

Impediments to Creating Properly Functioning XBRL-based Reports (SFAC 6)

Understanding the logical system consequences of specific actions

By Charles Hoffman, CPA (Charles.Hoffman@me.com)

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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 summarizes information about versions of a very simple logical system, FASB’s SFAC 6 *Elements of a Financial Statement*, for the purpose of demonstrating what can go wrong and the rules that can be used to prevent those things from going wrong.
- Rules provide a specification of the permissible manipulations of the model of a logical system. Rules prevent anarchy.
- For every action there is an equal and opposite reaction.
- Being conscious of the consequences of actions related to an XBRL-based digital financial report helps you understand how to create high-quality reports.
- Being unconscious can lead to quality problems.
- While the accounting equation example is simple, it is not simplistic at all but rather can be used to help one understand sophisticated information represented cases.
- This document points out 10 states of the simple SFAC 6 example, what causes a state to function improperly, and what it takes to make that state properly functioning.
- The XBRL-based mechanisms used to do this are provided for each example.

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

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If you are reading this you are likely an adult. But computers are not like adults, they are more like babies. Not children, babies. Literally. Computer have to be led by the hand and taken where you want them to go.

Rules provide a specification of the permissible manipulations of the model of a logical system. Rules prevent anarchy. Rules lead the computer by the hand, telling the computer where you need to go.

This document builds on a prior version² of the very basic “SFAC 6 *Elements of Financial Statements*” representation in XBRL. The point is to show the specific consequences of decisions that are made with respect to a logical system and the rules that are necessary as a result of those decisions.

You can download a zip file³ that contains all of the XBRL examples or the human-readable representation of the example⁴. The home page for this information can be found here⁵.

FASB’s SFAC 6, *Elements of Financial Statements*

The FASB’s SFAC 6, *Elements of Financial Statements*⁶,

“are the building blocks with which financial statements are constructed—the classes of items that financial statements comprise. The items in financial statements represent in words and numbers certain entity resources, claims to those resources, and the effects of transactions and other events and circumstances that result in changes in those resources and claims.”

The *Elements of Financial Statements* is part of the conceptual framework⁷ which defines the US GAAP financial reporting scheme⁸ and has the accounting equation model at its core. The accounting equation is:

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

² SFAC 6 Elements of a Financial Statement, prior version, <http://xbrlsite.azurewebsites.net/2019/core/core-sfac6/>

³ ZIP file download, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/download.zip>

⁴ Human readable representation, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/evidence-package.zip>

⁵ Index page, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/index.html>

⁶ FASB, SFAC 6, *Elements of Financial Statements*, Accounting Equation, <https://www.fasb.org/pdf/con6.pdf>

⁷ FASB, *Conceptual Framework*, <https://www.fasb.org/jsp/FASB/Page/BridgePage&cid=1176168367774>

⁸ Charles Hoffman, CPA, *Comparison of Financial Reporting Schemes High Level Concepts*, <http://xbrlsite.azurewebsites.net/2018/Library/ReportingSchemes-2018-12-30.pdf>

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

The FASB uses the analogy of a “photograph” and a “motion picture” to differentiate the two types of elements⁹. Three elements that are like a photograph are “Assets”, “Liabilities” and “Equity” and are for a point in time. In XBRL terms, these “photograph” type elements or “stocks” are instants or “as of” a specific point in time. The others elements are like “motion pictures” or “flows” over a period of time, in XBRL terms they are durations or “for period”.

The FASB explicitly states the components of comprehensive income which include: revenues, expenses, gains, and losses¹⁰.

Note that the balance types, “debit” or “credit”, of each of the 10 elements of financial statements are not articulated by the FASB. However, professional accountants understand the balance type of the 10 elements which are the building blocks of a financial report. As such, these balance types can be implied without dispute. However, I am explicitly specifying the balance types explicitly in my XBRL representation which makes this crystal clear.

Note the term “interrelated”. If you read the definitions you can implicitly understand the specific interrelations. The FASB uses the term “articulation” to describe the notion that financial statements are fundamentally interrelated¹¹. They result in financial statements that are fundamentally interrelated and connected mathematically.

⁹ FASB, SFAC 6, page 21, paragraph 20

¹⁰ FASB, SFAC 6, page 21, paragraph 20

¹¹ FASB, SFAC 6, page 21 and 22, paragraph 21

The following four equations (i.e. **rule or assertions**) articulate the fundamental relationships between all these elements of a financial report defined by the FASB in SFAC 6. First, as the FASB stated;

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

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.

$$0 = (\text{Equity}^{\text{T}0} + \text{Revenue}^{\text{P}1} - \text{Expenses}^{\text{P}1} + \text{Gains}^{\text{P}1} - \text{Losses}^{\text{P}1} + \text{InvestmentsByOwners}^{\text{P}1} - \text{DistributionsToOwners}^{\text{P}1}) + \text{Liabilities}^{\text{T}1} - \text{Assets}^{\text{T}1}$$

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):

$$\text{Equity}^{\text{T}1} = \text{Equity}^{\text{T}0} + \text{ComprehensiveIncome}^{\text{P}1} + \text{InvestmentsByOwners}^{\text{P}1} - \text{DistributionsToOwners}^{\text{P}1}$$

Finally, we add the accounting equation which is the basis of every financial reporting scheme and no professional accountant can dispute:

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

And so, using those three equations, the interrelationships between each of the elements that make up a financial statement is explicitly defined and crystal clear as long as you understand the balance type (debit, credit) of each of the core elements.

SFAC 6 states explicitly that economic entities creating financial reports will define their report line items based on these financial statement elements¹²,

“Particular economic things and events, such as cash on hand or selling merchandise, that may meet the definitions of elements are not elements as the term is used in this Statement. Rather, they are called **items** or other descriptive names. This Statement focuses on the broad classes and their characteristics instead of defining particular assets, liabilities, or other items.”

While financial reports must fit within the elements of a financial report defined by a financial reporting scheme; financial reports are not forms. Specific variability in these items, subtotals, and totals is anticipated between reporting economies entities and allowed by financial

¹² FASB, SFAC 6, page 14, paragraph 5

reporting schemes such as US GAAP¹³. By far, the most variability that exists within a set of financial statements exists on the income statement. SFAC 6 discusses the notion of intermediate components¹⁴ of comprehensive income:

“Examples of intermediate components in business enterprises are *gross margin, income from continuing operations before taxes, income from continuing operations, and operating income*. Those **intermediate components** are, in effect, *subtotals* of comprehensive income and often of one another in the sense that they can be combined with each other or with the basic components to *obtain other intermediate measures* of comprehensive income.”

Practices exist for determining the items, subtotals, and totals that make up a financial statement. Basically, variability can be caused by choosing to report different common subtotals or not or by choosing to report specific line items rather than other line items. I refer to these different totals, subtotals, and specific line items as the notion of **reporting styles**¹⁵. This variability is by no means random or completely arbitrary. There are common reporting style patterns. And all must ultimately be reducible to and consistent with the 10 elements of financial statements. Essentially, reporting styles are **models**¹⁶.

Of the four concepts “revenues”, “expenses”, “gains”, and “losses” there are themes in the definitions of the terms. One theme is the notion of something related to an “entity’s ongoing major or central operations” (i.e. revenues, expenses) and something “from peripheral or incidental transactions” (i.e. gains, losses). This notion is discussed in SFAC 6. These themes are used to, for example, distinguish operating from nonoperating report line items.

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)

¹³ Charles Hoffman, CPA, *Comparison of Elements of Financial Statements*, <http://xbrlsite.azurewebsites.net/2019/Core/ElementsOfFinancialStatements.pdf>

¹⁴ FASB, SFAC 6, page 47, paragraph 77.

¹⁵ Open Framework for Implementing XBRL-based Financial Reporting, *Reporting Styles*, <http://xbrlsite.azurewebsites.net/2019/Framework/Details/ReportingStyle.html>

¹⁶ *Stanford Encyclopedia of Philosophy, First-order Model Theory*, <https://plato.stanford.edu/entries/modeltheory-fo/>

- Changes in equity (i.e. connects the balance sheet to the income statement per 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**¹⁷ 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

¹⁷ Human readable rendering of balance sheet, <http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/evidence-package/contents/index.html#Rendering-BS-Implied.html>

Shell of a **comprehensive income** statement¹⁸ which measures performance:

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**¹⁹ 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.)

¹⁸ Human readable rendering of comprehensive income statement, <http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/evidence-package/contents/index.html#Rendering-IS-Implied.html>

¹⁹ Human readable rendering of changes in equity, http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/evidence-package/contents/index.html#Rendering-ChangesInEquity-sfac6_ChangesInEquityHypercube.html

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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 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:

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

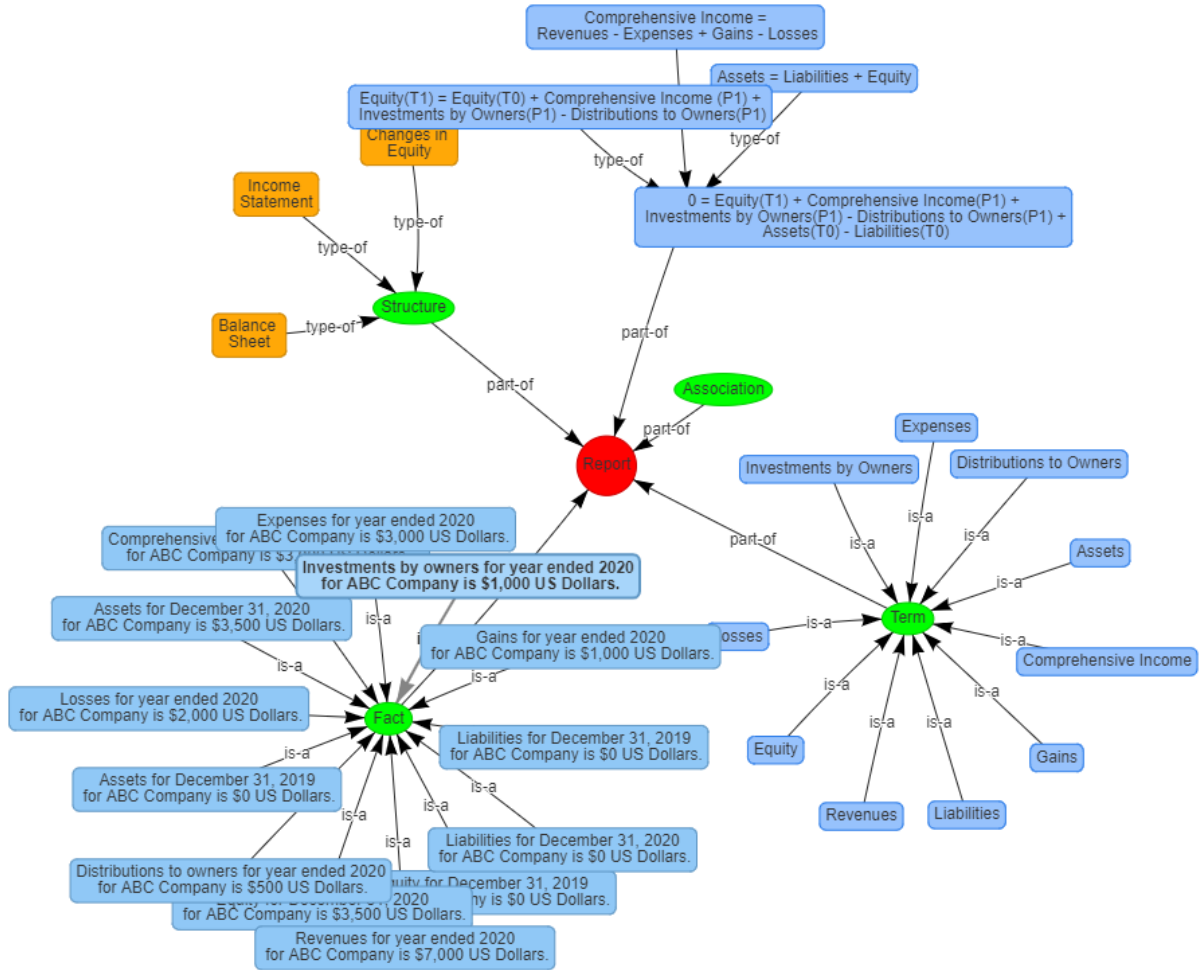
Comprehensive Income Statement [Line Items]	Period [Axis]
	2020-01-01 - 2020-12-31
Comprehensive Income [Roll Up]	
Revenues	7,000
(Expenses)	(3,000)
Gains	1,000
(Losses)	(2,000)
Comprehensive Income	3,000

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

And so, the information that has been explained above can be represented²⁰ as the following set of vertices and edges using graph theory²¹:

²⁰ Visualization using graph theory, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/Visualization.html>

²¹ Wikipedia, *Graph Theory*, https://en.wikipedia.org/wiki/Graph_theory



SFAC 6 is essentially a simple man-made logical system²² that builds on the mathematical model of double entry accounting²³.

A **logical system**²⁴. A logical system can be described by a logical theory²⁵. 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.

²² YouTube, *Understanding the Financial Report Logical System*, https://www.youtube.com/playlist?list=PLqMZRUzQ64B7EWamzDP-WaYbS_WORL9nt

²³ David Ellerman, *The Mathematics of Double Entry Bookkeeping*, http://www.ellerman.org/wp-content/uploads/2012/12/DEB-Math-Mag.CV_.pdf

²⁴ 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>

²⁵ Wikipedia, *Theory (Mathematical Logic)*, [https://en.wikipedia.org/wiki/Theory_\(mathematical_logic\)](https://en.wikipedia.org/wiki/Theory_(mathematical_logic))

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 their 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 AI²⁶ (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 information²⁷. This SFAC 6 logical system is a demonstration of how XBRL-based digital financial reporting works²⁸. What is more important is that the SFAC 6 logical system can show where digital financial reporting “breaks” or experiences impediments and the mechanisms necessary to overcome or mitigate those impediments.

SFAC 6 Logical System Represented Using XBRL

The following is a summary of the logical model of FASB’s SFAC 6 logical system expressed in both machine-readable and human-readable terms.

One specific thing to note is that additional details are being added to the simple explanation provided above. For example, above we defined “Assets”. But now, we define “Assets” as being a data type of “monetary”, being “as of” a specific point in time (i.e. instant), and being a “Debit”. Computers need this precise representation to help humans achieve what they desire to achieve from this logical system. You probably were aware that Assets is a debit and as of a point in time and is a number.

In this explanation we are eliminating some details to keep the explanation of what we are discussing and the information we are trying to convey as simple as possible.

And so the following provides an overview and both human-readable and machine-readable examples of the terms, structures, associations, assertions, and facts of the SFAC 6 logical system represented in XBRL and using off-the-shelf commercial software applications.

²⁶ ACCA, Narayanan Vaidyanathan, *Explainable AI: Putting the user at the core*, https://www.accaglobal.com/uk/en/professional-insights/technology/Explainable_AI.html

²⁷ Charles Hoffman, CPA, *Special Theory of Machine-based Automated Communication of Semantic Information of Financial Statements*, <http://xbrl.azurewebsites.net/2019/Library/SpecialTheoryOfSemanticCommunicationOfFinancialInformation.pdf>

²⁸ *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>

TERMS^{29,30}:

The 10 elements of financial statements of the SFAC 6 logical system are defined using simple terms (a.k.a report elements) as follows:

#	Label	Data Type	Period Type	Balance Type	Prefix	Standard label, Documentation, References, Concept name	Count						
1	Assets	Monetary	As Of (instant)	Debit	sfac6	<p><i>Filer label:</i> Assets</p> <p><i>Documentation:</i> Assets are probable future economic benefits obtained or controlled by a particular entity as a result of past transactions or events.</p> <p><i>References:</i></p> <table border="1"> <thead> <tr> <th>Publisher</th> <th>Reference Name</th> <th>Reference Information</th> </tr> </thead> <tbody> <tr> <td>FASB</td> <td>SFAC</td> <td>Paragraph: 25 URIDate: 2019-10-22 URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true Number: 6</td> </tr> </tbody> </table> <p><i>Name:</i> sfac6:Assets</p>	Publisher	Reference Name	Reference Information	FASB	SFAC	Paragraph: 25 URIDate: 2019-10-22 URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true Number: 6	1
Publisher	Reference Name	Reference Information											
FASB	SFAC	Paragraph: 25 URIDate: 2019-10-22 URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true Number: 6											
2	Comprehensive Income	Monetary	For Period (duration)	Credit	sfac6	<p><i>Filer label:</i> Comprehensive Income</p> <p><i>Documentation:</i> Comprehensive income is the change in equity of a business enterprise during a period from transactions and other events and circumstances from nonowner sources. It includes all changes in equity during a period except those resulting from investments by owners and distributions to owners.</p> <p><i>References:</i></p> <table border="1"> <thead> <tr> <th>Publisher</th> <th>Reference Name</th> <th>Reference Information</th> </tr> </thead> <tbody> <tr> <td>FASB</td> <td>SFAC</td> <td>Paragraph: 79 URIDate: 2019-10-22 URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true Number: 6</td> </tr> </tbody> </table> <p><i>Name:</i> sfac6:ComprehensiveIncome</p>	Publisher	Reference Name	Reference Information	FASB	SFAC	Paragraph: 79 URIDate: 2019-10-22 URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true Number: 6	2
Publisher	Reference Name	Reference Information											
FASB	SFAC	Paragraph: 79 URIDate: 2019-10-22 URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true Number: 6											
3	Distributions to Owners	Monetary	For Period (duration)	Debit	sfac6	<p><i>Filer label:</i> Distributions to Owners</p> <p><i>Documentation:</i> Distributions to owners are decreases in equity of a particular business enterprise resulting from transferring assets, rendering services, or incurring liabilities by the enterprise to owners. Distributions to owners decrease ownership interest (or equity) in an enterprise.</p> <p><i>References:</i></p> <table border="1"> <thead> <tr> <th>Publisher</th> <th>Reference Name</th> <th>Reference Information</th> </tr> </thead> <tbody> <tr> <td>FASB</td> <td>SFAC</td> <td>Paragraph: 68 URIDate: 2019-10-22 URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true Number: 6</td> </tr> </tbody> </table> <p><i>Name:</i> sfac6:DistributionsToOwners</p>	Publisher	Reference Name	Reference Information	FASB	SFAC	Paragraph: 68 URIDate: 2019-10-22 URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true Number: 6	1
Publisher	Reference Name	Reference Information											
FASB	SFAC	Paragraph: 68 URIDate: 2019-10-22 URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true Number: 6											
4	Equity	Monetary	As Of (instant)	Credit	sfac6	<p><i>Filer label:</i> Equity</p>	2						

STRUCTURES^{31,32}

In addition to the three simple terms, three functional term are defined to represent the balance sheet, income statement, and changes in equity structures using XBRL hypercubes:

#	Label	Prefix	Standard label, Documentation, References, Concept name	Count
1	Balance Sheet [Hypercube]	sfac6	<p><i>Filer label:</i> Balance Sheet [Hypercube]</p> <p><i>Documentation:</i></p> <p><i>References:</i> NONE</p> <p><i>Name:</i> sfac6:BalanceSheetHypercube</p>	1
2	Changes in Equity [Hypercube]	sfac6	<p><i>Filer label:</i> Changes in Equity [Hypercube]</p> <p><i>Documentation:</i></p> <p><i>References:</i> NONE</p> <p><i>Name:</i> sfac6:ChangesInEquityHypercube</p>	1
3	Comprehensive Income Statement [Hypercube]	sfac6	<p><i>Filer label:</i> Comprehensive Income Statement [Hypercube]</p> <p><i>Documentation:</i></p> <p><i>References:</i> NONE</p> <p><i>Name:</i> sfac6:ComprehensiveIncomeStatementHypercube</p>	1

²⁹ Machine-readable terms, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/sfac6.xsd>

³⁰ Human-readable terms, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/evidence-package/contents/ReportElements-Concepts.html>

³¹ Machine-readable structures, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/sfac6.xsd>

³² Human-readable structures, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/evidence-package/contents/ReportElements-Tables.html>

ASSOCIATIONS^{33,34}:

The association between the 10 simple terms and the 3 structures (i.e. functional terms) are provided. Some additional infrastructure report elements are created when representing information using XBRL to help organize the human-readable representation:

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

#	Label	Report Element Class	Period Type	Balance	Name
1	Balance Sheet [Hypercube]	[Table]			sfac6:BalanceSheetHypercube
2	Balance Sheet [Line Items]	[Line Items]			sfac6:BalanceSheetLineItems
3	<i>Balance Sheet [Arithmetic Expression]</i>	[Abstract]			sfac6:BalanceSheetSet
4	Assets	[Concept] Monetary	As Of	Debit	sfac6:Assets
5	Liabilities	[Concept] Monetary	As Of	Credit	sfac6:Liabilities
6	Equity	[Concept] Monetary	As Of	Credit	sfac6:Equity

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

#	Label	Report Element Class	Period Type	Balance	Name
1	Comprehensive Income Statement [Hypercube]	[Table]			sfac6:ComprehensiveIncomeStatementHypercube
2	Comprehensive Income Statement [Line Items]	[Line Items]			sfac6:ComprehensiveIncomeStatementLineItems
3	<i>Comprehensive Income [Roll Up]</i>	[Abstract]			sfac6:ComprehensiveIncomeRollUp
4	Revenues	[Concept] Monetary	For Period	Credit	sfac6:Revenues
5	(Expenses)	[Concept] Monetary	For Period	Debit	sfac6:Expenses
6	Gains	[Concept] Monetary	For Period	Credit	sfac6:Gains
7	(Losses)	[Concept] Monetary	For Period	Debit	sfac6:Losses
8	Comprehensive Income	[Concept] Monetary	For Period	Credit	sfac6:ComprehensiveIncome

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

#	Label	Report Element Class	Period Type	Balance	Name
1	Changes in Equity [Hypercube]	[Table]			sfac6:ChangesInEquityHypercube
2	Changes in Equity [Line Items]	[Line Items]			sfac6:ChangesInEquityLineItems
3	<i>Changes in Equity [Roll Forward]</i>	[Abstract]			sfac6:ChangesInEquityRollForward
4	Equity, Beginning Balance	[Concept] Monetary	As Of	Credit	sfac6:Equity
5	Comprehensive Income	[Concept] Monetary	For Period	Credit	sfac6:ComprehensiveIncome
6	Investments by Owners	[Concept] Monetary	For Period	Credit	sfac6:InvestmentsByOwners
7	(Distributions to Owners)	[Concept] Monetary	For Period	Debit	sfac6:DistributionsToOwners
8	Equity, Ending Balance	[Concept] Monetary	As Of	Credit	sfac6:Equity

ASSERTIONS^{35,36}:

The four mathematical relationships or assertions (a.k.a. rules) are represented between the 10 elements defined: (you see five assertions because the balance sheet assertion fires twice, once for the beginning and once for the ending balance sheet facts)

³³ Machine-readable associations, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/sfac6-pre.xml>

³⁴ Human-readable associations, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/evidence-package/contents/ModelSummary.html>

³⁵ Machine-readable assertions, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/RollForward-1-Code-SHE01-formula.xml>

³⁶ Human-readable assertions, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/evidence-package/contents/BusinessRulesSummary.html>

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#	Label	Result	Rule
1	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$ (CONSISTENCY_6)	Pass	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$
2	$\$Assets = (\$Liabilities + \$Equity)$ (CONSISTENCY_5)	Pass	$\$Assets = (\$Liabilities + \$Equity)$
3	$\$Assets = (\$Liabilities + \$Equity)$ (CONSISTENCY_5)	Pass	$\$Assets = (\$Liabilities + \$Equity)$
4	$\$Equity_BalanceStart + \$ComprehensiveIncome + \$InvestmentsByOwners - \$DistributionsToOwners = \$Equity_BalanceEnd$ (RollForward_1)	Pass	$\$Equity_BalanceStart + \$ComprehensiveIncome + \$InvestmentsByOwners - \$DistributionsToOwners = \$Equity_BalanceEnd$
5	$0 = (Equity\{T0\} + (Revenue\{P1\} - Expenses\{P1\} + Gains\{P1\} - Losses\{P1\}) + (InvestmentsByOwners\{P1\} - DistributionsToOwners\{P1\})) + Liabilities\{T1\} - Assets\{T1}$ (ASSERTION_SFAC6_CONCEPTUAL_FRAMEWORK_RECONCILIATION)	Pass	$0 = ((\$Equity_BalanceStart + ((\$Revenues - \$Expenses) + (\$Gains - \$Losses)) + (\$InvestmentsByOwners - \$DistributionsToOwners)) + (\$Liabilities_BalanceEnd - \$Assets_BalanceEnd))$

FACTS^{37,38}:

We created 13 facts to exercise the logical system. Facts shown below are organized into sets, or fact sets, for each of the financial report structures included in the financial report for the imaginary reporting entity *ABC Company*:

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

#	Reporting Entity [Axis]	Period [Axis]	Concept	Fact Value	Unit	Rounding	Parentetical Explanations
1	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2019-12-31	Assets	0	USD	INF	
2	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-12-31	Assets	3500	USD	INF	
3	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2019-12-31	Liabilities	0	USD	INF	
4	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-12-31	Liabilities	0	USD	INF	
5	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2019-12-31	Equity	0	USD	INF	
6	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-12-31	Equity	3500	USD	INF	

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

#	Reporting Entity [Axis]	Period [Axis]	Concept	Fact Value	Unit	Rounding	Parentetical Explanations
1	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Revenues	7000	USD	INF	
2	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Expenses	3000	USD	INF	
3	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Gains	1000	USD	INF	
4	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Losses	2000	USD	INF	
5	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Comprehensive Income	3000	USD	INF	

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

#	Reporting Entity [Axis]	Period [Axis]	Concept	Fact Value	Unit	Rounding	Parentetical Explanations
1	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2019-12-31	Equity	0	USD	INF	
2	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-12-31	Equity	3500	USD	INF	
3	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Comprehensive Income	3000	USD	INF	
4	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Investments by Owners	1000	USD	INF	
5	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Distributions to Owners	500	USD	INF	

The facts are rendered into human-readable form using software algorithms; the machine-readable terms, structures, associations, assertions, and facts; common knowledge about how

³⁷ Machine-readable facts, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/instance.xml>

³⁸ Human-readable facts, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/evidence-package/contents/FactTableSummary.html>

professional accountants want to see reported financial information; and patterns in the form of logical rules about the nature of business and financial reports³⁹.

Balance sheet⁴⁰

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

Income statement⁴¹

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

³⁹ YouTube, *Phase Transitions*, <https://youtu.be/K-aqk7dM9Ok>

⁴⁰ Human-readable balance sheet, http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/evidence-package/contents/index.html#Rendering-BalanceSheet-sfac6_BalanceSheetHypercube.html

⁴¹ Human-readable income statement, http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-sfac6_ComprehensiveIncomeStatementHypercube.html

Changes in equity⁴²

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

And so, the automatically machine-generated human-readable logical model above is used to explain the details of the report information in human-readable terms and if you go and fiddle with those human-readable representations you can see that you can see all the underlying details of the both human-readable and machine-readable financial report. Keep in mind that this information is static HTML. Just as well, this information can be represented in more dynamic form which is configurable by a software user or by any software application that supports the XBRL global standard technical syntax.

Below you can see an alternative representation in the form of the Inline XBRL format⁴³. The Inline XBRL representation was automatically generated from the machine-readable information.

Alternatively, the Inline XBRL presentation layer can be manually created and the human-readable HTML representation can be configured using all of the precision offered by HTML, cascading style sheets (CSS), and other presentation layout tools such as XSL Formatting Objects⁴⁴ (XSL-FO) and a Formatting Objects Processor⁴⁵ (FOP) to generate PDF, Word, or any other arbitrary presentation format as precisely as that format supports. Again, note that this Inline XBRL was auto-generated from the raw XBRL and the XBRL taxonomy information:

⁴² Human-readable changes in equity, http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/evidence-package/contents/index.html#Rendering-ChangesInEquity-sfac6_ChangesInEquityHypercube.html

⁴³ Human-readable and machine-readable facts using Inline XBRL, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/instance.html>

⁴⁴ Wikipedia, XSL-Formatting Objects, https://en.wikipedia.org/wiki/XSL_Formatting_Objects

⁴⁵ Apache, Apache FOP Project, <https://xmlgraphics.apache.org/fop/>

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Inline XBRL Business Report

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

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

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

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, 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:

Consistent

Complete

Precise

Assets = 3,500^{T1}; 0^{T0}

Liabilities = 0^{T1}; 0^{T0}

Equity = 3,500^{T1}; 0^{T0}

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^{T1} = Equity^{T0} + Comprehensive
Income^{P1} + Investments by Owners^{P1} -
Distributions to Owners^{P1}

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

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

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.

SFAC 6 Logical System Represented Using Prolog

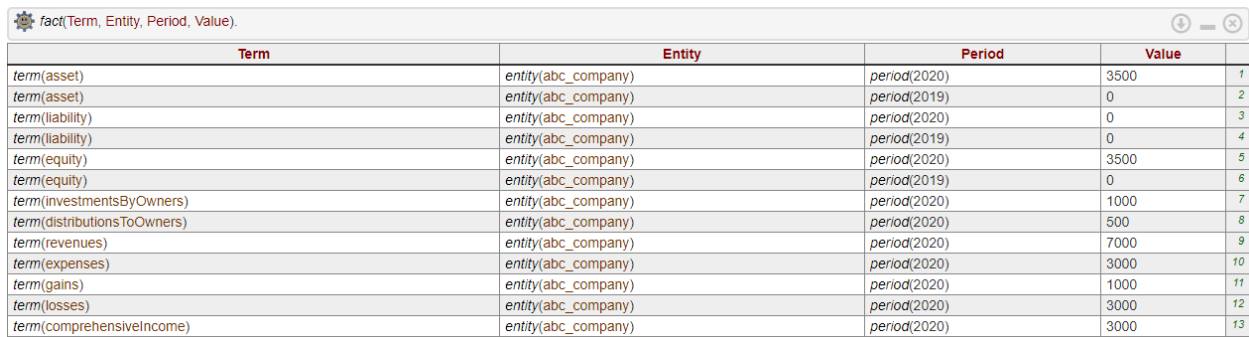
In addition to representing SFAC 6 using the XBRL technical syntax, it was also represented using Prolog which is a first-order logic programming language⁴⁶.

Note that the same results were obtained by representing the logical system using the Prolog technical syntax⁴⁷. The Prolog syntax was processed using the online cloud-based SWISH SWI-Prolog Processor⁴⁸. This video helps you understand how to process the Prolog example yourself⁴⁹.

The terms, facts, and rules were represented in the Prolog syntax. The structures and their associations can be implied per the rules. The Prolog representation is not as precise, for example, we did not take the time to indicate the balance type of terms or other details. This was due to my limited knowledge of Prolog only and the level of experimentation we desired to achieve. All of these additional details could be added. Further, there is no current support for generating things like renderings and information audit trails. Our focus was to explore whether the fundamental logical results realized by the XBRL-based representation could be duplicated using Prolog.

The following are the result that were received from processing the SFAC 6 example that was also represented in XBRL:

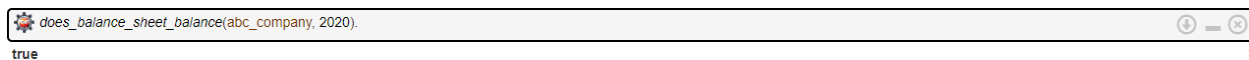
Facts:



The screenshot shows a Prolog query result for the fact `fact(Term, Entity, Period, Value)`. The results are displayed in a table with the following columns: Term, Entity, Period, Value, and an index. The data rows are as follows:

Term	Entity	Period	Value	
<code>term(asset)</code>	<code>entity(abc_company)</code>	<code>period(2020)</code>	3500	1
<code>term(asset)</code>	<code>entity(abc_company)</code>	<code>period(2019)</code>	0	2
<code>term(liability)</code>	<code>entity(abc_company)</code>	<code>period(2020)</code>	0	3
<code>term(liability)</code>	<code>entity(abc_company)</code>	<code>period(2019)</code>	0	4
<code>term(equity)</code>	<code>entity(abc_company)</code>	<code>period(2020)</code>	3500	5
<code>term(equity)</code>	<code>entity(abc_company)</code>	<code>period(2019)</code>	0	6
<code>term(investmentsByOwners)</code>	<code>entity(abc_company)</code>	<code>period(2020)</code>	1000	7
<code>term(distributionsToOwners)</code>	<code>entity(abc_company)</code>	<code>period(2020)</code>	500	8
<code>term(revenues)</code>	<code>entity(abc_company)</code>	<code>period(2020)</code>	7000	9
<code>term(expenses)</code>	<code>entity(abc_company)</code>	<code>period(2020)</code>	3000	10
<code>term(gains)</code>	<code>entity(abc_company)</code>	<code>period(2020)</code>	1000	11
<code>term(losses)</code>	<code>entity(abc_company)</code>	<code>period(2020)</code>	3000	12
<code>term(comprehensiveIncome)</code>	<code>entity(abc_company)</code>	<code>period(2020)</code>	3000	13

Validation of facts using rules:



The screenshot shows a Prolog query result for the fact `does_balance_sheet_balance(abc_company, 2020)`. The result is a single row with the value `true`.

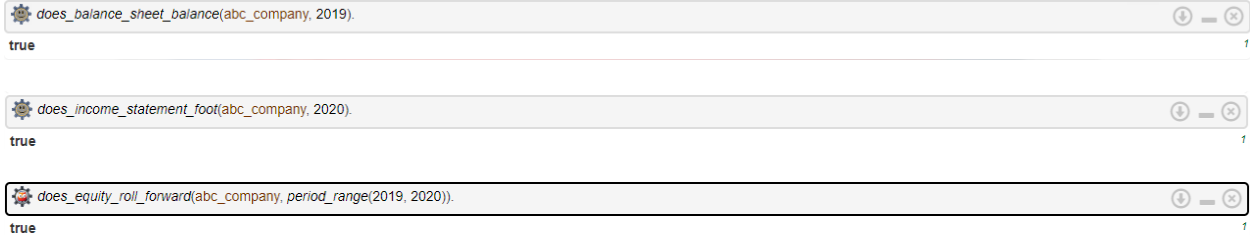
<code>does_balance_sheet_balance(abc_company, 2020)</code>	<code>true</code>
--	-------------------

⁴⁶ Wikipedia, Prolog, <https://en.wikipedia.org/wiki/Prolog>

⁴⁷ SFAC 6 logical system information represented using Prolog, http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/Prolog_FASB_SFAC6.txt

⁴⁸ SWISH SWI-Prolog, <https://swish.swi-prolog.org/>

⁴⁹ YouTube.com, SFAC 6 Logical System in Prolog, <https://youtu.be/-McqmlhFLy4>



This is the complete Prolog syntax:

```
% FASB SFAC 6, Elements of Financial Statements, in Prolog %
% https://www.fasb.org/pdf/con6.pdf %
% Created by Charles Hoffman, CPA (charles.hoffman@me.com). %
% Public domain: https://creativecommons.org/publicdomain/zero/1.0/ %
% Run SWI-Prolog using https://swish.swi-prolog.org/ %

term(asset).
term(liability).
term(equity).
term(comprehensiveIncome).
term(investmentsByOwners).
term(distributionsToOwners).
term(revenues).
term(expenses).
term(gains).
term(losses).

structure(statementOfFinancialPosition).
structure(statementOfIncome).
structure(statementOfChangesInEquity).

entity(abc_company).
period(2020).
period(2019).

assertion(does_balance_sheet_balance).
assertion(does_income_statement_foot).
assertion(does_equity_roll_forward).

fact(term(asset), entity(abc_company), period(2020), 3500).
fact(term(asset), entity(abc_company), period(2019), 0).
fact(term(liability), entity(abc_company), period(2020), 0).
fact(term(liability), entity(abc_company), period(2019), 0).
fact(term(equity), entity(abc_company), period(2020), 3500).
fact(term(equity), entity(abc_company), period(2019), 0).

fact(term(investmentsByOwners), entity(abc_company), period(2020), 1000).
fact(term(distributionsToOwners), entity(abc_company), period(2020), 500).

fact(term(revenues), entity(abc_company), period(2020), 7000).
fact(term(expenses), entity(abc_company), period(2020), 3000).
fact(term(gains), entity(abc_company), period(2020), 1000).
fact(term(losses), entity(abc_company), period(2020), 2000).
fact(term(comprehensiveIncome), entity(abc_company), period(2020), 3000).

% rule Assets = Liabilities + Equity %
```

```
does_balance_sheet_balance(Entity, Period) :-
    fact(term(asset),entity(Entity),period(Period),Asset),
    fact(term(liability),entity(Entity),period(Period),Liability),
    fact(term(equity),entity(Entity),period(Period),Equity),
    Asset is Liability + Equity.

% rule ComprehensiveIncome = Revenues - Expenses + Gains - Losses %
does_income_statement_foot(Entity, Period) :-
    fact(term(comprehensiveIncome),entity(Entity),period(Period),ComprehensiveIncome),
    fact(term(revenues),entity(Entity),period(Period),Revenues),
    fact(term(expenses),entity(Entity),period(Period),Expenses),
    fact(term(gains),entity(Entity),period(Period),Gains),
    fact(term(losses),entity(Entity),period(Period),Losses),
    ComprehensiveIncome is Revenues - Expenses + Gains - Losses.

% rule EndingEquity = BeginningEquity + ComprehensiveIncome + InvestmentsByOwners - DistributionsToOwners %
does_equity_roll_forward(Entity, Period) :-
    fact(term(equity),entity(Entity),period(2019),BeginningEquity),
    fact(term(comprehensiveIncome),entity(Entity),period(Period),ComprehensiveIncome),
    fact(term(equity),entity(Entity),period(Period),EndingEquity),
    fact(term(distributionsToOwners),entity(Entity),period(Period),DistributionsToOwners),
    EndingEquity is BeginningEquity + ComprehensiveIncome - DistributionsToOwners.

% rule EndingEquity = BeginningEquity + ComprehensiveIncome + InvestmentsByOwners - DistributionsToOwners %
does_equity_roll_forward(Entity, period_range(BeginningPeriod,EndPeriod)) :-
    fact(term(equity),entity(Entity),period(BeginningPeriod),BeginningEquity),
    fact(term(comprehensiveIncome),entity(Entity),period(EndPeriod),ComprehensiveIncome),
    fact(term(equity),entity(Entity),period(EndPeriod),EndingEquity),
    fact(term(investmentsByOwners),entity(Entity),period(EndPeriod),InvestmentsByOwners),
    fact(term(distributionsToOwners),entity(Entity),period(EndPeriod),DistributionsToOwners),
    EndingEquity is BeginningEquity + ComprehensiveIncome + InvestmentsByOwners - DistributionsToOwners.

/** <examples>

?- fact(Term, Entity, Period, Value).
?- does_balance_sheet_balance(abc_company, 2020).
?- does_income_statement_foot(abc_company, 2020).
?- does_equity_roll_forward(abc_company, period_range(2019, 2020)).
?- does_equity_roll_forward(abc_company, period_range(2018, 2020)).

*/
```

I want to thank the members of the SWI Prolog List⁵⁰ for helping me create the Prolog that is shown above.

What I have demonstrated using Prolog can also likely be achieved by other logic programming languages such as CLIPS⁵¹, Answer Set Programming⁵² (ASP), RDF+OWL+SHACL, or other such logic programming language.

⁵⁰ SWI Prolog List, <https://swi-prolog.discourse.group/>

⁵¹ Wikipedia, *CLIPS*, <https://en.wikipedia.org/wiki/CLIPS>

⁵² Wikipedia, *Answer Set Programming*, https://en.wikipedia.org/wiki/Answer_set_programming

Properly and Improperly Functioning Logical Systems

Now, we want to use this base logical system that is properly functioning to explain the sorts of things that can make the system inconsistent, incomplete, or imprecise. This will help you to better understand what is entailed in creating a properly functioning logical system.

When I showed an example of properly and improperly functioning *accounting equation* logical systems it was easy to put six different states on one page and compare/contrast those different states⁵³.

But because the SFAC 6 logical system is about three times larger than the accounting equation logical system, comparisons are harder to show. However, it is still possible to get your head around the moving parts of the SFAC 6 logical system because it is still rather small with 10 terms, 3 structures, 4 assertions (a.k.a. rules).

In the next section you see state #1, the properly functioning SFAC 6 logical system which is consistent, complete, and precise.

In the subsequent sections I want to make some adjustments to the properly functioning logical system above which will make the SFAC 6 logical system either ***inconsistent***, ***incomplete***, and/or ***imprecise*** and explain why the system is then not a properly functioning logical system. You should be able to follow the changes because of the relatively small size of the SFAC 6 logical system and (a) see the impact on the SFAC 6 logical system and (b) understand how to avoid such errors in other larger logical systems.

Before we get to the improperly functioning logical systems, let's take one final look at the properly functioning logical system so that you can compare and contrast the properly functioning and improperly functioning logical systems.

State 1: Properly Functioning SFAC 6 Logical System

For completeness, I want to start by mentioning again our properly functioning SFAC 6 logical system which is *consistent*, *complete*, and *precise*. It can be helpful to contrast other improperly functioning states to this properly functioning state to understand the difference between properly functioning logical systems and improperly functioning systems.

⁵³ *Impediments to Creating Properly Functioning XBRL-based Reports*, page 10, <http://xbrlsite.azurewebsites.net/2020/core/master-ae/Documentation.pdf>

Consistent
Complete
Precise

Assets = 3,500^{T1}; 0^{T0}
Liabilities = 0^{T1}; 0^{T0}
Equity = 3,500^{T1}; 0^{T0}

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^{T1} = Equity^{T0} + Comprehensive Income^{P1} + Investments by Owners^{P1} - Distributions to Owners^{P1}

Balance Sheet

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

Changes in Equity

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

Income Statement

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

This is considered a properly functioning logical system because (a) all the statements within the system are **consistent**; (b) the set of statements that describe the system is **complete**; and (c) the information conveyed by the system is **precise** in its representation of reality. Further, we are formally declaring this “reality”⁵⁴ to be our base understanding.

The structures are constructed correctly within the XBRL representation. When representing information within XBRL presentation relations, the following report element relation patterns are used when you create your representation⁵⁵. We will not be covering this in the document but wanted to include this for the sake of completeness.

		Parent						
		Network	Table	Axis	Member	Line Items	Abstract	Concept
Child	Network	Illegal XBRL	Illegal XBRL	Illegal XBRL	Illegal XBRL	Illegal XBRL	Illegal XBRL	Illegal XBRL
	Table	OK	Disallowed	Disallowed	Disallowed	Disallowed	OK	Disallowed
	Axis	Disallowed	OK	Disallowed	Disallowed	Disallowed	Disallowed	Disallowed
	Member	Disallowed	Disallowed	OK	OK	Disallowed	Disallowed	Disallowed
	Line Items	Disallowed	OK	Disallowed	Disallowed	Disallowed	Disallowed	Disallowed
	Abstract	OK	Disallowed	Disallowed	Disallowed	OK	OK	Disallowed
	Concept	Disallowed	Disallowed	Disallowed	Disallowed	OK	OK	Disallowed

⁵⁴ YouTube, *Reality*, <https://youtu.be/eq2Jw6waaCI>

⁵⁵ XBRL definition relations to represent structure rules for report element organization within XBRL presentation relations, <http://xbrlsite.azurewebsites.net/2020/prototype/sbrm/sbrm-structure-rules-strict-def.xml>

Also, we need to be explicit. We defined 10 terms in the SFAC 6 system: Assets, Liabilities, Equity, Comprehensive Income, Investments by Owners, Distributions to Owners, Revenues, Expenses, Gains, Losses.

Now, you may know what those 10 terms are; but a computer does not. You have to define what you work with relative to something that you know. Imagine our system defines four terms, “fac:Assets”, “fac:Liabilities”, “fac:Equity”, and “fac:LiabilitiesAndEquity”⁵⁶. You understand your system but you have to map every external system into your system⁵⁷. Your internal system understands more than the SFAC 6 system (i.e. you have LiabilitiesAndEquity). You have to be able to compute that value based on some other system’s information⁵⁸. It is perfectly reasonable for our system to create a concept LiabilitiesAndEquity and compute that value even though the SFAC 6 logical system does not have that explicit value.

The point is that different economic entities have different internal report models; but all models of a financial reporting scheme are reconcilable from/to one another in some manner⁵⁹.

State 2: Incomplete Coverage by Rules

The logical system #2 below is intended to show exactly the same information as our #1 properly functioning logical system, except that #2 leaves out the rule “Assets = Liabilities and Equity” and the rule “Equity^{T1} = Equity^{T0} + ComprehensiveIncome^{P1} + InvestmentsByOwners^{P1} - DistributionsToOwners^{P1}” which are showed as grayed out (i.e. because it is assumed to be missing from the logical system).

Coverage is a measure of how well you do or can represent a domain of information within a logical system. “Do” is about using the tools you have correctly and effectively. “Can” is about the capabilities of the tools you are using to represent the rule.

For example, if your logical system neglects to include the rule “Assets = Liabilities + Equity” or “Equity^{T1} = Equity^{T0} + ComprehensiveIncome^{P1} + InvestmentsByOwners^{P1} - DistributionsToOwners^{P1}” or if your tools don’t provide the capabilities to allow you to represent that rule; then there is the possibility that the facts being represented to be

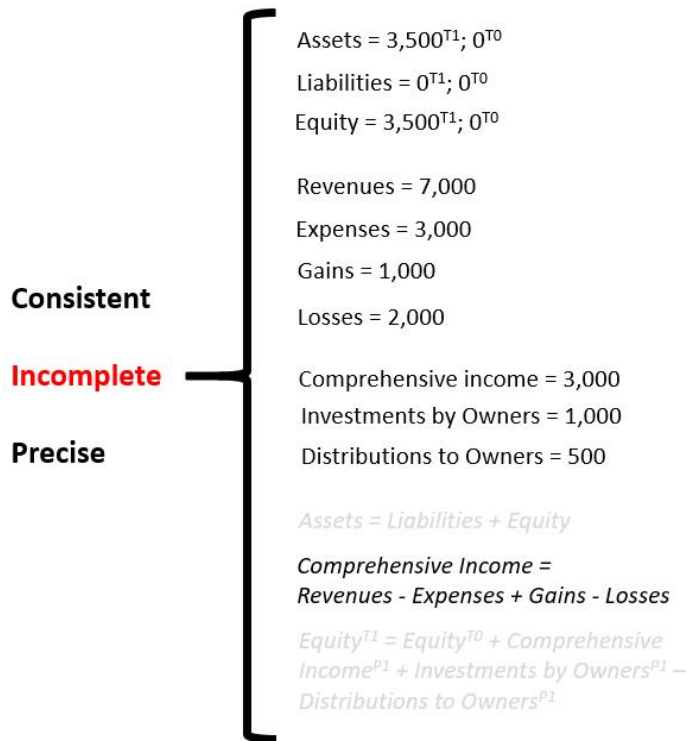
⁵⁶ Fundamental accounting concepts, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/fac.xsd>

⁵⁷ Mapping from SFAC 6 to fundamental accounting concepts in our system, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/fac-mapping-definition.xml>

⁵⁸ XBRL Formula to derive the value for LiabilitiesAndEquity, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/fac-ImputeRule-LiabilitiesAndEquity-formula.xml>

⁵⁹ Charles Hoffman, CPA, *Special Theory of Machine-based Automated Communication of Semantic Information of Financial Statements*, <http://xbrl.squarespace.com/journal/2019/12/30/special-theory-of-machine-based-automated-communication-of-s.html>

represented incorrectly and the system will not detect the inconsistency. As such, that logical system has **incomplete coverage**.



Balance Sheet

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

Changes in Equity

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

Income Statement

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

While this specific state #2 does have the Assets, Liabilities, and Equity facts consistent with the absent rule; the system is still **incomplete** because the coverage can be improved by adding the missing rule. If that missing rules were added back to the system, then the logical system can be considered complete again.

State 3: Inconsistent and Imprecise

All the statements in the system must be **consistent** for the logical system to be considered properly functioning. If statements are inconsistent, the logical system is not properly functioning. In this system #3 the value for Assets in 2020 was changed from \$3,500 to \$8,500, and therefore the values for Assets, Liabilities, and Equity are inconsistent with the rule “Assets = Liabilities + Equity”. This inconsistency is detected by the rule “Assets = Liabilities + Equity”:

id	satisfied	message
CONSISTENCY_5 (evaluation 1)	notSatisfied	\$Assets=8500 = (\$Liabilities=0 + \$Equity=3500)
CONSISTENCY_5 (evaluation 2)	satisfied	\$Assets=0 = (\$Liabilities=0 + \$Equity=0)

From looking at the information provided, it is impossible to know exactly which of the three facts are incorrect; it is only possible to understand that the statements made within the logical system is inconsistent. It could be the case that the rule is incorrect.

But, because we are assuming that in our reality, state #1 has the proper results; we can know that the statement “Assets=\$8,500” is inconsistent with the rule “Assets = Liabilities + Equity”

Inconsistent

Complete

Imprecise

Assets = 8,500^{T1}; 0^{T0}
 Liabilities = 0^{T1}; 0^{T0}
 Equity = 3,500^{T1}; 0^{T0}

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^{T1} = Equity^{T0} + Comprehensive
 Income^{P1} + Investments by Owners^{P1} –
 Distributions to Owners^{P1}*

Balance Sheet

Balance Sheet [Line Items]	Period [Axis]	
	2020-12-31	2019-12-31
Balance Sheet [Arithmetic Expression]		
Assets	8,500	0
Liabilities	0	0
Equity	3,500	0

Changes in Equity

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

Income Statement

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

And so, given that we know from state #1 that the value for Assets is \$3,500 and not \$8,000; the facts in this system is imprecise because the fact for Assets does not reflect reality. And so, the system is made consistent by correcting the fact for Assets for the 2020 balance sheet.

State 4: Unreported Facts

In state #4, the situation is that the economic entity representing information in their report neglected to include the fact for Assets. Whether it is the case that a fact can, or cannot, be left unreported is a decision that can be made by the stakeholders of the system.

If it is the case that it is decided that the fact “Assets” can be omitted if both Liabilities and Equity are reported; then you must provide a rule to derive the value of Liabilities when that fact Assets is not reported. In our system, if the fact Assets is not reported then the machine-

readable rule assumes that the value of the missing fact Assets is 0. As such, the rule indicates that the facts are not consistent with the rule:

id	satisfied	message
CONSISTENCY_5 (evaluation 1)	satisfied	\$Assets=0 = (\$Liabilities=0 + \$Equity=0)
CONSISTENCY_5 (evaluation 2)	notSatisfied	\$Assets=0 = (\$Liabilities=0 + \$Equity=3500)

Because the information is incomplete, users of the information have to make assumptions about the value of a missing fact. This same situation could exist for any fact, for example Liabilities, Equity, or some other fact could go unreported.

Consistent

Incomplete

Precise

- Assets = 0^{T0}
- Liabilities = 0^{T1}; 0^{T0}
- Equity = 3,500^{T1}; 0^{T0}
- 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^{T1} = Equity^{T0} + Comprehensive Income^{P1} + Investments by Owners^{P1} - Distributions to Owners^{P1}

Balance Sheet

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

Changes in Equity

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	

Income Statement

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	

Below in state #4' you see that the system has been adjusted to add the rule "IF Liabilities exists and if Equity exists; THEN Assets = Liabilities + Equity"⁶⁰.

⁶⁰ Here is the impute or derivation rule that would be added to the SFAC6 logical system for this situation, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/ImputeRule-Key-3-Code-BS-Impute-03-formula.xml>

Consistent
Complete
Precise

$Assets = 0^{T0}$

$Liabilities = 0^{T1}; 0^{T0}$

$Equity = 3,500^{T1}; 0^{T0}$

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

$Assets = Liabilities + Equity$

$Comprehensive\ Income = Revenues - Expenses + Gains - Losses$

$Equity^{T1} = Equity^{T0} + Comprehensive\ Income^{P1} + Investments\ by\ Owners^{P1} - Distributions\ to\ Owners^{P1}$

IF Liabilities exists and if Equity exists; THEN Assets = Liabilities + Equity

Balance Sheet

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

Changes in Equity

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

Income Statement

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

If it were likewise true that either Liabilities⁶¹ or Equity⁶² could also be left unreported, similarly derivation rules could be created for each of those facts. Note that XBRL Formula chaining⁶³ can be used to physically derive unreported facts if any one of these three facts remain unreported. Note that it is impossible to derive missing information if any two of the facts remain unreported. Adding the derivation rule makes the system complete.

Allowing certain line items of a report to go unreported specifies the need to create rules to derive missing information. Or saying this another way, omitting the possibility of unreported facts negates the need for creating derivation rules.

A second downside of allowing unreported facts is that you lose the parity check or cross check if facts can go unreported. Said another way, it would be considered best practice to not leave important high-level financial report line items to go unreported.

⁶¹ XBRL Formula rule for deriving Liabilities, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/ImputeRule-Key-1-Code-BS-Impute-01-formula.xml>

⁶² XBRL Formula rule for deriving Equity, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/ImputeRule-Key-2-Code-BS-Impute-02-formula.xml>

⁶³ Deriving Facts Using XBRL Formula Chaining (Example), <http://xbrl.squarespace.com/journal/2019/4/24/deriving-information-using-xbrl-formula-chaining-example.html>

State 5: Incomplete

Similar to state #4, in state #5 the logical system is incomplete because both (a) the fact Assets is unreported and also (b) the consistency rule “Assets = Liabilities + Equity” is missing from the logical system.

Because **both** a fact and the rule are missing from the logical system, it would be impossible to derive the value of Assets in this case. There is simply not enough information in the logical system to allow Assets to be derived. Because both the fact is missing and the rule is missing, the XBRL processing software does not notify the user that there is an issue related to the logical system:

#	Label	Result	Rule
1	$\$Equity_BalanceStart + \$ComprehensiveIncome + \$InvestmentsByOwners - \$DistributionsToOwners = \$Equity_BalanceEnd$ (RollForward_1)	Pass	$\$Equity_BalanceStart + \$ComprehensiveIncome + \$InvestmentsByOwners - \$DistributionsToOwners = \$Equity_BalanceEnd$
2	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$ (CONSISTENCY_6)	Pass	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$

Here you see the information for state #5:

Consistent

Incomplete

Precise

$Assets = 3,500^{T1}; 0^{T0}$

Liabilities = $0^{T1}; 0^{T0}$

Equity = $3,500^{T1}; 0^{T0}$

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

$Equity^{T1} = Equity^{T0} + Comprehensive$
 $Income^{P1} + Investments\ by\ Owners^{P1} -$
 $Distributions\ to\ Owners^{P1}$

Balance Sheet

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

Changes in Equity

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

Income Statement

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

At a minimum, both a consistency crosscheck rule⁶⁴ plus the derivation rule to impute Assets⁶⁵

⁶⁴ XBRL Formula consistency crosscheck rule Assets = Liabilities + Equity, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/Consistency-5-Code-BS01-formula.xml>

⁶⁵ XBRL Formula derivation rule to impute Assets, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/ImputeRule-Key-3-Code-BS-Impute-03-formula.xml>

would be necessary to be added to the system, or the fact could be added to the system without the impute rule to derive the value of Assets. Again, consistent with state #4; Liabilities and Equity would require similar rules if they could be omitted from a report and there would be no parity check of reported information.

State 6: Imprecise

A logical system is a true and fair representation of some agreed upon realism. **Precision** is a measure of how precisely you do or can represent the information of a domain within a logical theory. The reality that we formalized in state #1 indicates that “Assets = Liabilities + Equity”. Yet, here in the state #6 example, the rule “Assets = Liabilities” was provided instead of the rule per state \$1. Further, the values of Assets and Liabilities are, in fact, consistent with the rule that has been provided.

#	Label	Result	Rule
1	$\$Equity_BalanceStart + \$ComprehensiveIncome + \$InvestmentsByOwners - \$DistributionsToOwners = \$Equity_BalanceEnd$ (RollForward_1)	Pass	$\$Equity_BalanceStart + \$ComprehensiveIncome + \$InvestmentsByOwners - \$DistributionsToOwners = \$Equity_BalanceEnd$
2	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$ (CONSISTENCY_6)	Pass	$\$ComprehensiveIncome = (\$Revenues - \$Expenses + \$Gains - \$Losses)$
3	$\$Assets = (\$Liabilities + \$Equity)$ (CONSISTENCY_5)	Pass	$\$Assets = \$Liabilities$
4	$\$Assets = (\$Liabilities + \$Equity)$ (CONSISTENCY_5)	Pass	$\$Assets = \$Liabilities$

Here is the logical system where you see that the information is consistent and complete, but not precise:

Consistent

Complete

Imprecise

- Assets = $0^{T1}; 0^{T0}$
- Liabilities = $0^{T1}; 0^{T0}$
- Equity = $3,500^{T1}; 0^{T0}$
- 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**
- Comprehensive Income = Revenues - Expenses + Gains - Losses
- Equity^{T1} = Equity^{T0} + Comprehensive Income^{P1} + Investments by Owners^{P1} - Distributions to Owners^{P1}

Balance Sheet

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

Changes in Equity

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

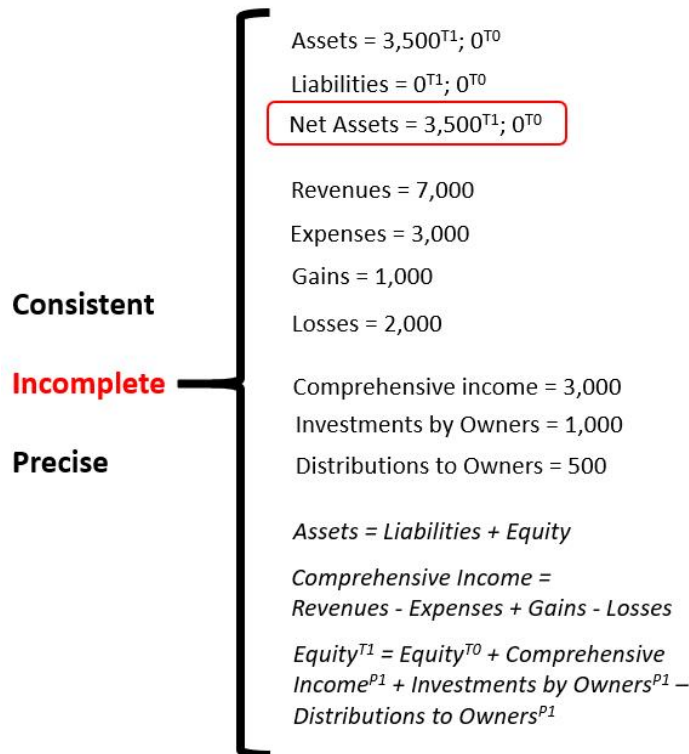
Income Statement

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

Remember that in state #1 we formalized our truth to be that “Assets = Liabilities + Equity”. As such, this logical system can be described as being imprecise. To make this logical system precise, all that needs to be done is to fix the imprecise rule.

State 7: Extension Concept

In state #7, what we are trying to convey is that the economic entity reported the fact for Equity using the extension concept “Net Assets” that it had created. If a fact is represented using an extension concept created by a reporting entity; then a “general-special” or “wider-narrower” or “class-equivalentClass” association must be created to indicate to software applications of the relationship so that information can be used correctly.



Balance Sheet

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

Changes in Equity

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

Income Statement

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

State #7' below, the rule “Net Assets is equivalent to the term Equity” has been added to the logical system which allows the system to operate effectively⁶⁶. Also, the rules would need to be adjusted to use the extension concept Net Assets rather than Equity because the base taxonomy has no knowledge of the extension concept that was created by the reporting economic entity.

⁶⁶ XBRL Definition relations showing example of a mapping rule, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/fac-mapping-definition.xml>

Consistent
Complete
Precise

Assets = 3,500^{T1}; 0^{T0}

Liabilities = 0^{T1}; 0^{T0}

Net Assets = 3,500^{T1}; 0^{T0}

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

Net Assets = Assets + Liabilities

*Comprehensive Income =
Revenues - Expenses + Gains - Losses*

*Net Assets^{T1} = Net Assets^{T0} + Comprehensive
Income^{P1} + Investments by Owners^{P1} -
Distributions to Owners^{P1}*

*Net Assets is equivalent to the term
Equity*

Balance Sheet

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

Changes in Equity

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

Income Statement

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

State 8: Base Taxonomy Wider/Narrower Concept Use

State #8' on the left below is similar to state #7 in that a different concept is used to report a fact; but while state #7 focuses on using an extension concept; state #8' points out that using a wider or narrower base taxonomy concept gives exactly the same result and is just as important.

Now, our base state #1 does not have the concept "Net Assets"; but let's assume for a moment that it does have the concept "Net Assets". Also suppose that there was no information in the base logical system indicating the relationship between "Net Assets" and any other concept. If a fact is represented using a BASE TAXONOMY CONCEPT by a reporting entity; then a "general-special" or "wider-narrower" or "class-equivalentClass" association must exist in that base taxonomy to indicate that some concept is a permissible alternative for some other concept.

State #8' below shown below adds the rule “Net Assets is equivalent to the term Equity”⁶⁷ and assumes this was included in the BASE TAXONOMY in addition to the concept Equity. Further, all rules have been adjusted and would also be included in addition to the other existing rules.

Consistent
Complete
Precise

Assets = 3,500^{T1}; 0^{T0}
 Liabilities = 0^{T1}; 0^{T0}
 Net Assets = 3,500^{T1}; 0^{T0}

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

Net Assets = Assets + Liabilities

Comprehensive Income = Revenues - Expenses + Gains - Losses

Net Assets^{T1} = Net Assets^{T0} + Comprehensive Income^{P1} + Investments by Owners^{P1} – Distributions to Owners^{P1}

Net Assets is equivalent to the term Equity

Balance Sheet

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

Changes in Equity

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

Income Statement

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

⁶⁷ XBRL Definition relations showing example of a mapping rule, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/fac-mapping-definition.xml>

State 9: Defining a Completely New Structure

State #9 below on the left focuses on the **structure** as contrast all the prior examples which focused on the terms and rules. If a new structure is created, the new structure must be referenced to the base taxonomy and the new structure needs to be explained using machine-readable rules⁶⁸. Even base taxonomy structures need to be defined in order to be referred to⁶⁹. When you say “Balance Sheet” you know what that means. But a machine does not know what a Balance Sheet is unless you tell it.

A base taxonomy should (a) provide all necessary structures separately, not intermingle different models in the same set of associations and (b) define what each structure must look like. Remember, computers are like babies and need to be led by the hand in order to understand the details you need them to understand.

Balance Sheet

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

$Assets = Liabilities + Equity$

Consistent
Complete
Precise

Assets = 3,500^{T1}; 0^{T0}
Liabilities = 0^{T1}; 0^{T0}
Net Assets = 3,500^{T1}; 0^{T0}

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

$Net\ Assets = Assets + Liabilities$

$Comprehensive\ Income = Revenues - Expenses + Gains - Losses$

$Net\ Assets^{T1} = Net\ Assets^{T0} + Comprehensive\ Income^{P1} + Investments\ by\ Owners^{P1} - Distributions\ to\ Owners^{P1}$

Net Assets is equivalent to the term Equity

Statement of Net Assets

Net Assets (Line Items)	Period (Axis)	
	2020-12-31	2019-12-31
Net Assets (Arithmetic Expression)		
Assets	3,500	0
Liabilities	0	0
Net Assets	3,500	0

Changes in Equity

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

Income Statement

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	

Information about which concepts should be used to represent the structure must be provided as well as any other information helpful to those that must create such structures.

Finally, in our case we have only three disclosure, Balance Sheet, Income Statement, and Changes in Equity. In our case, the Balance Sheet, Income Statement and Changes in Equity are always required to be reported per this logical system. As such, that rule is stated in a machine-readable reporting checklist⁷⁰. Other logical systems with more disclosures will have more rules

⁶⁸ XBRL Definition relations used to represent structure rules, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/dm-ChangesInEquity-rules-def.xml>

⁶⁹ XBRL taxonomy schema used to define “Balance Sheet”, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/disclosures.xsd>

⁷⁰ XBRL Definition relations used to represent a reporting checklist or disclosure rules, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/reporting-checklist-rules-def.xml>

relating to when a disclosure is required to be provided in a report. Rules can also be specified relating to which disclosures are required when certain specific line items are reported.

State 10: Organizing Disclosures Using Topics

State #10 points out that while the SFAC 6 logical system has only three structures, the Balance Sheet, Income Statement, and Changes in Equity; ultimately if a complete financial reporting scheme were represented one might have hundreds or even thousands of disclosures.

Disclosures can be organized into topics⁷¹. Then, rather than having one flat list of disclosures, they can be organized into a handy hierarchy⁷² which makes the information more manageable to users of the logical system.

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

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

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

More Complex Examples

While the SFAC 6 logical system is small, it can be used to demonstrate incredibly sophisticated functionality. To see more sophisticated examples, see my *Modern Approach to Creating*

⁷¹ XBRL taxonomy schema used to represent topics, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/topics.xsd>

⁷² XBRL definition relations used to create a hierarchy of disclosures, <http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/disclosures-with-topics-def.xml>

Financial Reporting Scheme examples⁷³ and the document *Proving Financial Reports are Properly Functioning Logical Systems*⁷⁴ which starts with the accounting equation logical system, then models the slightly larger SFAC 6 elements of a financial statement logical system, the common elements of a financial report logical system, a MINI financial reporting scheme logical system, and then contrasts that to the Microsoft 10-K financial report logical system.

Conclusion

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.

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 facts⁷⁵.

⁷³ *Modern Approach to Creating a Financial Reporting Scheme*,
<http://xbrl.squarespace.com/journal/2019/12/19/modern-approach-to-creating-a-financial-reporting-scheme.html>

⁷⁴ *Proving Financial Reports are Properly Functioning Logical Systems*,
<http://xbrl.azurewebsites.net/2019/Library/ProvingFinancialReportAreProperlyFunctioning.pdf>

⁷⁵ *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>