature of Operations [Text Block]	<p><b>Sed justo: Nibh, placerat</b></p> <table border="1"> <thead> <tr> <th></th> <th>20XX</th> <th>20XX</th> </tr> </thead> <tbody> <tr> <td>Sed dapibus dui quis lectus; Donec id sem. Integer sit amet 2% diam ac nibh consequat vestibulum; Sed eget augue malesuada quam adipiscing mattis</td> <td>XX,XXX</td> <td>XX,XXX</td> </tr> <tr> <td>Sed lobortis, Maecenas scelerisque ullamcorper libero, Aliquam porta \$880 leo imperdiet pede</td> <td>XX,XXX</td> <td>-</td> </tr> <tr> <td>Nunc congue. Fusce venenatis. Maecenas tincidunt, ipsum in fringilla hendrerit, dolor metus eleifend neque, vel tincidunt mi nunc a purus</td> <td>-</td> <td>XX,XXX</td> </tr> <tr> <td>Fusce venenatis. Maecenas tincidunt, ipsum in fringilla \$1,200 hendrerit, dolor metus eleifend neque, vel tincidunt mi nunc a purus</td> <td>XX,XXX</td> <td>XX,XXX</td> </tr> <tr> <td>Pellentesque</td> <td>XXX,XXX</td> <td>XXX,XXX</td> </tr> </tbody> </table>			20XX	20XX	Sed dapibus dui quis lectus; Donec id sem. Integer sit amet 2% diam ac nibh consequat vestibulum; Sed eget augue malesuada quam adipiscing mattis	XX,XXX	XX,XXX	Sed lobortis, Maecenas scelerisque ullamcorper libero, Aliquam porta \$880 leo imperdiet pede	XX,XXX	-	Nunc congue. Fusce venenatis. Maecenas tincidunt, ipsum in fringilla hendrerit, dolor metus eleifend neque, vel tincidunt mi nunc a purus	-	XX,XXX	Fusce venenatis. Maecenas tincidunt, ipsum in fringilla \$1,200 hendrerit, dolor metus eleifend neque, vel tincidunt mi nunc a purus	XX,XXX	XX,XXX	Pellentesque	XXX,XXX	XXX,XXX
	20XX	20XX																		
Sed dapibus dui quis lectus; Donec id sem. Integer sit amet 2% diam ac nibh consequat vestibulum; Sed eget augue malesuada quam adipiscing mattis	XX,XXX	XX,XXX																		
Sed lobortis, Maecenas scelerisque ullamcorper libero, Aliquam porta \$880 leo imperdiet pede	XX,XXX	-																		
Nunc congue. Fusce venenatis. Maecenas tincidunt, ipsum in fringilla hendrerit, dolor metus eleifend neque, vel tincidunt mi nunc a purus	-	XX,XXX																		
Fusce venenatis. Maecenas tincidunt, ipsum in fringilla \$1,200 hendrerit, dolor metus eleifend neque, vel tincidunt mi nunc a purus	XX,XXX	XX,XXX																		
Pellentesque	XXX,XXX	XXX,XXX																		
Revenue Recognition Policy [Text Block]	<p><b>Nature of business</b></p> <p>Sed mauris. Nulla facilisi. Fusce tristique posuere ipsum. Nulla facilisi. Aliquam viverra risus vitae ante. Sed rhoncus mi in wisi. Nullam nibh dui, molestie vitae, imperdiet non, ornare at, elit.</p> <ul style="list-style-type: none"> <li>• Suspendisse accumsan, arcu vel ornare interdum, magna tellus porta mauris, in porta mi lacus sodales felis.</li> <li>• Phasellus eleifend, diam vitae dapibus pulvinar, erat ligula auctor dui, eget congue justo lorem hendrerit tellus.</li> <li>• Fusce gravida, ligula a placerat placerat, leo erat euismod lectus, et lacinia justo libero non pede.</li> </ul> <p>Fusce gravida, ligula a placerat placerat, leo erat euismod lectus, et lacinia justo libero non pede. Vivamus ac velit vel magna nonummy pretium.</p> <ol style="list-style-type: none"> <li>1. Etiam ut augue</li> <li>2. Aliquam erat volutpat</li> </ol>																			

As such, the logical system can still be considered consistent, complete, and precise.

## Add: Member Aggregation

Finally, not really a concept arrangement pattern itself; (a) the [Member]s of a dimension can be related to one another mathematically and (b) any other concept arrangement pattern might be supplemented with a Member Arrangement Pattern. This is exemplified by the Segment Revenues structure shown below<sup>44</sup>:

Segment Revenues [Line Items]	Period [Axis]			
	2020-01-01 - 2020-12-31			
	Segments [Axis]			
	Segment Alpha [Member]	Segment Bravo [Member]	Segment Charlie [Member]	All Segments [Member]
<b>Segment Revenues [Set]</b>				
Revenues	1,000	2,000	4,000	7,000

What you see above is a Member Aggregation of the segment revenues. This Member Aggregation is 100% consistent with the logic of a Roll Up concept arrangement pattern. The Segment Revenues [Set] contains exactly one concept “Revenues” for which four Facts are

<sup>44</sup> Segment Revenues Structure, [http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-SegmentRevenues-proof\\_SegmentRevenuesHypercube.html](http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-SegmentRevenues-proof_SegmentRevenuesHypercube.html)

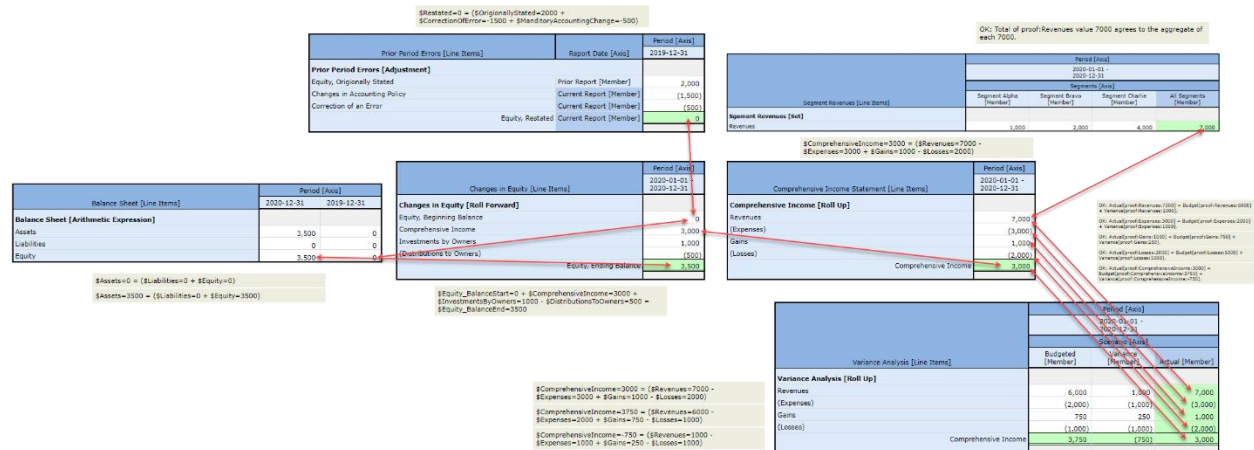
provided; one each for segments Alpha, Bravo, and Charlie and in addition the total of all segments. The mathematical relation is represented using an XBRL Formula<sup>45</sup>.

Note that the Revenues of “All Segments” ties to the structure Comprehensive Income and to the structure Variance Analysis as well.

As such, the logical system can still be considered consistent, complete, and precise.

## Proof Continues to be a Properly Functioning Logical System

At each increment and at the conclusion of adding all increments the Proof logical system continues to be consistent, complete, and precise and therefore a properly functioning logical system. Further, the logic of the financial report makes sense and this logical information is effectively represented within the XBRL technical syntax. Four different XBRL processors provide the same result.



As such, the representation approach is provably correct. Could there be other possible representation approaches? Yes, for example, a structure that we have represented as a set of [Line Items] could perhaps be represented as a set of [Member]s of a dimension. But while the technical representation syntax preference or choice might impact the technical representation the logic of the information would remain unchanged.

<sup>45</sup> Segment Revenues XBRL Formula for Member Aggregation, <http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-MemberAggregation-formula.xml>



## Conclusion

It may seem inconceivable that all XBRL-based financial reports can be explained by 10 concept arrangement patterns. But, when you think about it, a larger report is comprised of numerous structures that are of the same fundamental patterns. For example, consider the Microsoft 10-K for 2017. The Microsoft 2017 10-K has exactly 194 structures<sup>46</sup>. This is a breakdown of those structures by concept arrangement pattern<sup>47</sup> and by SEC reporting level:

Concept Arrangement Pattern	Count	SEC Level	Count
Text Block	89	Level 4 Disclosure Detail	102
Set	64	Level 3 Disclosure Text Block	47
Roll Up	31	Level 2 Policy Text Block	23
Roll Forward	9	Level 1 Note Text Block	22
Roll Forward Info	1		

What all this shows is how rules are used to specify permissible manipulations of a logical system and how rules, terms, structures, and associations all work together to represent a financial report logical system. The Proof representation shows how the logic is represented effectively and consistent with expectations using the XBRL technical syntax.

While, for example, SFAC 6 system has only a handful of terms, structures, associations, and assertions within its logical system which can be used to represent financial facts; it works identically to how the financial report of Microsoft works which has 194 structures and 2,235 facts<sup>48</sup>.

The document *Comparison of Renderings for Concept Arrangement Patterns*<sup>49</sup> shows three consistent implementations of software that understand and work with these concept arrangement patterns consistently.

The next iteration of the series of proofs that I am creating is the *Common Elements of Financial Statements*<sup>50</sup>. Beyond that is the *Trial Balance*<sup>51</sup> iteration which adds additional aspects to this proof.

<sup>46</sup> Microsoft 10-K for 2017, [http://xbrl.azurewebsites.net/2017/Prototypes/Microsoft2017/evidence-package/#Rendering-DocumentDocumentAndEntityInformation-us\\_gaap\\_StatementTable.html](http://xbrl.azurewebsites.net/2017/Prototypes/Microsoft2017/evidence-package/#Rendering-DocumentDocumentAndEntityInformation-us_gaap_StatementTable.html)

<sup>47</sup> Concept Arrangement Pattern, <http://xbrl.azurewebsites.net/2019/Framework/Details/ConceptArrangementPattern.html>

<sup>48</sup> *Summary of Human Readable Renderings*, see second bullet, US-GAAP Microsoft 10-K, <http://xbrl.squarespace.com/journal/2019/3/23/summary-of-human-readable-renderings.html>

<sup>49</sup> *Comparison of Renderings for Concept Arrangement Patterns*, <http://xbrl.azurewebsites.net/2019/Prototype/conformance-suite/Production/ComparisonOfConceptArrangementPatternRenderings.pdf>

<sup>50</sup> *Common Elements of Financial Statements*, <http://xbrl.azurewebsites.net/2019/core/master-elements/>

<sup>51</sup> *Trial Balance*, <http://xbrl.azurewebsites.net/2019/core/core-trialbalance/>