Understanding Proof

Understanding the Proof representation which exercises 100% of SBRM per the XBRL technical syntax

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> "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*[1]

Executive summary:

- This document exercises 100% of the meaning provided by the OMG Standard Business Report Model (SBRM) both proving those semantics and providing an example of a business report represented using the XBRL technical syntax following the SBRM logical conceptualization of a business report.
- Four XBRL processors and XBRL formula processers 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.
- This effectively demonstrates a control mechanism which can be used to keep the quality of XBRL-based financial reports high.

[1] WikiQuotes, Richard Buckminster Fuller, https://simple.wikiquote.org/wiki/Richard_Buckminster_Fuller

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This document builds on the base created by the accounting equation represented in XBRL[2] and the FASB's SFAC 6 *Elements of Financial Statements* represented in XBRL[3] and other examples of XBRL-based financial reports[4].

This specific example, referred to as the **Proof** representation[5], 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[6], testing the set together in one report for the purpose to both (a) test and demonstrate the representation of each pattern and (b) test and demonstrate the interaction between each pattern.

You can download a zip file[7] that contains all of the XBRL examples or the human-readable representation of the example[8]. The home page for this information can be found here[9]. You can download the tool used to generate this prototype here[10].

We will start by explaining the notion of a concept arrangement pattern. Note that definitions of important terms used within this document are referenced to their SBRM term definitions[11] (drafts because SBRM is still yet to be formally released).

Concept Arrangement Patterns

The *US GAAP Financial Reporting Taxonomy Architecture*[12] decomposes a report into various notions including "fragments" and "schedules" and finally into "facts".

[2] Accounting Equation represented in XBRL, http://xbrlsite.azurewebsites.net/2020/core/master-ae/
[3] FASB's SFAC 6 *Elements of Financial Statements* represented in XBRL, http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/
[4] Mastering XBRL-based Digital Financial Reports, http://xbrlsite.azurewebsites.net/2020/master/
[5] Proof representation, http://xbrlsite.azurewebsites.net/2020/master/proof/index.html
[6] Concept Arrangement Patterns, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.7a_ConceptArrangementPatterns.pdf
[7] Proof, ZIP file download, http://xbrlsite.azurewebsites.net/2020/core/master-proof/proof.zip
[8] Proof, Human readable representation, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package.zip
[9] Proof, Index page, http://xbrlsite.azurewebsites.net/2020/core/master-proof/index.html
[10] Download database application, http://xbrlsite-app.azurewebsites.net/Proof/Download.aspx
[11] *SBRM Terms*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/TermsSummary.html
[12] 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

I have similarly decomposed the objects of a financial report. This was done by reverse engineering XBRL-based financial reports that have been submitted to the U.S. Securities and Exchange Commission in both US GAAP and IFRS.

The following is a comparison of the terms that I use (i.e "My Term") reconciled to the terms the *US GAAP Financial Reporting Taxonomy Architecture* uses as best as possible and providing a definition of a common term which is used by the forthcoming OMG Standard Business Report Model (SBRM)[13]:

Definition	My Term	US GAAP Financial Reporting Taxonomy Architecture Term
A **report** is information published by a reporting entity at some point in time for some purpose.	Report[14]	Financial Report
A **fragment** is a set of one to many fact sets which go together for some specific purpose within a report.	Fragment[15]	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[16]	Schedule
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[17]	Reported Fact
A **report set** is a set or collection of reports. For example, all of the reports within the SEC EDGAR system is a report set.	Report Set[18]	EDGAR System[19]

The analysis of a set of 6,023 XBRL-based financial reports submitted to the SEC by public companies revealed[20]:

- 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

[13] SBRM Progress Report, http://xbrl.squarespace.com/journal/2020/1/30/sbrm-progress-report.html
[14] SBRM Terms, *Report*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Report.html
[15] **NOTE that I am not sure if Fragment should be defined by SBRM; a Fragment could be considered a set of structures**.
[16] SBRM Terms, *Fact Set*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/FactSet.html
[17] SBRM Terms, *Fact*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Fact.html
[18] SBRM Terms, *Report Set*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/ReportSet.html
[19] FASB, *US GAAP Financial Report Taxonomy Architecture, Figure 2. System Context* – Actors and Data Stores, page 7, implied by figure, https://www.fasb.org/cs/ContentServer?c=Document_C&cid=1176163689810&d=&pagename=FASB%2FDocument_C%2FDocumentPage
[20] Breaking Down the Pieces of an XBRL-based Digital Financial Report, http://xbrl.squarespace.com/journal/2019/4/9/breaking-down-the-pieces-of-an-xbrl-based-digital-financial.html

- 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.

Note that a **structure**[21] is represented in XBRL using one of three ways: (1) using a Network, (2) using a Hypercube, or (3) using a combination of a Network and Hypercube. Note that an XBRL Network that does not explicitly contain a Hypercube is deemed to provide an implied hypercube, thus every reported fact can be said to exist within a Network and within a Hypercube which is explicitly provided or implied.

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

- **Text Blocks**[22]: 407,392 (54%) are text blocks (Level 1 Notes[23], Level 2 Policies[24], Level 3 Disclosures[25])
- **Sets**[26]: 181,063 (24%) are sets (or hierarchies, no mathematical computations)
- **Roll Ups**[27]: 120,708 (16%) are roll ups
- **Roll Forwards**[28]: 37,721 (5%) are roll forwards
- **Roll Forward Info**[29]: 3,963 (.5%) are roll forward info[30]

[21] SBRM Terms, *Structure*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Structure.html
[22] SBRM Terms, *Text Block*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/TextBlock.html
[23] SBRM Terms, *Level 1 Note Text Block*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Level1NoteTextBlock.html
[24] SBRM Terms, *Level 2 Policy Text Block*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Level2PolicyTextBlock.html
[25] SBRM Terms, *Level 3 Disclosure Text Block*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Level3DisclosureTextBlock.html
[26] SBRM Terms, *Set*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Set.html
[27] SBRM Terms, *Roll Up*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/RollUp.html
[28] SBRM Terms, *Roll Forward*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/RollForward.html
[29] SBRM Terms, *Roll Forward Info*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/RollForwardinfo.html
[30] Note that this is an estimate per testing of another set of reports, see line 33 of this analysis, http://xbrlsite.azurewebsites.net/2019/Library/DisclosureMechanics_ByDisclosure_2019-03-31.jpg

- **Other** (including Adjustment[31], Variance[32], and unknown): 3,583 (.5%) are adjustments, variance, some other pattern, or an error

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**[33] 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. This information is both machine-readable XBRL[34] and in a human-readable[35] form generated from the machine-readable XBRL. 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 Builds on Accounting Equation, SFAC 6, and Common Elements of Financial Statements

The FASB's SFAC 6 *Elements of Financial Statements* is part of the conceptual framework[36] which defines the US GAAP financial reporting scheme[37] and has the accounting equation model at its core although the accounting equation is not explicitly defined by SFAC 6. While not explicitly defined, no professional accountant would dispute the existence of the accounting equation. The accounting equation is:

"Assets = Liabilities + Equity"

SFAC 6 defines 10 interrelated elements of US GAAP financial statements **terms** (a.k.a. report elements[38]) 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,

[31] SBRM Terms, *Adjustment*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Adjustment.html
[32] SBRM Terms, *Variance*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Variance.html
[33] Proof representation, http://xbrlsite.azurewebsites.net/2020/master/proof/index.html
[34] Proof representation, *XBRL instance with rules attached*, http://xbrlsite.azurewebsites.net/2020/master/proof/instance-WithRules.xml
[35] Proof representation, *Human readable review tool*, http://xbrlsite.azurewebsites.net/2020/master/proof/evidence-package/contents/index.html#Rendering-BalanceSheet-proof_BalanceSheetHypercube.html
[36] FASB, *Conceptual Framework*, https://www.fasb.org/jsp/FASB/Page/BridgePage&cid=1176168367774
[37] Charles Hoffman, CPA, *Comparison of Financial Reporting Schemes High Level Concepts*, http://xbrlsite.azurewebsites.net/2018/Library/ReportingSchemes-2018-12-30.pdf
[38] SBRM Terms, *Report Element*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/ReportElement.html

Equity, Comprehensive income, Investments by Owners, Distributions to Owners, Revenues, Expenses, Gains, Losses.

SFAC 6 defines additional **assertions** (a.k.a. rules[39]). The FASB explicitly states the components of comprehensive income which include: Revenues, Expenses, Gains, and Losses[40].

"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.

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

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 replace by this equation):

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

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**[41]:

- Balance sheet (i.e. status as of a point it 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**[42] 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

[39] SBRM Terms, *Rule*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Rule.html
[40] FASB, SFAC 6, page 21, paragraph 20
[41] SBRM Terms, *Structure*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Structure.html
[42] SBRM Terms, Fact, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Fact.html

- 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**[43] which measures status:

Component: (Network and Table)	
Network	**01-Balance Sheet** (http://www.xbrlsite.com/sfac6/role/BalanceSheet)
Table	Balance Sheet [Hypercube]

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

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

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

Shell of a **comprehensive income** statement[44] which measures performance:

[43] Human readable rendering of balance sheet, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-N0-RE5.html

[44] 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

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

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

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

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

Shell of **changes in equity**[45] which connects the income statement to the balance sheet:

Component: (Network and Table)	
Network	**03-Changes in Equity** (http://www.xbrlsite.com/sfac6/role/ChangesInEquity)
Table	Changes in Equity [Hypercube]

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

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

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

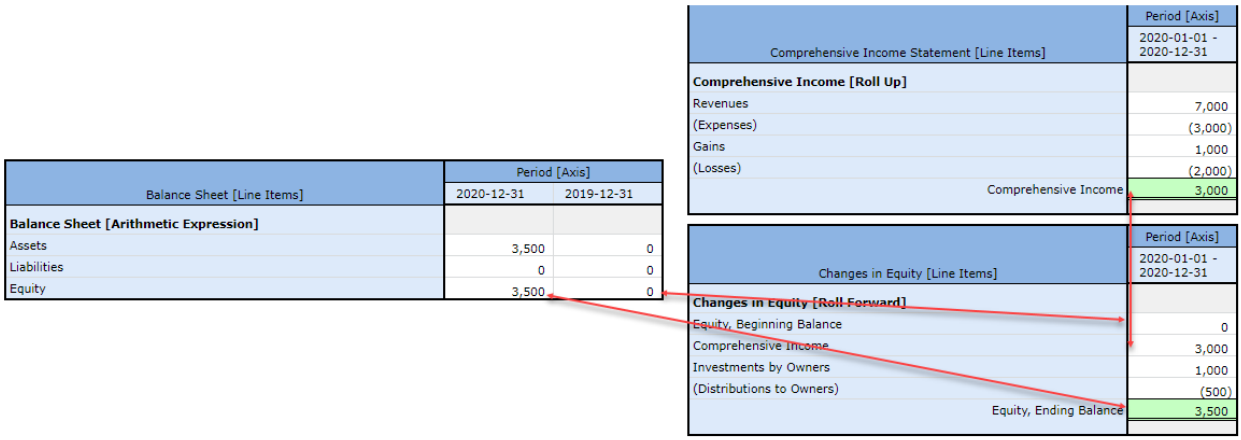
The rules (a.k.a. assertions) that show that everything ticks and ties numerically per the four rules represented. (Note that the balance sheet rule is executed twice, once for the beginning and again for the ending balance.)

[45] 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

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 = $Equity_BalanceEnd=3500
ASSERTION_SFAC6_CONCEPTUAL_FRAMEWORK_RECONCILATION (evaluation 1)	satisfied	0= (($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*[46], which will include the cash flow statement.

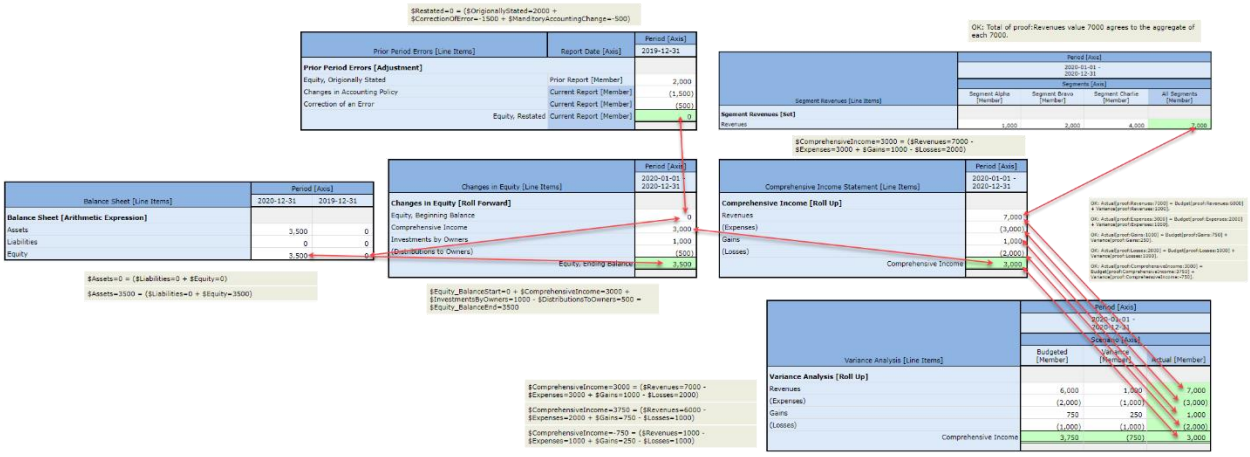
The four statement (we are using three of the four) model shows the explicitly created **articulation** or the interrelationships between the three primary financial statements defined by the FASB in SFAC 6. However, since net cash flow is not defined by SFAC 6 we can only represent the interrelationships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



SFAC 6 is essentially a simple man-made logical system[47] that builds on the mathematical model of double entry accounting[48]. To that base model have incrementally add additional structures

[46] Common Elements of Financial Statements, http://xbrlsite.azurewebsites.net/2019/core/master-elements/
[47] YouTube, *Understanding the Financial Report Logical System*, https://www.youtube.com/playlist?list=PLqMZRUzQ64B7EWamzDP-WaYbS_W0RL9nt
[48] David Ellerman, *The Mathematics of Double Entry Bookeeping*, http://www.ellerman.org/wp-content/uploads/2012/12/DEB-Math-Mag.CV_.pdf

that are common to financial statements and connect them to the three core statements. The is provided by the Common Elements of Financial Statement representation[49].



A financial report is a **logical system**[50]. A logical system can be described by a logical theory[51]. A logical theory enables a community of stakeholders trying to achieve a specific goal or objective or a range of goals/objectives to agree on important common models, structures, and 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

[49] *Common Elements of Financial Statement Representation*, http://xbrlsite.azurewebsites.net/2020/master/common/index.html
[50] Charles Hoffman, CPA, *Explanation of a Financial Report Logical System in Simple Terms*, http://xbrl.squarespace.com/journal/2019/11/1/explanation-of-a-financial-report-logical-system-in-simple-t.html
[51] Wikipedia, *Theory (Mathematical Logic)*, https://en.wikipedia.org/wiki/Theory_(mathematical_logic)

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[52] (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[53]. This SFAC 6 logical system is a demonstration of how XBRL-based digital financial reporting works[54].

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[52] ACCA, Narayanan Vaidyanathan, *Explainable AI: Putting the user at the core*, https://www.accaglobal.com/uk/en/professional-insights/technology/Explainable_AI.html

[53] Charles Hoffman, CPA, Special Theory of Machine-based Automated Communication of Semantic Information of Financial Statements, http://xbrlsite.azurewebsites.net/2019/Library/SpecialTheoryOfSemanticCommunicationOfFinancialInformation.pdf

[54] *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

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.

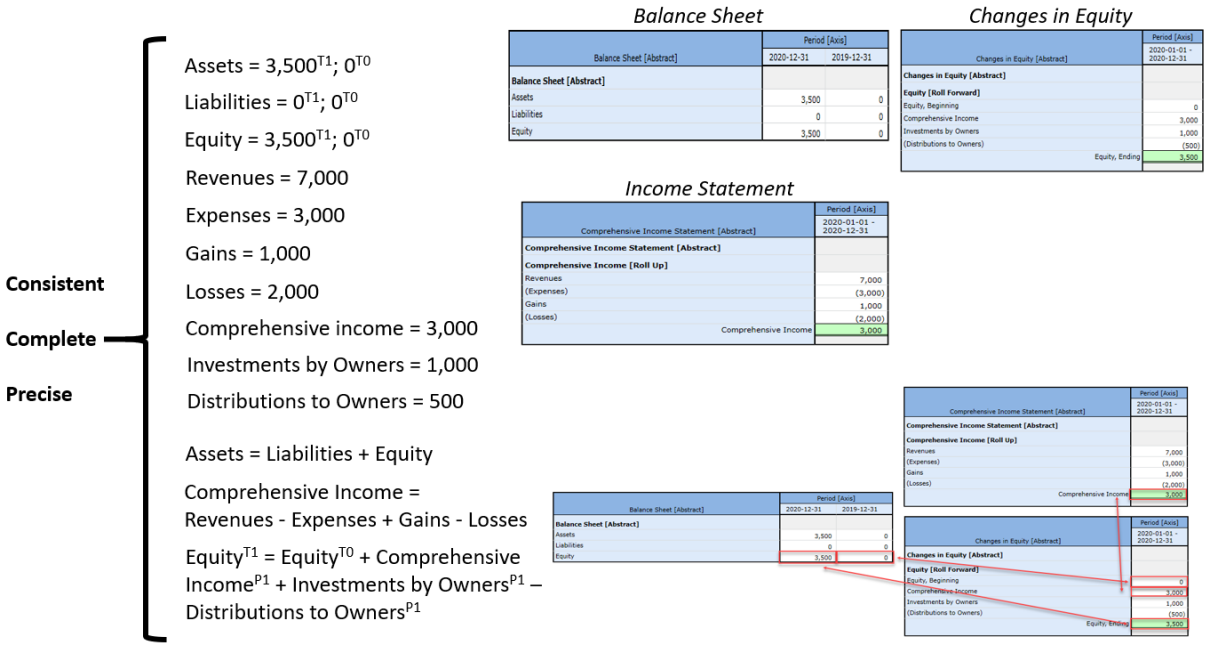
Properly Functioning Logical System: Consistent, Precise, Complete

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 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:



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.

It is helpful to understand logical systems that are not properly functioning. This helps one understand the **impediments to a properly functioning logical system**[55] and what must be done to control such systems to keep them properly functioning.

Adding Missing Concept Arrangement Patterns

But there is one aspect of a financial report logical system that the Accounting equation, the SFAC 6, and the Common Elements of a Financial Report do not cover: several concept arrangement patterns that exist within a financial report. Specifically, the Adjustment, Variance, Roll Forward Info, Text Block, and Member Aggregation patterns are not covered and therefore not exercised and tested thus far.

The **Proof** representation of a financial report logical system uses the proven properly functioning SFAC 6 logical system as its base and expands that base incrementally to add all the known necessary functionality required to represent all known types of structures that exist in the XBRL-based financial reports submitted to the SEC using US GAAP and IFRS financial reports provided by empirical evidence effectively.

[55] Comparing States, http://xbrlsite.azurewebsites.net/2020/Library/UnderstandingDigital_ImpedimentsOnly.pdf

Keeping the Logical System Properly Functioning and Adding Missing Information Patterns

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 to the report, the XBRL Formula results should likewise be consistent, the system should be complete, the information should be precise, and the expanded system should likewise be a properly functioning logical system.

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:[56]

[56] UBmatrix XPE 4.0 XBRL Formula Validation Results, http://xbrlsite.azurewebsites.net/2020/master/proof/_XPE_instance.xml_Formula.html

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 = $Equity_BalanceEnd=3500
CONSISTENCY_SFAC6_Conceptual_Framework_Reconcilation (evaluation 1)	satisfied	0= (($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	$Restated=0 = ($OrigionallyStated=2000 + $CorrectionOfError=-1500 + $ManditoryAccountingChange=-500)

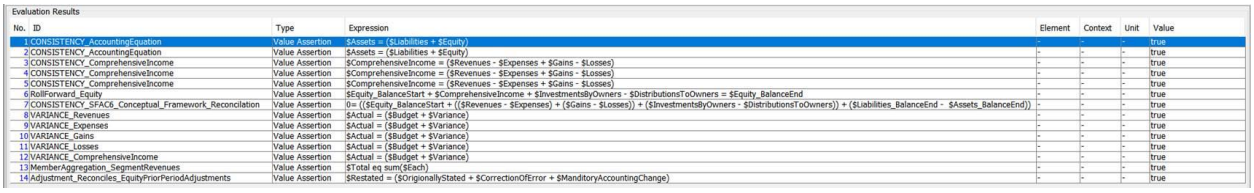
XBRL Cloud Evidence Package:[57]

Assertions Summary

	Defined	Executed	Pass	Fail
Existence assertions	0	0	0	0
Value assertions	11	14	14	0
Consistency assertions	0	0	0	0
Total all assertions	11	14	14	0

#	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: origionally stated balance + adjustments restated balance across the Report Date [Axis] (Adjustment_Reconciles_EquityPriorPeriodAdjustments)	Pass	$Restated = ($OrigionallyStated + $CorrectionOfError + $ManditoryAccountingChange)
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{T0} + (Revenue{P1} - Expenses{P1} + Gains{P1} - Losses{P1}) + (InvestmentsByOwners{P1} - DistributionsToOwners{P1})) + Liabilities{T1} - Assets{T1} (CONSISTENCY_SFAC6_Conceptual_Framework_Reconcilation)	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)

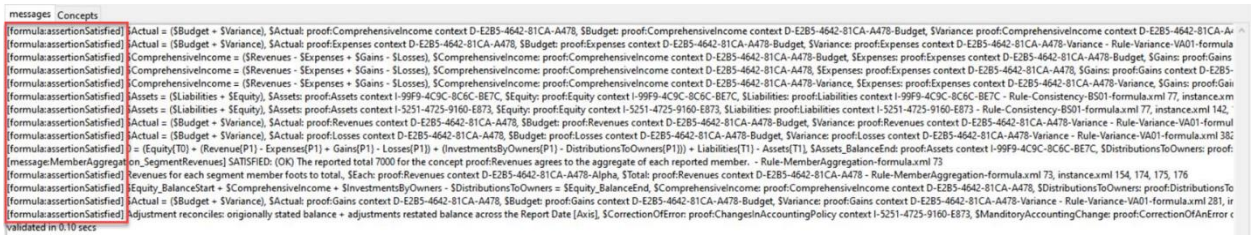
Fujutsu XWand:



Evaluation Results

No.	ID	Type	Expression	Element	Context	Unit	Value
1	CONSISTENCY_AccountingEquation	Value Assertion	$Assets = ($Liabilities + $Equity)	-	-	-	true
2	CONSISTENCY_AccountingEquation	Value Assertion	$Assets = ($Liabilities + $Equity)	-	-	-	true
3	CONSISTENCY_ComprehensiveIncome	Value Assertion	$ComprehensiveIncome = ($Revenues - $Expenses + $Gains - $Losses)	-	-	-	true
4	CONSISTENCY_ComprehensiveIncome	Value Assertion	$ComprehensiveIncome = ($Revenues - $Expenses + $Gains - $Losses)	-	-	-	true
5	CONSISTENCY_ComprehensiveIncome	Value Assertion	$ComprehensiveIncome = ($Revenues - $Expenses + $Gains - $Losses)	-	-	-	true
6	RollForward_Equity	Value Assertion	$Equity_BalanceStart + $ComprehensiveIncome + $InvestmentsByOwners - $DistributionsToOwners = $Equity_BalanceEnd	-	-	-	true
7	CONSISTENCY_SFAC6_Conceptual_Framework_Reconcilation	Value Assertion	0= (($Equity_BalanceStart + (($Revenues - $Expenses) + ($Gains - $Losses)) + ($InvestmentsByOwners - $DistributionsToOwners)) + ($Liabilities_BalanceEnd - $Assets_BalanceEnd))	-	-	-	true
8	VARIANCE_Revenues	Value Assertion	$Actual = ($Budget + $Variance)	-	-	-	true
9	VARIANCE_Expenses	Value Assertion	$Actual = ($Budget + $Variance)	-	-	-	true
10	VARIANCE_Gains	Value Assertion	$Actual = ($Budget + $Variance)	-	-	-	true
11	VARIANCE_Losses	Value Assertion	$Actual = ($Budget + $Variance)	-	-	-	true
12	VARIANCE_ComprehensiveIncome	Value Assertion	$Actual = ($Budget + $Variance)	-	-	-	true
13	MemberAggregation_SegmentRevenues	Value Assertion	$Total eq sum($Each)	-	-	-	true
14	Adjustment_Reconciles_EquityPriorPeriodAdjustments	Value Assertion	$Restated = ($OrigionallyStated + $CorrectionOfError + $ManditoryAccountingChange)	-	-	-	true

Arelle:

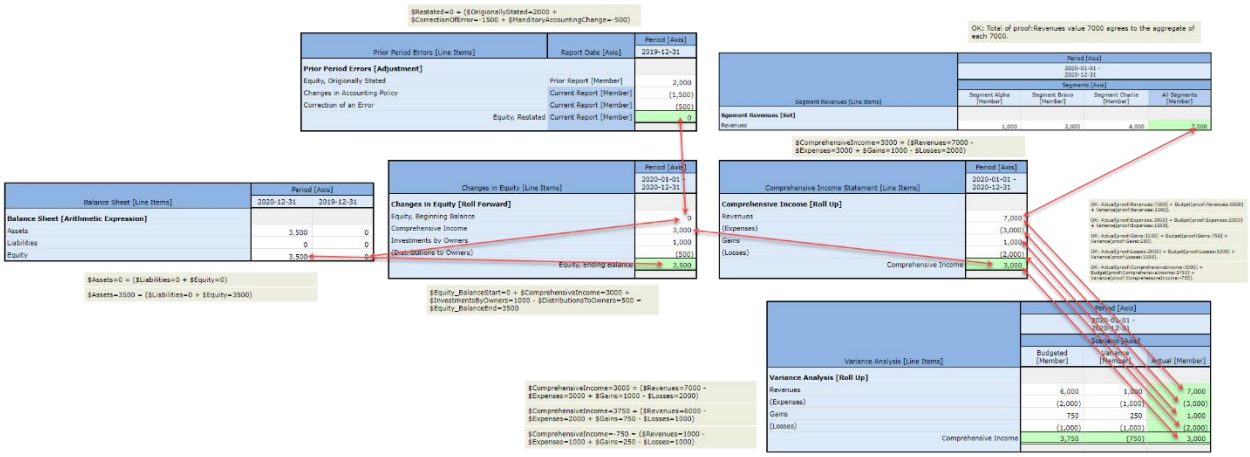


messages Concepts

[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-A
[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-VA01-formula
[formula:assertionSatisfied] $ComprehensiveIncome = ($Revenues - $Expenses + $Gains - $Losses), $ComprehensiveIncome: proof:ComprehensiveIncome context D-E2B5-4642-81CA-A478-Budget, $Expenses: proof:Expenses context D-E2B5-4642-81CA-A478-Budget, $Gains: proof:Gains
[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-
[formula:assertionSatisfied] $ComprehensiveIncome = ($Revenues - $Expenses + $Gains - $Losses), $ComprehensiveIncome: proof:ComprehensiveIncome context D-E2B5-4642-81CA-A478-Variance, $Expenses: proof:Expenses context D-E2B5-4642-81CA-A478-Variance, $Gains: proof:Gai
[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-BS01-formula.xml 77, instance.xm
[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-BS01-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-VA01-formul
[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-VA01-formula.xml 38
[formula:assertionSatisfied] 0 = (Equity{T0} + (Revenue{P1} - Expenses{P1} + Gains{P1} - Losses{P1}) + (InvestmentsByOwners{P1} - DistributionsToOwners{P1})) + Liabilities{T1} - Assets{T1}, $Assets_BalanceEnd: proof:Assets context I-99F9-4C9C-8C6C-BE7C, $DistributionsToOwners: proof:
[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, 176
[formula:assertionSatisfied] $Equity_BalanceStart + $ComprehensiveIncome + $InvestmentsByOwners - $DistributionsToOwners = $Equity_BalanceEnd, $ComprehensiveIncome: proof:ComprehensiveIncome context D-E2B5-4642-81CA-A478, $DistributionsToOwners: proof:DistributionsTo
[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-VA01-formula.xml 281, ir
[formula:assertionSatisfied] Adjustment reconciles: origionally stated balance + adjustments restated balance across the Report Date [Axis], $CorrectionOfError: proof:ChangesInAccountingPolicy context I-5251-4725-9160-E873, $ManditoryAccountingChange: proof:CorrectionOfAnError
Validated in 0.10 secs

[57] XBRL Cloud Evidence Package, http://xbrlsite.azurewebsites.net/2020/master/proof/evidence-package/contents/BusinessRulesSummary.html

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[58]:



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[59]:

[58] Proof mathematical computations, http://xbrlsite.azurewebsites.net/2020/core/master-proof/ProofMathematicalComputations.jpg

[59] Comprehensive Income, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-proof_ComprehensiveIncomeStatementHypercube.html

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

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 Up is explained by machine-readable rules represented in the form of either XBRL calculation relations[60] or XBRL Formulas[61] that articulate the mathematical relation in machine-readable form.

Existing: Roll Forward

A second very common mathematical oriented pattern of relations between numeric concepts in financial reports and accounting systems 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[62]:

Changes in Equity [Line Items]	Period [Axis] 2020-01-01 - 2020-12-31
Changes in Equity [Roll Forward]	
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[63]. Note that a roll forward and a roll up might look similar, but they are very different. A roll up can aggregate a set of

[60] Comprehensive Income XBRL calculation rules for Roll Up, http://xbrlsite.azurewebsites.net/2020/core/master-proof/proof-cal.xml
[61] Comprehensive Income XBRL Formula rules for Roll Up, http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-Arithmetic-IS01-formula.xml
[62] Changes in Equity, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ChangesInEquity-proof_ChangesInEquityHypercube.html
[63] Changes in Equity XBRL Formula rules for Roll Forward, http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-RollForward-formula.xml

stocks (i.e. a roll up of assets) or a set of flows (i.e. a roll up of net income); but a roll forward is used to represent the change in a stock between two points in time per the flows that cause the change.

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 simple Balance Sheet structure[64] in the proof representation:

Balance Sheet [Line Items]	Period [Axis]	
	2020-12-31	2019-12-31
Balance Sheet [Arithmetic Expression]		
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[65]. Therefore, any mathematical relation that involves addition, subtraction, multiplication, or division can be represented using the Arithmetic Expression pattern: (a) a list of facts involved in the expression and (b) the mathematical relations.

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

[64] Balance Sheet structure, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-BalanceSheet-proof_BalanceSheetHypercube.html
[65] Balance Sheet XBRL Formula rules, http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-Consistency-BS01-formula.xml

adding or subtracting specific adjustments to the originally stated balance to arrive at the restated balance. You see that example here in the Prior Period Error structure[66]:

Prior Period Errors [Line Items]	Report Date [Axis]	Period [Axis] 2019-12-31
Prior Period Errors [Adjustment]		
Equity, Origionally 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[67]:

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

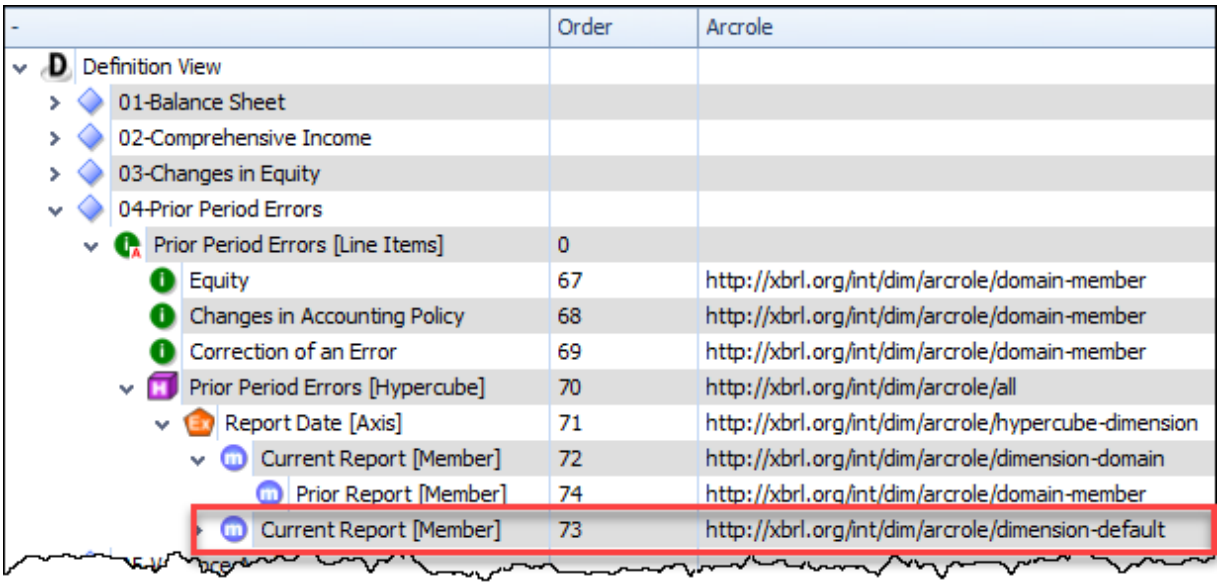
Note that in the *Prior Period Errors* structure has the dimension "Report Date [Axis]" and that the *Changes in Equity* structure does not have that dimension. And so, you might ask the question, "How can a fact exist only once but have a dimension in one structure and not have that dimension in a different 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[68]:

#	Label	Report Element Class	Period Type	Balance	Name
1	**Prior Period Errors [Hypercube]**	[Table]			proof:PriorPeriodErrorsHypercube
2	**Report Date [Axis]**	[Axis]			proof:ReportDateAxis
3	Current Report [Member]	[Member]			proof:CurrentReportMember
4	Prior Report [Member]	[Member]			proof:PriorReportMember
5	**Prior Period Errors [Line Items]**	[Line Items]			proof:PriorPeriodErrorsLineItems
6	*Prior Period Errors [Adjustment]*	[Abstract]			proof:PriorPeriodErrorsAdjustment
7	Equity, Origionally 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

[66] Prior Period Errors, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-PriorPeriodErrors-proof_PriorPeriodErrorsHypercube.html
[67] Changes in Equity, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ChangesInEquity-proof_ChangesInEquityHypercube.html
[68] Prior Period Error, Model Structure, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#NetworkStructure-PriorPeriodErrors-proof_PriorPeriodErrorsHypercube.html

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[69].



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[70].

Adjustment_Reconciles_EquityPriorPeriodAdjustments (evaluation 1)	satisfied	$Restated=0 = ($OrigionallyStated=2000 + $CorrectionOfError=-1500 + $ManditoryAccountingChange=-500)

As such, the logical system remains consistent, complete, and precise. Note that any error could be represented using this Adjustment concept arrangement pattern.

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

[69] Proof XBRL taxonomy schema, http://xbrlsite.azurewebsites.net/2020/core/master-proof/proof.xsd
[70] XBRL Formula for Adjustment, http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-Adjustment-formula.xml

reporting scenarios can be achieved using an Actual [Member], a Budgeted [Member], and a Variance [Member] and is exemplified below[71]:

Variance Analysis [Line Items]	Period [Axis] 2020-01-01 - 2020-12-31		
	Scenario [Axis]		
	Budgeted [Member]	Variance [Member]	Actual [Member]
Variance Analysis [Roll Up]			
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[72]:

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

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[73].

#	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 more explicitly within the XBRL definition relations, have a look at them for more specific information.

[71] Variance Analysis, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-VarianceAnalysis-proof_VarianceAnalysisHypercube.html
[72] Comprehensive Income structure, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-proof_ComprehensiveIncomeStatementHypercube.html
[73] Variance Analysis Model Structure, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#NetworkStructure-VarianceAnalysis-proof_VarianceAnalysisHypercube.html

Finally, the mathematical computation to verify the relationship between actual, budgeted, and variance values are represented using XBRL Formula and are consistent with expectation[74]:

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. Further, this same approach could be used to represent other sorts of comparisons between reporting scenarios such as a forecast, different budget scenarios, etc.

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[75] in the proof representation:

Weighted Average Grant Date Fair Value [Line Items]	Period [Axis] 2020-01-01 - 2020-12-31
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 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.

[74] Variance Analysis XBRL Formulas, http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-Variance-VA01-formula.xml
[75] Stock Activity Plan structure, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-StockPlanActivity-proof_WeightedAverageGrantDateFairValueHypercube.html

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

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 within that specific fact set. A Set is exemplified by the Financial Highlights structure[76]:

Financial Highlights [Line Items]	Period [Axis] 2020-01-01 - 2020-12-31
Financial Highlights [Set]	
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. Further, the Set concept arrangement pattern can be used to represent literally anything. You can think of every other pattern as having its roots in the Set concept arrangement pattern but is then differentiated by some other characteristic that makes that other specific pattern unique. In essence, every structure represented within an XBRL-based financial report is some sort of set.

Add: Text Blocks

A financial report can contain words and/or numbers that do not connect mathematically to other facts represented within a financial report. At times the words/numbers are more that simply text, rather then 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.

[76] Financial Highlights, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-FinancialHighlights-proof_FinancialHighlightsHypercube.html

While only one is necessary, three Text Blocks have been created and are exemplified using the Policies structure[77]:

Policies [Line Items]	Period [Axis] 2020-01-01 - 2020-12-31
Basis of Reporting [Text Block]	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. 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.
Nature of Operations [Text Block]	**Sed justo: Nibh, placerat** 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]	**Nature of business** 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. • Suspendisse accumsan, arcu vel ornare interdum, magna tellus porta mauris, in porta mi lacus sodales felis. • Phasellus eleifend, diam vitae dapibus pulvinar, erat ligula auctor dui, eget congue justo lorem hendrerit tellus. • Fusce gravida, ligula a placerat placerat, leo erat euismod lectus, et lacinia justo libero non pede. Fusce gravida, ligula a placerat placerat, leo erat euismod lectus, et lacinia justo libero non pede. Vivamus ac velit vel magna nonummy pretium. 1. Etiam ut augue 2. Aliquam erat volutpat

As such, the logical system can still be considered consistent, complete, and precise. Note that any prose[78] can be represented in this manner. While a machine-based process can generally not identify information within the block of prose (i.e. parse the text block) which is represented as a fragment of escaped XHTML; a machine can identify the specific fragment of information. Finally, the U.S. SEC and the US GAAP XBRL Taxonomy differentiate text blocks that represent an entire note (i.e. Level 1 Note Text Block), a policy (i.e. Level 2 Policy Text Block), and a specific disclosure (i.e. Level 3 Disclosure Text Block). The SEC goes on to explicitly define the notion of a Level 4 Disclosure Detail being anything other than a text block.

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

[77] Policies, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-Policies-proof_PoliciesHypercube.html
[78] SBRM Terms, *Prose*, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/Prose.html

might be supplemented with a Member Arrangement Pattern. This is exemplified by the Segment Revenues structure shown below[79]:

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]
Sgement Revenues [Set]				
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 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[80].

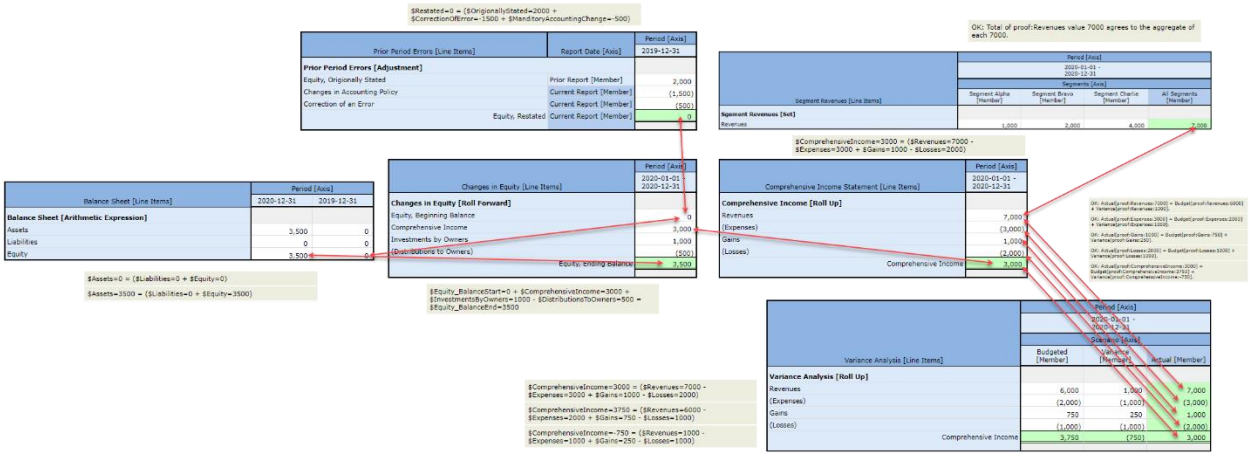
Note that the Revenues of "All Segments" ties to the structure Comprehensive Income and to the structure Variance Analysis as well.

As such, the logical system can still be considered consistent, complete, and precise. Further, any number of dimensions (a.k.a. Axis) can be used to represent a member aggregation, in this specific example we are showing only one dimension, but this would work the same with two, three, or any number of dimensions. Finally, the Member Aggregation Pattern implies the existence of a set of members that are somehow related but do not aggregate, Member Nonaggregation[81]. This can occur either when members of a dimension do not aggregate or when an aggregated value is not required to be disclosed.

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.

[79] Segment Revenues Structure, http://xbrlsite.azurewebsites.net/2020/core/master-proof/evidence-package/contents/index.html#Rendering-SegmentRevenues-proof_SegmentRevenuesHypercube.html
[80] Segment Revenues XBRL Formula for Member Aggregation, http://xbrlsite.azurewebsites.net/2020/core/master-proof/Rule-MemberAggregation-formula.xml
[81] SBRM Terms, Member Nonaggregation, http://xbrlsite.azurewebsites.net/2019/Prototype/sbrm/Terms/MemberNonaggregation.html



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.

Conclusion

It may seem inconceivable that all XBRL-based financial reports can be explained by 10 concept arrangement patterns (the nine shown plus the Member Nonaggregation which is not shown). 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[82]. The Microsoft 2017 10-K has exactly 194 structures[83]. This is a breakdown of those structures by concept arrangement pattern[84] and by SEC reporting level:

Concept Arrangement Pattern	Count
Text Block	89
Set	64
Roll Up	31
Roll Forward	9
Roll Forward Info	1

SEC Level	Count
Level 4 Disclosure Detail	102
Level 3 Disclosure Text Block	47
Level 2 Policy Text Block	23
Level 1 Note Text Block	22

[82] Microsoft XBRL-based Report Analysis, http://xbrl.squarespace.com/journal/2020/4/13/microsoft-xbrl-based-report-analysis.html
[83] Microsoft 10-K for 2017, http://xbrlsite.azurewebsites.net/2017/Prototypes/Microsoft2017/evidence-package/#Rendering-DocumentDocumentAndEntityInformation-us_gaap_StatementTable.html
[84] Concept Arrangement Pattern, http://xbrlsite.azurewebsites.net/2019/Framework/Details/ConceptArrangementPattern.html

These same ideas apply not only to the Microsoft XBRL-based financial report; but also to the XBRL-based financial reports of Apple, Amazon, Facebook, Google/Alphabet, and Salesforce[85].

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.

What this proves is not only that XBRL-based financial reports can work and the proper approaches to conveying meaning within such XBRL-based reports; but also it shows the **process control mechanisms**[86] required to be sure you are creating quality XBRL-based reports.

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[87].

The document *Comparison of Renderings for Concept Arrangement Patterns*[88] shows three consistent implementations of software that understand and work with these concept arrangement patterns correctly and consistently.

The next iteration of the series of proofs that I am creating is the *Common Elements of Financial Statements*[89]. Beyond that is the *Trial Balance*[90] iteration which adds additional aspects to this proof. These same ideas can be used to control accounting, reporting, auditing, and analysis processes which is explained in the document *Understanding Digital*[91]. An overview of the method used to create this document is provided in Understanding Method[92]. Finally, if you

[85] Software Companies Prototype, http://xbrl.squarespace.com/journal/2020/4/2/software-companies-prototype.html
[86] Control Mechanisms, http://xbrl.squarespace.com/journal/2020/5/21/control-of-a-system.html
[87] *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
[88] Comparison of Renderings for Concept Arrangement Patterns, http://xbrlsite.azurewebsites.net/2019/Prototype/conformance-suite/Production/ComparisonOfConceptArrangementPatternRenderings.pdf
[89] Common Elements of Financial Statements, http://xbrlsite.azurewebsites.net/2019/core/master-elements/
[90] Trial Balance, http://xbrlsite.azurewebsites.net/2019/core/core-trialbalance/
[91] Charles Hoffman, CPA, *Understanding Digital*, http://xbrlsite.azurewebsites.net/2020/Library/UnderstandingDigital.pdf
[92] Charles Hoffman, CPA, *Understanding Method*, http://xbrlsite.azurewebsites.net/2020/Library/UnderstandingMethod.pdf

really think about what is going on, what we have here is essentially a semantic workbook as is explained in *Understanding Semantic Spreadsheets*[93].

[93] Charles Hoffman, CPA, *Understanding Semantic Spreadsheets*, http://xbrlsite.azurewebsites.net/2020/Library/UnderstandingSemanticSpreadsheets.pdf