

Intermediate XBRL-based Digital Financial Reporting¹

By Charles Hoffman, CPA (December 17, 2020)

This document helps professional accountants and auditors build on their gentle introduction to XBRL-based digital financial reporting², expanding their knowledge to the next level.

Fundamentally, XBRL-based digital financial reports are a medium for exchanging information³ which is important in today's digital world and which can supercharge what artificial intelligence can achieve for professional accountants.

Accounting existed before writing. Between 5,000 and 10,000 years ago farmers in Mesopotamia, where agriculture was born, used physical objects to count crops and animals⁴. The distinction between types of crops or animals was made by using different types and shapes of objects. These farmers began documenting information using clay tablets in the earliest form of human writing ever discovered called Cuneiform. They partitioned their clay tablet into rows, columns, and cells. Then, in about 3200 BC, around 5,000 years ago, the first spreadsheet was invented. Clay tablets gave way to papyrus, then paper. In the late 20th century, paper began being replaced by electronic versions of paper such as PDF files, word processing documents, HTML files, and electronic spreadsheets.

Structured formats such as XBRL take this transition one step further making the information contained within those documents and making that information not only readable but understandable and interpretable by computer-based processes. This is an important feature in the information age as the complexity and volume of information increases and manual processes are overwhelmed.

Ultimately, software applications will be able to assist professional accountants in the repetitive, monotonous, routine, mechanical, mundane, rote processes and tasks that they perform much like a calculator augments the ability of a professional accountant to do math.

How exactly can this be made to work? Magic? There is no magic involved, just sound engineering and attention to detail. While no magic is involved the resulting functionality will seem quite magical. So how exactly do we get computers to perform this work?

¹ *Intermediate XBRL-based Digital Financial Reporting*, <http://xbrl.squarespace.com/journal/2020/12/15/intermediate-xbrl-based-financial-reporting.html>

² *Gentle and Cheap Introduction to XBRL-based Digital Financial Reporting*, <http://xbrl.squarespace.com/journal/2020/12/4/gentle-and-cheap-introduction-to-xbrl-based-digital-financia.html>

³ *Understanding that XBRL is a Knowledge Media*, <http://xbrl.squarespace.com/journal/2017/1/16/understanding-that-xbrl-is-a-knowledge-media.html>

⁴ Denise Schmandt-Bessersat, *On the origins of writing*, YouTube.com, <https://www.youtube.com/watch?v=kidWY-pJFb0>

Getting Computers to Effectively Perform Work

Per Wikipedia, a **computation**⁵ is defined as:

“A computation is any type of calculation that includes both arithmetical and non-arithmetical steps and which follows a well-defined model (e.g. an algorithm).”

The key takeaway here is that by computation we don't just mean math. Computation means steps that can be followed by a computer. Per Wikipedia (paraphrasing), **algorithm**⁶ is defined as:

“An algorithm is a finite sequence of well-defined instructions, typically to solve a class of problems or to perform a computation. Algorithms are always unambiguous and are used as *specifications* for performing calculations, data processing, automated reasoning, and other tasks.”

Computational logic⁷ is the use of logic to perform or reason about computation. Logic is used to define the steps and tasks. Logic is a set of principles that forms a framework for correct reasoning.

Humans are very capable of carrying out steps and performing tasks. Mechanical devices can also be created to carry out steps and perform tasks, for example a vending machine is such a device. A calculator is also such a device. Computers via the software programs they run can likewise carry out steps and perform tasks.

Can computers perform all work?⁸ The answer is no. For example, computers cannot exercise professional judgment. But computers can help out with many routine, repetitious, monotonous, mechanical, boring, grueling tasks and processes of accounting, reporting, auditing, and analysis.

So again, how do you get computers to perform work? ‘Hope’ is not a sound engineering principle. To get computers to do work effectively one needs “know how”. Know how is a type of practical knowledge. A **best practice** is a method or technique that has been generally accepted as superior to any other known alternatives because it produces results that are superior to those achieved by other means or because it has become a standard way of doing things. This information provides an introduction to a tested, proven, best practices-based method for creating XBRL-based financial reports⁹.

Key to getting computers to perform work effectively is controlling processes. Key to controlling computer-based processes is using computer understandable rules.

Control + Rules = Effective Automation (High Quality)

If a process cannot be controlled then the process simply cannot repeatedly and reliably output high-quality. If process output is not high-quality, automation cannot possibly be effective.

⁵ Wikipedia, *Computation*, <https://en.wikipedia.org/wiki/Computation>

⁶ Wikipedia, *Algorithm*, <https://en.wikipedia.org/wiki/Algorithm>

⁷ Wikipedia, *Computational Logic*, https://en.wikipedia.org/wiki/Computational_logic

⁸ Artificial Intelligence and Knowledge Engineering Basics in a Nutshell, <http://xbrlsite.azurewebsites.net/2019/Library/KnowledgeEngineeringInNutShell.pdf>

⁹ *Understanding Method (Abridged)*, http://xbrlsite.azurewebsites.net/2020/Library/UnderstandingMethod_Abridged.pdf

So, control of a process is necessary in order for the process to be effective. How do you control a process? You control a process using rules. Manual processes are controlled by rules that are read by humans. Automated processes are controlled by rules that are readable by both machines (i.e. to execute the process) and humans (i.e. to make sure the rules are right).

Who creates these machine-readable rules that are used to control processes that yield effective automation? Accountants must create these rules because the rules tend to be accounting oriented. Technical rules tend to relate to rule syntax and such technical rules can be hidden from business professionals. What is left is the business logic and accounting rules that are used to control information and control process workflow. As such, the creation of machine-readable rules must be “self-service”. Business professionals must be empowered to create, adjust, maintain, and otherwise manage the rules that are used to control and therefor effectively automate processes.

We covered this in the introduction, but we will repeat our explanation of what a logical theory is because it introduces a bit of important jargon we need to communicate effectively about this topic.

Logical Theory in Simple Terms

A *logical theory* is made up of a set of *models*, *structures*, *terms*, *associations*, *rules*, and *facts*. In very, very simple terms,

- **Logical theory:** A *logical theory* is a set of models that are consistent with and permissible per that logical theory.
- **Model:** A *model*¹⁰ is a set of structures that are consistent with and permissible interpretations of that model.
- **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 to which the logical theory relates. There are four broad categories of statements:
 - **Terms:** Terms are statements that define ideas used by the logical theory such as “assets”, “liabilities”, “equity”, and “balance sheet”.
 - **Associations:** Associations are statements that describe permissible interrelationships between the terms such as “assets is part-of the balance sheet” or “operating expenses is a type-of expense” or “an asset is a ‘debit’ and is ‘as of’ a specific point in time and is always a monetary numeric value”.
 - **Rules:** Rules are statements that describe what is permissible per the logical system and other constraints. For example, “Assets = Liabilities + Equity” is an example of a consistency type rule.
 - **Facts:** Facts are statements about the numbers and words that are provided by an economic entity within a business report. For example, the financial report, a type of business report, might state “assets for the consolidated legal entity Microsoft as of June 30, 2017 was \$241,086,000,000 expressed in US dollars and rounded to the nearest millions of dollars.”

Fundamentally, a logical theory is a set of statements. Those statements can be represented in machine-readable form. Once in machine-readable form, those statements can be interrogated using software applications. To the extent that this can be done effectively; software tools can assist professional accountants and others working with those statements. This includes the creation of these statements.

¹⁰ Wikipedia, *Model Theory*, https://en.wikipedia.org/wiki/Model_theory

A logical theory is said to be **consistent** if there are no contradictions or inconsistencies with respect to the statements made by the logical theory.

A logical theory 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.

An XBRL-based financial report is a machine-readable version of what has historically been represented on paper. Humans can interpret that paper, computers cannot. A logical theory can be used to break up the pieces of a financial report into ideas that can be explained to humans (to see if they agree with the theory) and to computers (to see if they understand the financial report).

But that logical theory must be consistent, precise, and complete in order to be certain that the logical system is operating as expected. While professional accountants can create true and fair representations of the financial position and financial performance of an economic entity using paper; to enable automation these accountants need to be able to likewise perform each step of this process using automated process and achieve the same high-quality result that is being achieved today; just perform these tasks and processes better, faster, and cheaper.

We explored the accounting equation, SFAC 6 elements of financial statements, and other subcomponents of a more complete financial report or financial reporting scheme from a mechanical perspective. Now we will revisit these ideas in order to build your knowledge of models, structures, terms, associations, rules, and facts.

Accounting Equation, the Simplest Financial Report

The double-entry accounting model and the accounting equation provide the very foundation of financial reporting. There are many different sources for the accounting equation, but I will use Wikipedia’s version¹¹, of the accounting equation: **Assets = Liabilities + Equity**

As Wikipedia points out, that fundamental accounting equation, also called the balance sheet equation, represents the relationship between the line items assets, liabilities, and equity of an economic entity. It is the foundation for the double-entry bookkeeping system. For each transaction, the total debits equal the total credits.

We can leverage this very simple equation to understand the fundamentals of XBRL-based financial reporting and learn important subtleties and nuances of working with this new digital report format.

We represented this accounting equation in the form of a model which looked something like the following in our gentle introduction to XBRL-based financial reports¹²:

Label	Object Class	Period Type	Balance	Report ElementName
Balance Sheet [Arithmetic]	Abstract			ae:BalanceSheetArithmetic
Assets	Concept (Monetary)	As Of	Debit	ae:Assets
Liabilities	Concept (Monetary)	As Of	Credit	ae:Liabilities
Equity	Concept (Monetary)	As Of	Credit	ae:Equity

As every accountant knows the accounting equation can be represented in another way to make it more appropriate for not for profit entities. That alternative equation is “**Net Assets = Assets - Liabilities**” and when represented in XBRL might look something like the following:

¹¹ Wikipedia, Accounting Equation, https://en.wikipedia.org/wiki/Accounting_equation

¹² Accounting Equation, Very Basic, http://xbrlsite.azurewebsites.net/2020/introduction/ae-basic/ae_ModelStructure.html

Label	Object Class	Period Type	Balance	Report ElementName
Net Assets [Roll Up]	Abstract			ae:NetAssetsRollUp
Assets	Concept (Monetary)	As Of	Debit	ae:Assets
Liabilities	Concept (Monetary)	As Of	Credit	ae:Liabilities
Net Assets	Concept (Monetary)	As Of	Debit	ae:NetAssets

So, what if you wanted to combine the first representation and the second representation together, how can you achieve that? You have to come up with some term that describes the first set of things and the second set of things.

That term is what we call a **structure**. As we defined the notion of a structure; it is a set of statements that describe the structure.

Here we combine the first set and the second set together and create the structures “Balance sheet” and “Statement of Net Assets” to differentiate the first structure from the second structure¹³ using a name for the structure:

Line	Label	Object Class	Period Type	Balance	Report ElementName
1	01-Balance Sheet	Network			http://www.xbrlsite.com/ae/role/BalanceSheet
2	Balance Sheet [Arithmetic]	Abstract			ae:BalanceSheetArithmetic
3	Assets	Concept (Monetary)	As Of	Debit	ae:Assets
4	Liabilities	Concept (Monetary)	As Of	Credit	ae:Liabilities
5	Equity	Concept (Monetary)	As Of	Credit	ae:Equity
6	02-Statement of Net Assets	Network			http://www.xbrlsite.com/ae/role/StatementOfNetAssets
7	Net Assets [Roll Up]	Abstract			ae:NetAssetsRollUp
8	Assets	Concept (Monetary)	As Of	Debit	ae:Assets
9	Liabilities	Concept (Monetary)	As Of	Credit	ae:Liabilities
10	Net Assets	Concept (Monetary)	As Of	Debit	ae:NetAssets

The statements that describe each of the terms used by each structure and the associations between those terms describe the structure. Do the structures have names? Can they be identified by someone who is looking for each of the structures in a report?

Note that for XBRL-based reports submitted to the SEC and to the ESMA, the networks that are used to define the structures as is being done above are each defined by the economic entity creating a report. So, for example, the balance sheet structure for Microsoft might be something like “<http://microsoft.com/role/BalanceSheet>” and Apple might define their balance sheet using something like “<http://apple.com/role/BalanceSheet>” and you would be able to identify the balance sheet of Microsoft and the balance sheet of Apple; but there is no way to identify the notion of a balance sheet to a machine. Just keep this notion in the back of your mind for now and the ramifications of what we are describing here will become more apparent in a few moments. To a human, those identifiers might be distinguishable as describing the same thing. But to a computer, those are two different names and some mechanism must be used to help a computer understand that they are in fact describing the same idea “balance sheet”.

The simple idea of the accounting equation is helpful here to communicate some basic ideas, but we will now move on with a slightly larger financial report structure, the SFAC 6 Elements of Financial Statements, so we can understand a few more moving pieces of an XBRL-based financial report. Again, while SFAC 6 is a simple system it is perfectly capable of getting the important ideas across.

¹³ Accounting Equation with Net Assets representation, http://xbrlsite.azurewebsites.net/2020/introduction/ae-na/ae_ModelStructure.html

SFAC 6 Elements of Financial Statements

As we pointed out in the introduction SFAC 6 Elements of Financial Statements includes three structures: balance sheet, income statement, and changes in equity¹⁴:

Label	Object Class	Period Type	Balance	Report ElementName
01-Balance Sheet	Network			http://www.xbrlsite.com/sfac6/role/BalanceSheet
Balance Sheet [Arithmetic]	Abstract			sfac6:BalanceSheetArithmetic
Assets	Concept (Monetary)	As Of	Debit	sfac6:Assets
Liabilities	Concept (Monetary)	As Of	Credit	sfac6:Liabilities
Equity	Concept (Monetary)	As Of	Credit	sfac6:Equity
02-Comprehensive Income	Network			http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome
Comprehensive Income [Roll Up]	Abstract			sfac6:ComprehensiveIncomeRollUp
Revenues	Concept (Monetary)	For Period	Credit	sfac6:Revenues
(Expenses)	Concept (Monetary)	For Period	Debit	sfac6:Expenses
Gains	Concept (Monetary)	For Period	Credit	sfac6:Gains
(Losses)	Concept (Monetary)	For Period	Debit	sfac6:Losses
Comprehensive Income	Concept (Monetary)	For Period	Credit	sfac6:ComprehensiveIncome
04-Changes in Equity	Network			http://www.xbrlsite.com/sfac6/role/ChangesInEquity
Changes in Equity [Roll Forward]	Abstract			sfac6:ChangesInEquityRollForward
Equity, Beginning Balance	Concept (Monetary)	As Of	Credit	sfac6:Equity
Comprehensive Income	Concept (Monetary)	For Period	Credit	sfac6:ComprehensiveIncome
Investments by Owners	Concept (Monetary)	For Period	Credit	sfac6:InvestmentsByOwners
(Distributions to Owners)	Concept (Monetary)	For Period	Debit	sfac6:DistributionsToOwners
Equity, Ending Balance	Concept (Monetary)	As Of	Credit	sfac6:Equity

So, we have three distinct structures as can be observed above.

However, a close reading of the definitions of the terms that make up SFAC 6, you will recognize that a second approach to representing an income statement is permissible which separates income into two groups: income from normal activities and income from peripheral or incidental activities. This is represented by adding a second income statement structure as can be seen below¹⁵:

Label	Object Class	Period Type	Balance	Report ElementName
01-Balance Sheet	Network			http://www.xbrlsite.com/sfac6/role/BalanceSheet
Balance Sheet [Arithmetic]	Abstract			sfac6:BalanceSheetArithmetic
Assets	Concept (Monetary)	As Of	Debit	sfac6:Assets
Liabilities	Concept (Monetary)	As Of	Credit	sfac6:Liabilities
Equity	Concept (Monetary)	As Of	Credit	sfac6:Equity
02-Comprehensive Income	Network			http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome
Comprehensive Income [Roll Up]	Abstract			sfac6:ComprehensiveIncomeRollUp
Revenues	Concept (Monetary)	For Period	Credit	sfac6:Revenues
(Expenses)	Concept (Monetary)	For Period	Debit	sfac6:Expenses
Gains	Concept (Monetary)	For Period	Credit	sfac6:Gains
(Losses)	Concept (Monetary)	For Period	Debit	sfac6:Losses
Comprehensive Income	Concept (Monetary)	For Period	Credit	sfac6:ComprehensiveIncome
03-Comprehensive Income 2	Network			http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome2
Comprehensive Income [Roll Up]	Abstract			sfac6:ComprehensiveIncomeRollUp
Income from Normal Activities of Entity	Concept (Monetary)	For Period	Credit	sfac6:IncomeFromNormalActivitiesOfEntity
Income from Peripheral or Incidental Transactions of Entity	Concept (Monetary)	For Period	Credit	sfac6:IncomeFromPeripheralOrIncidentalTransactionsOfEntity
Comprehensive Income	Concept (Monetary)	For Period	Credit	sfac6:ComprehensiveIncome
04-Changes in Equity	Network			http://www.xbrlsite.com/sfac6/role/ChangesInEquity
Changes in Equity [Roll Forward]	Abstract			sfac6:ChangesInEquityRollForward
Equity, Beginning Balance	Concept (Monetary)	As Of	Credit	sfac6:Equity
Comprehensive Income	Concept (Monetary)	For Period	Credit	sfac6:ComprehensiveIncome
Investments by Owners	Concept (Monetary)	For Period	Credit	sfac6:InvestmentsByOwners
(Distributions to Owners)	Concept (Monetary)	For Period	Debit	sfac6:DistributionsToOwners
Equity, Ending Balance	Concept (Monetary)	As Of	Credit	sfac6:Equity

As professional accountants understand, financial reports are not static forms. The conceptual frameworks of both US GAAP and IFRS have the notion of intermediate components which can be

¹⁴ SFAC 6 Elements of Financial Statements, <http://xbrlsite.azurewebsites.net/2020/master/sfac6/index.html>

¹⁵ SFAC 6 which adds second income statement, http://xbrlsite.azurewebsites.net/2020/introduction/sfac6-dim/sfac6_ModelStructure.html

different totals and subtotals. In these two income statement examples, the total “Comprehensive Income” is summarized in two different ways. Each of these ways is fundamentally a different income statement format.

And so, above you see two income statements. A careful reading of SFAC 6¹⁶ makes it clear that each of the concepts Revenues, Expenses, Gains, and Losses could include either from normal activities or peripheral/incidental activities so the two statements are correctly disjointed.

Further, SFAC 6 discusses net assets and therefore it would be very appropriate to add another structure for the notion of a statement of net assets. We will not make that addition here but will do so later to try and keep the examples as small as possible.

We talked about the notion of an XBRL network and how they are used to separate structures because you want to or because you have to in order to avoid conflicts. XBRL has another mechanism for creating structures which is called the hypercube which we will introduce now.

Note that the IFRS Conceptual Framework is similar in their explanation of these dynamics, they simply use slightly different terms¹⁷. In fact, these dynamics are the same for every financial reporting framework¹⁸.

Defining Structures using Hypercubes; Introducing the Hypercube

We want to now introduce you to the notion of the Hypercube. A **Hypercube** is a mechanism for defining a structure in the XBRL technical syntax. Before now, we were using another mechanism for defining structures in XBRL, the **Network**. To round out the three different approaches to defining a structure there is also the approach of using a combination of both a **Network and a Hypercube** to define a structure.

The first question you might have is, “Why three approaches?” That is a very good question but providing a good answer is harder. For now, don’t worry about the answer to the question because creating XBRL-based reports using IFRS or US GAAP allows either of the three approaches. The “best approach” can be a matter of opinion and circumstances.

Both a Hypercube and a Network are ways of connecting associations together to define a structure. Networks must always exist in XBRL-based reports. Hypercubes are optional until you need what only they can provide to structure information effectively.

Essentially, Networks and Hypercubes connect sets of associations and facts together and distinguish one set of associations with another set. What we try and do is make the notion of a Network and Hypercube invisible to you and expose only the notion of the Structure itself. This is done by automatically generating the Network, Hypercube, or combination of Network + Hypercube by cleverly designing software.

¹⁶ FASB, SFAC 6 Elements of Financial Statements, <https://www.fasb.org/pdf/con6.pdf>

¹⁷ IFRS.ORG, Conceptual Framework of Financial Reporting, <https://www.ifrs.org/issued-standards/list-of-standards/conceptual-framework/>

¹⁸ Comparison of Elements of Financial Statements, <http://xbrlsite.azurewebsites.net/2020/master/ElementsOfFinancialStatements.pdf>

But, let's forget about all that for now and look at a Hypercube. We do this by looking at the following SFAC 6 representation which for simplicity reverts back to a single income statement:¹⁹

Report Element Label	Report Element Category	Period Type	Balance Type	Report Element Name
01-Balance Sheet	Network			http://www.xbrl.com/sfac6/role/BalanceSheet
Balance Sheet [Hypercube]	Hypercube			sfac6:BalanceSheetHypercube
Balance Sheet [Line Items]	LineItems			sfac6:BalanceSheetLineItems
Balance Sheet [Arithmetic]	Abstract			sfac6:BalanceSheetArithmetic
Assets	Concept (Monetary)	As Of	Debit	sfac6:Assets
Liabilities	Concept (Monetary)	As Of	Credit	sfac6:Liabilities
Equity	Concept (Monetary)	As Of	Credit	sfac6:Equity
02-Comprehensive Income	Network			http://www.xbrl.com/sfac6/role/ComprehensiveIncome
Comprehensive Income Statement [Hypercube]	Hypercube			sfac6:ComprehensiveIncomeStatementHypercube
Comprehensive Income Statement [Line Items]	LineItems			sfac6:ComprehensiveIncomeStatementLineItems
Comprehensive Income [Roll Up]	Abstract			sfac6:ComprehensiveIncomeRollUp
Revenues	Concept (Monetary)	For Period	Credit	sfac6:Revenues
(Expenses)	Concept (Monetary)	For Period	Debit	sfac6:Expenses
Gains	Concept (Monetary)	For Period	Credit	sfac6:Gains
(Losses)	Concept (Monetary)	For Period	Debit	sfac6:Losses
Comprehensive Income	Concept (Monetary)	For Period	Credit	sfac6:ComprehensiveIncome
03-Changes in Equity	Network			http://www.xbrl.com/sfac6/role/ChangesInEquity
Changes in Equity [Hypercube]	Hypercube			sfac6:ChangesInEquityHypercube
Changes in Equity [Line Items]	LineItems			sfac6:ChangesInEquityLineItems
Changes in Equity [Roll Forward]	Abstract			sfac6:ChangesInEquityRollForward
Equity, Beginning Balance	Concept (Monetary)	As Of	Credit	sfac6:Equity
Comprehensive Income	Concept (Monetary)	For Period	Credit	sfac6:ComprehensiveIncome
Investments by Owners	Concept (Monetary)	For Period	Credit	sfac6:InvestmentsByOwners
(Distributions to Owners)	Concept (Monetary)	For Period	Debit	sfac6:DistributionsToOwners
Equity, Ending Balance	Concept (Monetary)	As Of	Credit	sfac6:Equity

A hypercube is a type of XBRL **report element**. Up until now we have not really discussed the different types of XBRL report elements because there was only one type, the concept, which could or could not be abstract. Along with the hypercube comes two additional types of report elements: the dimension and the member.

A hypercube is a structure which combines a set of dimensions, members, and concepts to represent some set of information within an XBRL-based financial report. For now, we will briefly introduce the notion of the XBRL report element the fact that there are seven different categories of such report elements, and that the pattern of how those report elements can be arranged within a structure is explained by the following matrix:

		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

A report element can be a parent and/or it could be a child in an association. The matrix simply summarizes the appropriate and inappropriate parent/child associations of the different categories of report elements. Note that a "Table" is an alias for the term Hypercube and that "Axis" is an alias for the term Dimension. The US GAAP and IFRS XBRL taxonomies use the terms Table and Axis as opposed

¹⁹ SFAC 6 Adding Hypercubes, http://xbrl.com/intermediate/sfac6/sfac6_ModelStructure.html

the terms Hypercube and Dimension to describe those two categories of report elements. We are going to use the terms Hypercube and Dimension throughout this document.

Let us leave report elements for now, we will explain them in more detail as they are introduced in our modeling of different financial reporting related models.

So, to summarize what you see in the representation of SFAC 6 above; you have both a uniquely named network and a uniquely named hypercube that are used to represent each structure that we use to represent SFAC 6: balance sheet, income statement, changes in equity.

Is this the only approach? No. Let's now look at an alternative approach to representing exactly the same set of information from SFAC 6 and let's also add back that second income statement structure.

Alternative Approach to Representing SFAC 6 Hypercubes

To round out your understanding of hypercubes, we will introduce you to another viable approach to using hypercubes to represent information. Consider this SFAC 6 representation which adds back the second income statement²⁰:

Line	Label	Object Class	Period Type	Balance	Report ElementName
1	01-Balance Sheet	Network			http://www.xbrlsite.com/sfac6/role/BalanceSheet
2	Hypercube [Hypercube]	Table			sfac6:HypercubeHypercube
3	Hypercube [Line Items]	LineItems			sfac6:HypercubeLineItems
4	Balance Sheet [Arithmetic]	Abstract			sfac6:BalanceSheetArithmetic
5	Assets	Concept (Monetary)	As Of	Debit	sfac6:Assets
6	Liabilities	Concept (Monetary)	As Of	Credit	sfac6:Liabilities
7	Equity	Concept (Monetary)	As Of	Credit	sfac6:Equity
8	02-Comprehensive Income	Network			http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome
9	Hypercube [Hypercube]	Table			sfac6:HypercubeHypercube
10	Hypercube [Line Items]	LineItems			sfac6:HypercubeLineItems
11	Comprehensive Income [Roll Up]	Abstract			sfac6:ComprehensiveIncomeRollUp
12	Revenues	Concept (Monetary)	For Period	Credit	sfac6:Revenues
13	(Expenses)	Concept (Monetary)	For Period	Debit	sfac6:Expenses
14	Gains	Concept (Monetary)	For Period	Credit	sfac6:Gains
15	(Losses)	Concept (Monetary)	For Period	Debit	sfac6:Losses
16	Comprehensive Income	Concept (Monetary)	For Period	Credit	sfac6:ComprehensiveIncome
17	03-Comprehensive Income 2	Network			http://www.xbrlsite.com/sfac6/role/ComprehensiveIncome2
18	Hypercube [Hypercube]	Table			sfac6:HypercubeHypercube
19	Hypercube [Line Items]	LineItems			sfac6:HypercubeLineItems
20	Comprehensive Income [Roll Up]	Abstract			sfac6:ComprehensiveIncomeRollUp
21	Income from Normal Activities of Entity	Concept (Monetary)	For Period	Credit	sfac6:IncomeFromNormalActivitiesOfEntity
22	Income from Peripheral or Incidental Transactions of Entity	Concept (Monetary)	For Period	Credit	sfac6:IncomeFromPeripheralOrIncidentalTransactionsOfEntity
23	Comprehensive Income	Concept (Monetary)	For Period	Credit	sfac6:ComprehensiveIncome
24	04-Changes in Equity	Network			http://www.xbrlsite.com/sfac6/role/ChangesInEquity
25	Hypercube [Hypercube]	Table			sfac6:HypercubeHypercube
26	Hypercube [Line Items]	LineItems			sfac6:HypercubeLineItems
27	Changes in Equity [Roll Forward]	Abstract			sfac6:ChangesInEquityRollForward
28	Equity, Beginning Balance	Concept (Monetary)	As Of	Credit	sfac6:Equity
29	Comprehensive Income	Concept (Monetary)	For Period	Credit	sfac6:ComprehensiveIncome
30	Investments by Owners	Concept (Monetary)	For Period	Credit	sfac6:InvestmentsByOwners
31	(Distributions to Owners)	Concept (Monetary)	For Period	Debit	sfac6:DistributionsToOwners
32	Equity, Ending Balance	Concept (Monetary)	As Of	Credit	sfac6:Equity

In the representation of SFAC 6 above you see that each structure uses the same hypercube named "sfac6:HypercubeHypercube" to represent each of the four structures. This approach has certain advantages and also certain disadvantages. The advantages include the benefit of not having to think about what to name every hypercube that is added to a financial reporting scheme taxonomy. Further, it reduces the total number of XBRL report elements in the XBRL taxonomy. Similarly, the [Line Items]

²⁰ SFAC 6 alternative approach to representing hypercubes, http://xbrlsite.azurewebsites.net/2020/introduction/sfac6-dim2/sfac6_ModelStructure.html

term “Hypercube [Line Items]” which again reduces the number of XBRL report elements and makes it so you don’t have to think about what to name report elements.

Another benefit is that if an XBRL taxonomy is created in this manner, it forces the best practice which tends to be used by most reporting entities which is to include only one hypercube per XBRL network. This best practice approach is forced because it would be impossible to include a second hypercube in any network as doing so would cause association conflicts within the XBRL taxonomy.

Yet another benefit is that the naming of a structure is forced onto the network rather than the network and hypercube sharing the duties of identifying a specific structure.

However, if you combine this feature with the feature that every XBRL-based report created for submission to the SEC or ESAM is required to name each of their networks when they define their report model, it makes it more challenging to identify the specific structures of such XBRL-based financial reports.

You can still identify individual structures using prototype theory (i.e. you identify the structure based on the components of the structure rather than having a unique name, we will explain this in more detail a bit later).

Note that this approach is similar to how the US GAAP XBRL Taxonomy uses the single hypercube “us-gaap:StatementTable” to represent the income statements, balance sheets, cash flow statements, and statements of changes in equity. Further, if you look at the Microsoft XBRL-based financial report you will find that Microsoft uses the hypercube “us-gaap:StatementTable” to represent 52 of a total of 128 structures that exist within their 2017 10-K XBRL-based financial report.

Microsoft is not unique in this practice. Many other filing agents commonly use us-gaap:StatementTable to represent the primary financial statements or disclosures.

The fundamental point that you should be understanding here is that an approach to representing hypercubes in XBRL-based financial reports is to use one single hypercube to represent each and every structure.

We are not holding any of these approaches out to be good or bad at this point, we are simply helping the reader understand that there are different approaches and that each approach has a set of pros and a set of cons that go along with that choice.

So, lets expand on SFAC 6 a bit more and introduce the cash flow statement structure to our examples so we have a complete set of statements that make up the full four statement model²¹.

Common Elements of Financial Report

We want to round out our preliminary discussion of modeling a financial reporting scheme or a financial report using an XBRL taxonomy with the Common Elements of Financial Report representation. This adds only a few additional details to what we have shown in SFAC 6 to get to the four-statement model of a financial report which includes a balance sheet, income statement, cash flow statement, and

²¹ Articulation and the four statement model, <http://xbrlsite.azurewebsites.net/2020/core/master-common/ArticulationFourStatementModel.jpg>

changes in equity. Here we have added the two additional structures we have mentioned so that we have two balance sheets and two income statements. Here is that representation²²:

#	Report Element Label	Report Element Category	Period Type	Balance Type	Report Element Name
1	01-Balance Sheet	Network			http://www.xbrlsite.com/common/role/BalanceSheet
2	Balance Sheet [Hypercube]	Hypercube			common:BalanceSheetHypercube
3	Balance Sheet [Line Items]	LineItems			common:BalanceSheetLineItems
4	Assets (Roll Up)	Abstract			common:AssetsRollUp
5	Current Assets	Concept (Monetary)	As Of	Debit	common:CurrentAssets
6	Noncurrent Assets	Concept (Monetary)	As Of	Debit	common:NoncurrentAssets
7	Assets	Concept (Monetary)	As Of	Debit	common:Assets
8	Liabilities and Equity (Roll Up)	Abstract			common:LiabilitiesAndEquityRollUp
9	Liabilities (Roll Up)	Abstract			common:LiabilitiesRollUp
10	Current Liabilities	Concept (Monetary)	As Of	Credit	common:CurrentLiabilities
11	Noncurrent Liabilities	Concept (Monetary)	As Of	Credit	common:NoncurrentLiabilities
12	Liabilities	Concept (Monetary)	As Of	Credit	common:Liabilities
13	Equity (Roll Up)	Abstract			common:EquityRollUp
14	Equity Attributable To Controlling Interests	Concept (Monetary)	As Of	Credit	common:EquityAttributableToControllingInterests
15	Equity Attributable To Noncontrolling Interests	Concept (Monetary)	As Of	Credit	common:EquityAttributableToNoncontrollingInterests
16	Equity	Concept (Monetary)	As Of	Credit	common:Equity
17	Liabilities and Equity	Concept (Monetary)	As Of	Credit	common:LiabilitiesAndEquity
18	02-Net Assets	Network			http://www.xbrlsite.com/common/role/NetAssets
19	Net Assets [Hypercube]	Hypercube			common:NetAssetsHypercube
20	Net Assets [Line Items]	LineItems			common:NetAssetsLineItems
21	Net Assets (Roll Up)	Abstract			common:NetAssetsRollUp
22	Assets	Concept (Monetary)	As Of	Debit	common:Assets
23	Liabilities	Concept (Monetary)	As Of	Credit	common:Liabilities
24	Net Assets	Concept (Monetary)	As Of	Debit	common:NetAssets
25	03-Comprehensive Income	Network			http://www.xbrlsite.com/common/role/ComprehensiveIncome
26	Comprehensive Income Statement [Hypercube]	Hypercube			common:ComprehensiveIncomeStatementHypercube
27	Comprehensive Income Statement [Line Items]	LineItems			common:ComprehensiveIncomeStatementLineItems
28	Comprehensive Income (Roll Up)	Abstract			common:ComprehensiveIncomeRollUp
29	Revenues	Concept (Monetary)	For Period	Credit	common:Revenues
30	(Expenses)	Concept (Monetary)	For Period	Debit	common:Expenses
31	Gains	Concept (Monetary)	For Period	Credit	common:Gains
32	(Losses)	Concept (Monetary)	For Period	Debit	common:Losses
33	Comprehensive Income	Concept (Monetary)	For Period	Credit	common:ComprehensiveIncome
34	04-Comprehensive Income 2	Network			http://www.xbrlsite.com/common/role/ComprehensiveIncome2
35	Comprehensive Income Statement [Hypercube]	Hypercube			common:ComprehensiveIncomeStatementHypercube
36	Comprehensive Income Statement [Line Items]	LineItems			common:ComprehensiveIncomeStatementLineItems
37	Comprehensive Income (Roll Up)	Abstract			common:ComprehensiveIncomeRollUp
38	Income from Normal Activities of Entity	Concept (Monetary)	For Period	Credit	common:IncomeFromNormalActivitiesOfEntity
39	Income from Peripheral or Incidental Transactions of Entity	Concept (Monetary)	For Period	Credit	common:IncomeFromPeripheralOrIncidentalTransactionsOfEntity
40	Comprehensive Income	Concept (Monetary)	For Period	Credit	common:ComprehensiveIncome
41	05-Cash Flow	Network			http://www.xbrlsite.com/common/role/CashFlow
42	Cash Flow [Hypercube]	Hypercube			common:CashFlowHypercube
43	Cash Flow [Line Items]	LineItems			common:CashFlowLineItems
44	Net Cash Flow (Roll Up)	Abstract			common:NetCashFlowRollUp
45	Net Cash Flow Operating Activities	Concept (Monetary)	For Period	Debit	common:NetCashFlowOperatingActivities
46	Net Cash Flow Investing Activities	Concept (Monetary)	For Period	Debit	common:NetCashFlowInvestingActivities
47	Net Cash Flow Financing Activities	Concept (Monetary)	For Period	Debit	common:NetCashFlowFinancingActivities
48	Net Cash Flow	Concept (Monetary)	For Period	Debit	common:NetCashFlow
49	Assets Roll Forward (Roll Up)	Abstract			common:AssetsRollForward
50	Assets, Beginning Balance	Concept (Monetary)	As Of	Debit	common:Assets
51	Net Cash Flow	Concept (Monetary)	For Period	Debit	common:NetCashFlow
52	Assets, Ending Balance	Concept (Monetary)	As Of	Debit	common:Assets
53	07-Changes in Equity	Network			http://www.xbrlsite.com/common/role/ChangesInEquity
54	Changes in Equity [Hypercube]	Hypercube			common:ChangesInEquityHypercube
55	Changes in Equity [Line Items]	LineItems			common:ChangesInEquityLineItems
56	Changes in Equity (Roll Forward)	Abstract			common:ChangesInEquityRollForward
57	Equity, Beginning Balance	Concept (Monetary)	As Of	Credit	common:Equity
58	Comprehensive Income	Concept (Monetary)	For Period	Credit	common:ComprehensiveIncome
59	Investments by Owners	Concept (Monetary)	For Period	Credit	common:InvestmentsByOwners
60	(Distributions to Owners)	Concept (Monetary)	For Period	Debit	common:DistributionsToOwners
61	Equity, Ending Balance	Concept (Monetary)	As Of	Credit	common:Equity

There is one specific idiosyncrasy which was included in the representation above in order to make a specific point. Notice that the hypercube “common:ComprehensiveIncomeStatementHypercube” is used to identify two different income statement representations.

Further note that this is not the case for the balance sheet and statement of net assets where different hypercube names were used.

This choice has ramifications for those extracting information from XBRL-based financial reports and want to use hypercubes in order to facilitate comparisons between different financial reports of reporting economic entities. Because each hypercube is not unique, it is impossible to rely only on the hypercube to distinguish one structure from another. As such, you must use both the network and the hypercube to make that distinction.

²² Common Elements of Financial Report, http://xbrlsite.azurewebsites.net/2020/intermediate/common/common_ModelStructure.html

Proof Representation Rounds Out Financial Report Model

Up until now, there have been three information patterns that we have worked with: roll ups, roll forwards, and sets. The Proof representation²³ rounds out the information model representation patterns that you will run across in XBRL-based financial reports. We will explain the additional patterns here.

Every information model within an XBRL-based financial report is fundamentally a set²⁴ of information. A **set** information pattern has no mathematical associations or other specific characteristics of other information model representations we explain below.

A **roll up** is simply a set but the set of concepts forms some total plus items which aggregate to that roll up total.

A **roll forward** is a set but the set is of an instant concept at two points in time (beginning balance, ending balance) plus a set of changes between those two points in time.

An **adjustment** is a set but the set represents some instant that has been previously reported (i.e. originally stated) and has been restated along with a set of adjustments that reconcile the originally stated and restated values and has the mathematical associations that explain the relationship between all reported facts.

53	06-Prior Period Errors	Network			http://www.xbrlsite.com/proof/role/PriorPeriodErrors
54	Prior Period Errors [Hypercube]	Hypercube			proof:PriorPeriodErrorsHypercube
55	Report Date [Axis]	Dimension			proof:ReportDateAxis
56	Current Report [Member]	Member			proof:CurrentReportMember
57	Prior Report [Member]	Member			proof:PriorReportMember
58	Prior Period Errors [Line Items]	LineItems			proof:PriorPeriodErrorsLineItems
59	Prior Period Errors [Adjustment]	Abstract			proof:PriorPeriodErrorsAdjustment
60	Equity, Originally Stated	Concept (Monetary)	As Of	Credit	proof:Equity
61	Changes in Accounting Policy	Concept (Monetary)	As Of	Credit	proof:ChangesInAccountingPolicy
62	Correction of an Error	Concept (Monetary)	As Of	Credit	proof:CorrectionOfAnError
63	Equity, Restated	Concept (Monetary)	As Of	Credit	proof:Equity

Every adjustment has a mathematical rule which follows the pattern: Restated = Originally stated + Adjustments. Also, note that it is critically important that every adjustment be represented such that it properly intersects with other reported information.

Here is an example of an adjustment from a report which will give you a good idea of what the adjustment information model is trying to accomplish²⁵:

²³ Proof representation, http://xbrlsite.azurewebsites.net/2020/intermediate/proof/proof_ModelStructure.html

²⁴ Wikipedia, *Set Theory*, https://en.wikipedia.org/wiki/Set_theory

²⁵ Adjustment, http://xbrlsite.azurewebsites.net/2020/intermediate-reports/proof/evidence-package/contents/index.html#Rendering-PriorPeriodErrors-proof_PriorPeriodErrorsHypercube.html

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

A **variance** is a set but the set represents information from two different reporting scenarios plus potentially a variance between the two reporting scenarios.

79	09-Variance Analysis	Network			http://www.xbrlsite.com/proof/role/VarianceAnalysis
80	Variance Analysis [Hypercube]	Hypercube			proof:VarianceAnalysisHypercube
81	Scenario [Axis]	Dimension			proof:ScenarioAxis
82	Actual [Member]	Member			proof:ActualMember
83	Variance [Member]	Member			proof:VarianceMember
84	Budgeted [Member]	Member			proof:BudgetedMember
85	Variance Analysis [Line Items]	LineItems			proof:VarianceAnalysisLineItems
86	Variance Analysis [Roll Up]	Abstract			proof:VarianceAnalysisRollUp
87	Revenues	Concept (Monetary)	For Period	Credit	proof:Revenues
88	(Expenses)	Concept (Monetary)	For Period	Debit	proof:Expenses
89	Gains	Concept (Monetary)	For Period	Credit	proof:Gains
90	(Losses)	Concept (Monetary)	For Period	Debit	proof:Losses
91	Comprehensive Income	Concept (Monetary)	For Period	Credit	proof:ComprehensiveIncome

Every variance has a mathematical rule which follows the pattern: Actual Scenario = Budgeted Scenario + Variance.

Here is an example of a variance from a report which will give you a good idea of what the variance information model is trying to accomplish²⁶:

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

Note that a variance could be combined with a Roll Up, Roll Forward, or Set information model to form a complex information model.

²⁶ Variance, http://xbrlsite.azurewebsites.net/2020/intermediate-reports/proof/evidence-package/contents/index.html#Rendering-VarianceAnalysis-proof_VarianceAnalysisHypercube.html

A **member aggregation** is a set but the set represents a roll up but the roll up is represented as an aggregation of dimensional members as contrast to a roll up of a set of line items. The semantics of a roll up and member aggregation are identical, it is only the syntax that is different.

92	10-Segment Revenues	Network			http://www.xbrlsite.com/proof/role/SegmentRevenues
93	Segment Revenues [Hypercube]	Hypercube			proof:SegmentRevenuesHypercube
94	Segments [Axis]	Dimension			proof:SegmentsAxis
95	All Segments [Member]	Member			proof:AllSegmentsMember
96	Segment Alpha [Member]	Member			proof:SegmentAlphaMember
97	Segment Bravo [Member]	Member			proof:SegmentBravoMember
98	Segment Charlie [Member]	Member			proof:SegmentCharlieMember
99	Segment Revenues [Line Items]	LineItems			proof:SegmentRevenuesLineItems
100	Sgement Revenues [Set]	Abstract			proof:SegmentRevenuesSet
101	Revenues	Concept (Monetary)	For Period	Credit	proof:Revenues

Every member aggregation has a rule which follows the pattern: Total (Member) = Sum (Members).

Here is an example of a member aggregation from a report which will give you a good idea of what the member aggregation information model is trying to accomplish²⁷:

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	4,000	2,000	7,000

A **text block** (a.k.a. prose) is a set of exactly one concept that has the data type of text block that represents prose for a fact which is generally in the form of escaped XHTML or HTML.

73	08-Policies	Network			http://www.xbrlsite.com/proof/role/Policies
74	Policies [Hypercube]	Hypercube			proof:PoliciesHypercube
75	Policies [Line Items]	LineItems			proof:PoliciesLineItems
76	Basis of Reporting [Text Block]	Concept (Text Block (HTML))	For Period		proof:BasisOfReportingTextBlock
77	Nature of Operations [Text Block]	Concept (Text Block (HTML))	For Period		proof:NatureOfOperationsTextBlock
78	Revenue Recognition Policy [Text Block]	Concept (Text Block (HTML))	For Period		proof:RevenueRecognitionPolicyTextBlock

Here is an example of a text block from a report which will give you a good idea of what the text block information is trying to accomplish²⁸:

²⁷ Member aggregation, http://xbrlsite.azurewebsites.net/2020/intermediate-reports/proof/evidence-package/contents/index.html#Rendering-SegmentRevenues-proof_SegmentRevenuesHypercube.html

²⁸ Text block, http://xbrlsite.azurewebsites.net/2020/intermediate-reports/proof/evidence-package/contents/index.html#Rendering-Policies-proof_PoliciesHypercube.html

Policies [Line Items]	Period [Axis]
	2020-01-01 - 2020-12-31
Revenue Recognition Policy [Text Block]	<p>Nature of business</p> <p>Sed mauris. Nulla facilisi. Fusce tristique posuere ipsum. Nulla facilisi. Aliquam viverra risus vitae ante. Sed rhoncus mi in wisi. Nullam nibh dui, molestie vitae, imperdiet non, ornare at, elit.</p> <ul style="list-style-type: none"> • 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. <p>Fusce gravida, ligula a placerat placerat, leo erat euismod lectus, et lacinia justo libero non pede. Vivamus ac velit vel magna nonummy pretium.</p> <ol style="list-style-type: none"> 1. Etiam ut augue 2. Aliquam erat volutpat

A **roll forward info** is a set of concepts that provide information about a roll forward but is not in fact a roll forward itself.

102	11-Stock Plan Activity	Network		http://www.xbrlsite.com/proof/role/StockPlanActivity
103	Weighted Average Grant Date Fair Value [Hypercube]	Hypercube		proof:WeightedAverageGrantDateFairValueHypercube
104	Weighted Average Grant Date Fair Value [Line Items]	LineItems		proof:WeightedAverageGrantDateFairValueLineItems
105	Weighted Average Grant Date Fair Value [Roll Forward Info]	Abstract		proof:WeightedAverageGrantDateFairValueRollForwardInfo
106	Nonvested Fair Value, Beginning Balance	Concept (Share)	As Of	proof:NonvestedFairValue
107	Granted	Concept (Share)	For Period	proof:Granted
108	Vested	Concept (Share)	For Period	proof:Vested
109	Forfeited	Concept (Share)	For Period	proof:Forfeited
110	Nonvested Fair Value, Ending Balance	Concept (Share)	As Of	proof:NonvestedFairValue

Here is an example of a roll forward info from a report which will give you a good idea of what the roll forward info information²⁹:

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

And so, with those additional information models and the Roll Up, Roll Forward, and Set you have an understanding of 100% of the information models or concept arrangement patterns that you will ever run across in an XBRL-based digital financial report.

For more details on information models, please refer to *Concept Arrangement Patterns*³⁰ and *Member Arrangement Patterns*³¹.

²⁹ Roll Forward Info, http://xbrlsite.azurewebsites.net/2020/intermediate-reports/proof/evidence-package/contents/index.html#Rendering-StockPlanActivity-proof_WeightedAverageGrantDateFairValueHypercube.html

³⁰ Concept Arrangement Patterns, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.7a_ConceptArrangementPatterns.pdf

³¹ Member Arrangement Patterns, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part02_Chapter05.7b_MemberArrangementPatterns.pdf

Mathematical Connections Between Proof Information Structures

The Common Elements of Financial Statements representation was specifically referenced to make the point that is communicated in both the SFAC 6 conceptual framework and IFRS conceptual framework which is the notation of articulation. Articulation is the notion that the primary financial statements are connected together mathematically³²:

Balance Sheet [Line Items]		Period [Axis]	
		2020-12-31	2019-12-31
Assets [Roll Up]			
Current Assets		500	0
Noncurrent Assets		3,000	0
	Assets	3,500	0
Liabilities and Equity [Roll Up]			
Liabilities [Roll Up]			
Current Liabilities		0	0
Noncurrent Liabilities		0	0
	Liabilities	0	0
Equity [Roll Up]			
Equity Attributable To Controlling Interests		3,000	0
Equity Attributable to Noncontrolling Interests		500	0
	Equity	3,500	0
	Liabilities and Equity	3,500	0

Cash Flow [Line Items]		Period [Axis]
		2020-01-01 - 2020-12-31
Net Cash Flow [Roll Up]		
Net Cash Flow Operating Activities		1,500
Net Cash Flow Investing Activities		1,000
Net Cash Flow Financing Activities		1,000
	Net Cash Flow	3,500

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

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

Expanding this notion of articulation using the additional mathematical associations of the PROOF representation it becomes apparent that the information fragments represented are correctly represented because the model is completely intact mathematically as is shown below³³:

$\$Revised=0 = (\$OriginallyStated=2000 + \$CorrectionOfError=-1500 + \$StandortAccountingChange=500)$

$OK: Total of proof: Revenues value 7000 agrees to the aggregate of each 7000.$

$\$ComprehensiveIncome=3000 = (\$Revenues=7000 - \$Expenses=3000 + \$Gains=1000 - \$Losses=2000)$

$\$Equity_BalanceStart=0 + \$ComprehensiveIncome=3000 + \$InvestmentsByOwners=1000 - \$DistributionsToOwners=500 = \$Equity_BalanceEnd=3500$

$\$ComprehensiveIncome=3000 = (\$Revenues=7000 - \$Expenses=3000 + \$Gains=1000 - \$Losses=2000)$

$\$ComprehensiveIncome=3750 = (\$Revenues=6000 - \$Expenses=2000 + \$Gains=750 - \$Losses=1000)$

$\$ComprehensiveIncome=750 = (\$Revenues=1000 - \$Expenses=1000 + \$Gains=250 - \$Losses=1000)$

$\$Assets=0 = (\$Liabilities=0 + \$Equity=0)$

$\$Assets=3500 = (\$Liabilities=0 + \$Equity=3500)$

$\$ComprehensiveIncome=3000 = (\$Revenues=7000 - \$Expenses=3000 + \$Gains=1000 - \$Losses=2000)$

$\$ComprehensiveIncome=3750 = (\$Revenues=6000 - \$Expenses=2000 + \$Gains=750 - \$Losses=1000)$

$\$ComprehensiveIncome=750 = (\$Revenues=1000 - \$Expenses=1000 + \$Gains=250 - \$Losses=1000)$

Specifically note that:

1. The prior period adjustment properly connects to the beginning balance of the changes in equity roll forward.
2. The segment revenues member aggregation properly connects to the income statement roll up.
3. The variance analysis actual amounts tie to the income statement roll up and the variance between actual and budget foot and cross cast.

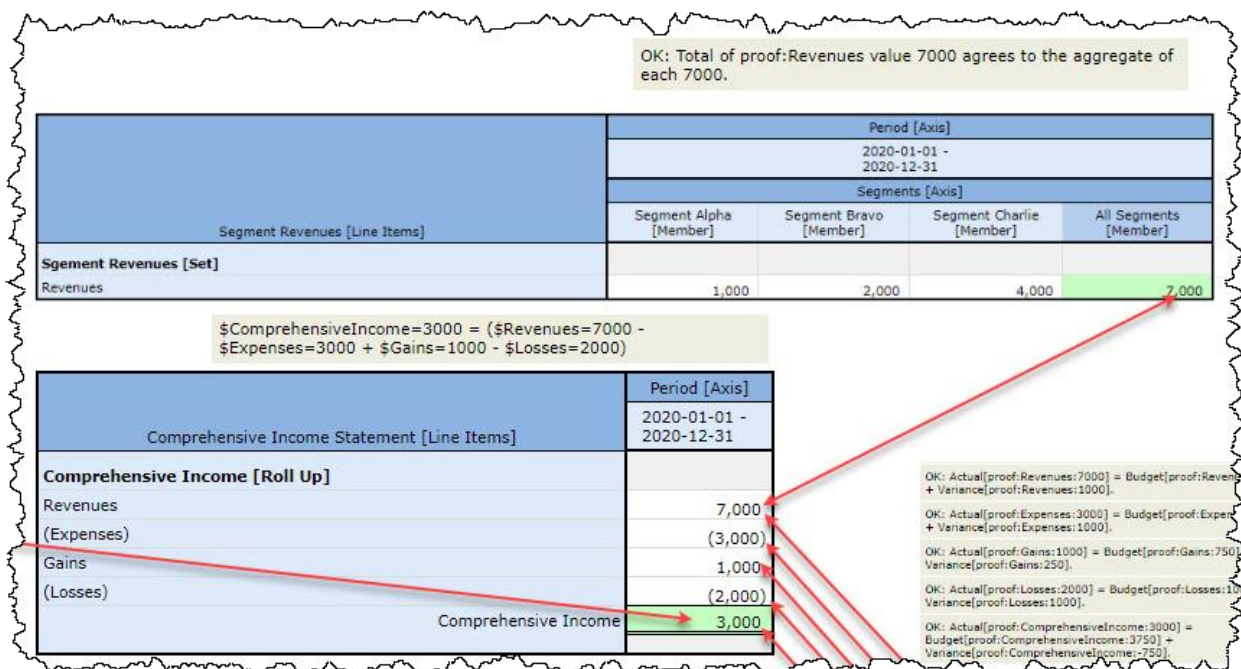
³² Articulation of Four Statement Model, <http://xbrlsite.azurewebsites.net/2020/core/master-common/ArticulationFourStatementModel.jpg>

³³ Articulation of Proof representation mathematical relations, <http://xbrlsite.azurewebsites.net/2020/master/proof/ProofMathematicalComputations.jpg>

This proves that the XBRL-based representation of financial report information is appropriate because that representation is confirmed by the global standard XBRL and rules processors show they are consistent with expectation.

Understanding Intersections between Structures and “Dimension Defaults”

As pointed out in the prior section one structure can be intersected with one or more other structures. For example, there is a relation between the structure which breaks down segment revenue by segment and the structure that represents the subcomponents of comprehensive income which also contains the fact revenues:



The fact Revenues for the period 2020-01-01 to 2020-12-31 exists only once in the report, but it is used to represent information in both structures. Notice that the dimensions of the fact Revenues is different in the two structures. Whereas in the comprehensive income breakdown there is no “Segments [Axis]” but in the segment revenues breakdown that dimension does exist.

Here is what is going on. If you examine the XBRL instance, the fact distinguished as representing Revenues for the period distinguished as being 2020-01-01 to 2020-12-31 exists in that XBRL instance only once. That fact “morphs” into the form it needs to be in, with or without that Segments [Axis] dimension using a mechanism named the “dimension-default”. Many people misinterpret the function of the dimension-default as there to save you time from having to enter a dimension. But that is not what is going on. What is going on is the dimension-default mechanism tells the fact how to morph in order to work correctly in both structures.

Proper morphing the dimensions to suit both hypercubes in the example structures above shows you how dimension-defaults are used to virtually indicate information that is not physically represented within the XBRL instance context information for an explicit dimension.

Patterns and Models are Rules

Why all the work to identify and understand patterns and models? Well, because patterns and models provide rules. These patterns and rules provide a specification for what is permissible per XBRL-based financial reporting.

These patterns and models are documented in the *Logical Theory Describing Financial Report*³⁴. Software engineers have a tendency to implement the XBRL technical specification verbatim. While that will work, it makes implemented software applications harder to use because you need to learn about the XBRL technical specification. Leveraging higher level models makes software both easier to implement and easier to use.

Software engineers use the rules provided by patterns and models to build software that is easy and straight forward to use.

Software Interoperability

Software interoperability, ease of use, completeness of functionality, and capability to prove that an XBRL-based financial report is a properly functioning logical system is important to effectively exchanging information using the XBRL technical format. Here are four software applications that support this method:

- Pesseract: <http://xbrlsite.azurewebsites.net/2020/master/Pesseract.html>
- Pacioli: <http://xbrlsite.azurewebsites.net/2020/master/Pacioli.html>
- XBRL Query: <http://xbrlsite.azurewebsites.net/2020/master/XBRLQuery.html>
- XBRL Cloud: <http://xbrlsite.azurewebsites.net/2020/master/XBRLCloud.html>

There is likely other software that can be used for XBRL-based digital financial reporting, I am simply pointing out software that I have rigorously tested.

Identifying Disclosures

When we work with a financial report, we generally work with the fragments that make up the report. As I have pointed out we can break a full report into the individual fragments that make up that report. Those fragments can be broken and identified by humans as to the individual disclosures that comprise a particular financial report. For example, a financial report can be broken down into the balance sheet, income statement, cash flow statement, statement of changes in equity, individual policies, and individual detailed disclosures that are included within the notes of a financial statement.

It is of critical important to differentiate the notion of a “note” and a “disclosure” in your mind. A disclosure is an informational artifact and indicates information that is being disclosed. A note is a presentational artifact and is comprised of a set of one to many disclosures. Accountants can somewhat arbitrarily organize disclosures into notes. But the disclosures themselves are generally prescribed and are driven by the information provided by the disclosure rather than what note a disclosure ends up being located within. Also, accountants may have different alternatives as to what form a disclosure can

³⁴ Logical Theory Describing Financial Report, <http://xbrl.squarespace.com/logical-theory-financial-rep/>

take and even whether a disclosure is required/necessary or not in some cases. But what makes up an individual disclosure is generally prescribed.

Accountants can work with these disclosures and even communicate with one another about individual disclosures fairly effectively. But computers cannot work with disclosures effectively unless you give each disclosure a unique name that identifies each individual disclosure.

We have done this for the disclosures relating to the PROOF representation³⁵. You can get to those disclosures in machine readable form here³⁶:

proof

[Entry Point \(Associations\)](#) | [Terms](#) | [Structures](#) | [Rules](#) | [Type-subtype](#) | [Disclosures](#) | [Disclosure Mechanics Rules](#) | [Disclosure Rules \(Reporting Checklist\)](#)

#	Report Element Label	Report Category
1	01-Balance Sheet	Network
2	Balance Sheet [Hypercube]	Hypercube
3	Balance Sheet [Line Items]	LineItems
4	Assets [Roll Up]	Abstract
5	Current Assets	Concept (Monetary)
6	Noncurrent Assets	Concept (Monetary)
7	Assets	Concept (Monetary)

If you open that machine-readable list of disclosures for the PROOF representation which is represented using the XBRL technical syntax and shown below using standard XBRL software, you can read that list:

Prefix	Label	Name	Data Type
disclosures	Assets Roll Forward	AssetsRollForward	disclosureItem
disclosures	Assets Roll Up	AssetsRollUp	disclosureItem
disclosures	Balance Sheet	BalanceSheet	disclosureItem
disclosures	Basis of Reporting	BasisOfReporting	disclosureItem
disclosures	Cash Flow Statement	CashFlowStatement	disclosureItem
disclosures	Changes in Equity	ChangesInEquity	disclosureItem
disclosures	Financial Highlights	FinancialHighlights	disclosureItem
disclosures	Income Statement	IncomeStatement	disclosureItem
disclosures	Income Statement Alternative	IncomeStatementAlterna...	disclosureItem
disclosures	Liabilities and Equity Roll Up	LiabilitiesAndEquityRollUp	disclosureItem
disclosures	Nature of Operations	NatureOfOperations	disclosureItem
disclosures	Net Assets Roll Up	NetAssetsRollUp	disclosureItem
disclosures	Net Cash Flow Roll Up	NetCashFlowRollUp	disclosureItem
disclosures	Prior Period Errors	PriorPeriodErrors	disclosureItem
disclosures	Revenue Recognition Policy	RevenueRecognitionPolicy	disclosureItem
disclosures	Segment Revenues	SegmentRevenues	disclosureItem
disclosures	Stock Plan Activity	StockPlanActivity	disclosureItem
disclosures	Variance Analysis	VarianceAnalysis	disclosureItem

What is more important is that a computer can read that list also.

³⁵ Proof representation, http://xbrlsite.azurewebsites.net/2020/intermediate/proof/proof_ModelStructure.html

³⁶ Proof disclosures, <http://xbrlsite.azurewebsites.net/2020/intermediate/proof/disclosures.xsd>

Think about this for a moment. Have you ever seen a complete list of disclosures before? Probably not. No one has really bothered to create such a list. But what if there were such a list of disclosure names. What if that same list of names was used by intermediate accounting textbooks, the authoritative literature, interpretations of the authoritative literature, disclosure checklists used to create financial reports, the preparers of financial reports, analysts extracting information from financial reports, etc. You probably get the point. None of the value of a complete, reliable, and machine-readable list is available until someone creates the list and puts that information into machine readable form. Here³⁷ is that list for US GAAP which contains 995 disclosures which have been named (a working prototype). Here³⁸ is a human readable version of that same list that is searchable and filterable.

Disclosures (US GAAP Financial Reporting Scheme)

A structure is a set of statements which describe a permissible structure per a logical theory. A disclosure is one way to represent a structure using the XBRL syntax.

Retrieve information by disclosure. ([List of all Disclosures](#)) | ([Machine Readable](#))

Disclosure Name	Examples
Accelerated Share Repurchases [Hierarchy]	6
Accounting Changes and Error Corrections [Hierarchy]	0
Accounting Changes and Error Corrections Note [Note Level]	21
Accounting Changes Note [Note Level]	9

And so, each disclosure for US GAAP can be named and 995 such named disclosures are provided for US GAAP in the working prototype above. Similar lists can be created for IFRS³⁹ or any financial reporting scheme really.

For example, one disclosure name for US GAAP is “**InventoryNetRollUp**”. The specific details of that disclosure are also described⁴⁰ including as an example a specific permissible prototype of the disclosure:

³⁷ US GAAP Disclosures, machine-readable <http://xbrlsite.azurewebsites.net/2020/reporting-scheme/us-gaap/disclosures-topics/disclosures.xsd>

³⁸ US GAAP Disclosures, human-readable, <http://xbrlsite.azurewebsites.net/2020/reporting-scheme/us-gaap/documentation/Disclosures.html>

³⁹ IFRS Disclosures, human-readable, <http://xbrlsite.azurewebsites.net/2020/reporting-scheme/ifrs/documentation/Disclosures.html>

⁴⁰ Inventory Net Roll Up disclosure details, <http://xbrlsite.azurewebsites.net/2020/reporting-scheme/us-gaap/disclosures-topics/disclosures-detail/Disclosure-517.html>

Line		Object Class (Data type)	Period Type	Balance	Report Element Name
1	Inventory balances	Abstract			us-gaap:InventoryRawMaterialsAndSuppliesNetOfReservesAbstract
2	Raw materials and packaging	Concept (Monetary)	As Of	Debit	us-gaap:InventoryRawMaterialsAndSuppliesNetOfReserves
3	Finished goods	Concept (Monetary)	As Of	Debit	us-gaap:InventoryFinishedGoodsNetOfReserves
4	Other	Concept (Monetary)	As Of	Debit	us-gaap:OtherInventoryNetOfReserves
5	Total inventories	Concept (Monetary)	As Of	Debit	us-gaap:InventoryNet

What is more, examples of actual disclosures provided by economic entities are available and identifiable from reports of public companies submitted to the Securities and Exchange Commission (SEC). These are all freely available in both human-readable form and machine-readable form. For example, here is the inventory roll up disclosure (InventoryNetRollUp) provided by Boeing⁴¹:

Component: (Network and Table)	
Network	2408403 - Disclosure - Inventories (Inventory Disclosure Table) (Details) (http://www.boeing.com/role/InventoriesInventoryDisclosureTableDetails)
Table	(Implied)

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

Reporting Entity [Axis]	0000012927 (http://www.sec.gov/CIK)
-------------------------	--

Inventory Disclosure [Abstract]	Period [Axis]	
	2013-12-31	2012-12-31
Inventory Disclosure [Abstract]		
Long-term contracts in progress	12,608,000,000	15,130,000,000
Commercial aircraft programs	48,065,000,000	40,389,000,000
Commercial spare parts, used aircraft, general stock materials and other	7,793,000,000	7,206,000,000
Inventory before advances and progress billings	68,466,000,000	62,725,000,000
Less advances and progress billings	(25,554,000,000)	(24,974,000,000)
Total	42,912,000,000	37,751,000,000

In fact, an entire system for researching disclosures can be created by taking the simple step of creating a name and then using that name to specify what disclosure you want to see examples for⁴²:

⁴¹ Boeing Inventory Disclosure, <http://www.xbrlsite.com/2015/fro/us-gaap/html/Disclosures/Exemplars/20982-Exemplar.html>

⁴² Working Prototype of disclosure research system, http://xbrlsite-app.azurewebsites.net/DisclosureBestPractices_USGAAP/DisclosureBestPractices.aspx?DisclosureName=InventoryNetRollUp

Select Disclosure: (US GAAP)

Inventory, Net (Current) [Roll Up]

#	Economic Entity Name
1	BOEING CO
2	BOEING CO
3	CARPENTER TECHNOLOGY CORP
4	CARPENTER TECHNOLOGY CORP
5	CATERPILLAR INC
6	CATERPILLAR INC
7	COCA COLA CO
8	COCA COLA CO
9	COLUMBUS MCKINNON CORP
10	COLUMBUS MCKINNON CORP
11	CUMMINS INC
12	CUMMINS INC
13	DIXIE GROUP INC
14	DIXIE GROUP INC
15	Dr Pepper Snapple Group, Inc.
16	Dr Pepper Snapple Group, Inc.
17	DUPONT E I DE NEMOURS & CO

Rendering

Component: (Network and Table)

Network	2408403 - Disclosure - Inventories (Inventory Disclosure Table) (Details) (http://www.boeing.com/role/InventoriesInventoryDisclosureTableDetails)	
Table	(Implied)	

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

Reporting Entity [Axis]	0000012927 (http://www.sec.gov/CIK)	
-------------------------	--	--

Inventory Disclosure [Abstract]	Period [Axis]	
	2013-12-31	2012-12-31
Inventory Disclosure [Abstract]		
Long-term contracts in progress	12,608,000,000	15,130,000,000
Commercial aircraft programs	48,065,000,000	40,389,000,000
Commercial spare parts, used aircraft, general stock materials and other	7,793,000,000	7,206,000,000
Inventory before advances and progress billings	68,466,000,000	62,725,000,000
Less advances and progress billings	(25,554,000,000)	(24,974,000,000)
Total	42,912,000,000	37,751,000,000

All this shows you the power of metadata and what can be achieved by the simple step of giving each disclosure a unique name so that you can refer to any disclosure in a manner that a software application can understand what you are talking about and do this for any financial reporting scheme!

But how do you use a name to discover a disclosure? Well, you don't use the name. You use other information that you attach to the name to help you discover the report fragment that discloses specific information.

Disclosure Mechanics

Disclosure mechanics is a set of machine-readable rules represented using XBRL⁴³ that describes how a specific disclosure is represented within an XBRL-based financial report. You can use that information for two things. First, you can use the information to detect the disclosure within the report. Second, you can use the information to verify that the disclosure is represented consistent with your expectations. Here is an example of the disclosure mechanics validation results of the Proof representation we are using.

⁴³ Disclosure Mechanics Rules for Proof, <http://xbrlsite.azurewebsites.net/2020/intermediate/proof/dm.xsd>

Primary Information									
#	Disclosure	Category	Level	Pattern	Disclosure Found	Disclosure Consistent	Applicable	Representation Concept [TEXT BLOCK]	Representation Concept DETAIL
1	Assets Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Assets
2	Assets Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Assets
3	Balance Sheet	Unknown	UNKNOWN	Component	True	CONSISTENT	True	-	-
4	Basis of Reporting	Unknown	Level1TextBlock	TextBlock	True	CONSISTENT	True	Basis of Reporting [Text Block]	NOT-EXPECTED
5	Cash Flow Statement	Unknown	UNKNOWN	Component	True	CONSISTENT	True	-	-
6	Changes in Equity	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Equity
7	Financial Highlights	Unknown	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Revenues
8	Income Statement	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Comprehensive Income
9	Income Statement Alternative	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Comprehensive Income
10	Liabilities and Equity Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Liabilities and Equity
11	Nature of Operations	Unknown	Level1TextBlock	TextBlock	True	CONSISTENT	True	Nature of Operations [Text Block]	NOT-EXPECTED
12	Net Assets Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Net Assets
13	Net Cash Flow Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Net Cash Flow
14	Prior Period Errors	Unknown	Level4Detail	Adjustment	True	CONSISTENT	True	NOT-EXPECTED	Equity
15	Revenue Recognition Policy	Unknown	Level1TextBlock	TextBlock	True	CONSISTENT	True	Revenue Recognition Policy [Text Block]	NOT-EXPECTED
16	Segment Revenues	Unknown	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Revenues
17	Stock Plan Activity	Unknown	Level4Detail	RollForwardInfo	True	CONSISTENT	True	NOT-EXPECTED	Nonvested Fair Value
18	Variance Analysis	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Comprehensive Income

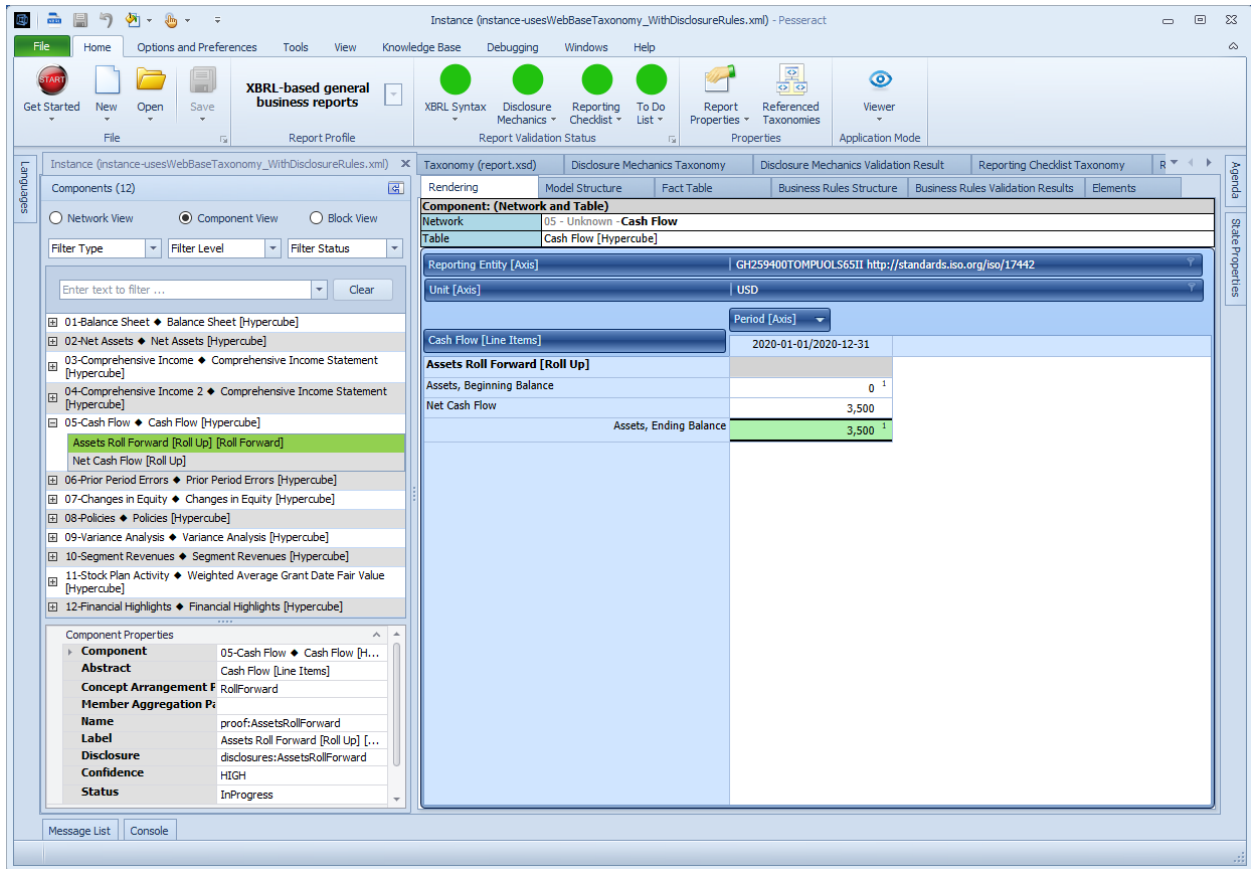
Consider the first disclosure, “Assets Roll Forward”. If you click on the plus sign, a human readable version of the rule is shown which appears as follows:

Rules Line of Reasoning

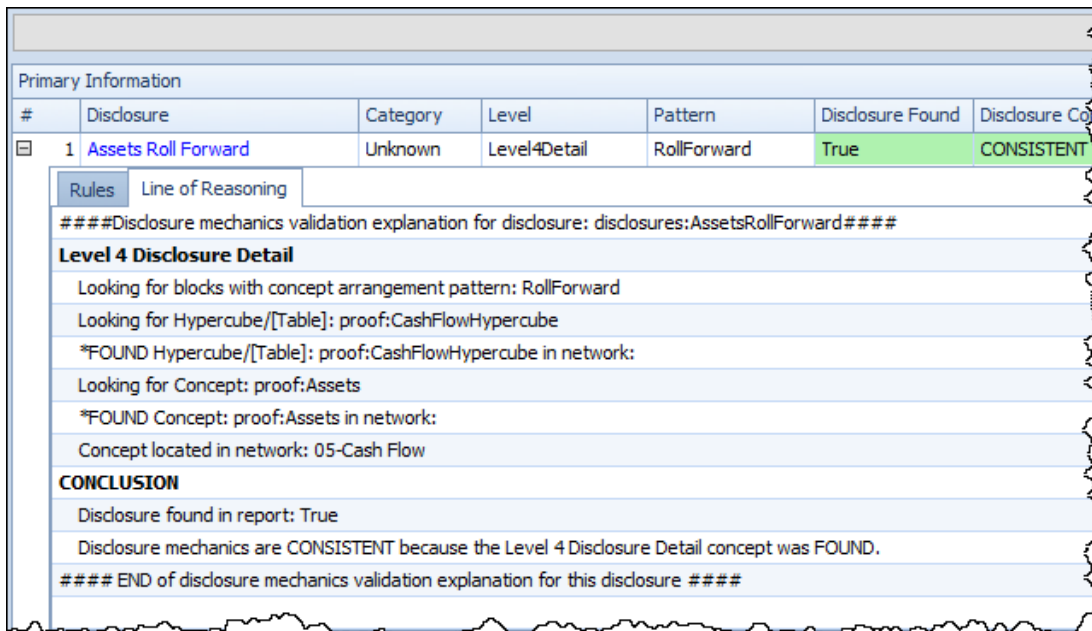
This disclosure `disclosures:AssetsRollForward`

- MUST be represented using the Hypercube/[Table] named: `proof:CashFlowHypercube`
- MUST be represented as a **Level 4 Disclosure Detail** with the concept arrangement pattern: `cm:RollForward`
- `cm:RollForward` REQUIRES beginning/ending balance `proof:Assets`

You see the name of the disclosure which is “AssetsRollForward”. You see that the disclosure is required to be represented within the “proof:CashFlowHypercube”. You see that the disclosure is a Roll Forward. Finally, you see that the disclosure is required to have the concept “proof:Assets” as the instant concept of that Roll Forward information pattern. Of the fragments contained within the Proof XBRL-based report there is only one fragment that has all of these characteristics above which you can see in the screen shot below:



Further, if you press on the “Line of Reasoning” tab you see the line of reasoning used to detect the disclosure:



The rule itself and the line of reasoning can help you have 100% transparency into what a disclosure must look like and why a computer algorithm did or did not locate the disclosure being sought.

In the case of the “Assets Roll Forward” disclosure, all you really needed was the name of the hypercube in order to discover where the disclosure was in the XBRL-based report. The information model of the disclosure (i.e. RollForward) and the required instant concept (i.e. proof:Assets) is not necessary for the disclosure discovery process. However, that information is necessary to determine whether the disclosure has been structured appropriately.

What we are showing for the Proof example might seem simplistic. To give you a better idea of the power of the reasoning software and the rules, consider this example of a US GAAP XBRL Taxonomy rule related to the InventoryNetRollUp disclosure:

Rules: disclosures:InventoryNetRollUp

Disclosure mechanics validation for disclosure: **disclosures:InventoryNetRollUp**

Roll up of details of components of current inventory, net.

This disclosure:

- **MUST** be represented by the networks with the SEC Category: **DISCLOSURE**
- **MUST** be represented as an **SEC Level 4 Disclosure Detail** with the concept arrangement pattern: **ROLL UP**
 - ROLL UP REQUIRES the total concept **us-gaap:InventoryNet**
 - or alternative concept: **us-gaap:InventoryNetOfAllowancesCustomerAdvancesAndProgressBillings**
 - or alternative concept: **us-gaap:PublicUtilitiesInventory**
 - or alternative concept: **us-gaap:AirlineRelatedInventory**
 - or alternative concept: **us-gaap:RetailRelatedInventory**
 - or alternative concept: **us-gaap:EnergyRelatedInventory**
 - or alternative concept: **us-gaap:AgriculturalRelatedInventory**
- **MUST** be represented using the **SEC Level 3/2 Disclosure Text Block**: **us-gaap:ScheduleOfInventoryCurrentTableTextBlock**
 - or alternative concept: **us-gaap:ScheduleOfUtilityInventoryTextBlock**
- Requires the note to be reported using the **SEC Level 1 Note Text Block**: **us-gaap:InventoryDisclosureTextBlock**
- Requires the policy to be reported using the **SEC Level 2 Policy Text Block**: **us-gaap:InventoryPolicyTextBlock**
 - or alternative concept: **us-gaap:InventoryMajorClassesPolicy**
 - or alternative concept: **us-gaap:InventorySuppliesPolicy**
 - or alternative concept: **us-gaap:InventoryWorkInProgressPolicy**
 - or alternative concept: **us-gaap:InventoryFinishedGoodsPolicy**

There are two important things to notice about the US GAAP XBRL taxonomy rule above. First, notice that no specific hypercube or network is referenced. The disclosure can be effectively discovered without network or hypercube information. Second, notice that other disclosures that should exist if the inventory is found are also queried for such as the inventory policy text block (level 2 text block), the disclosure text block (level 3 disclosure text block), and the note text block (level 1 note text block).

Effectively, the rules engine of software applications can use prototype theory to discover report information even if disclosures are not specifically identifiable via network or hypercube names. Prototype theory is simply a technique used to find something based on the characteristics of the thing you are looking for instead of a uniquely identifiable name. For more information on prototype theory, see *Understanding Prototype Theory*⁴⁴.

⁴⁴ *Understanding Prototype Theory*, <http://xbrl.squarespace.com/journal/2013/12/21/understanding-prototype-theory.html>

Reporting Checklist

Professional accountants use what they call a reporting checklist or disclosure checklist as a memory jogger for making sure a financial report is correctly created⁴⁵. A similar strategy can be used to make sure an XBRL-based financial report is correctly created. Here are the machine readable disclosure rules of the proof representation⁴⁶ and what those rules look like in human readable form:

	Arcrole	Order
Definition View		
Reporting Checklist		
[Thing]		0
[FinancialReport]	http://xbrlsite.azurewebsites.net/2016/conceptual-model/arcrole/class-equivalentClass	1
Balance Sheet	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-requiresDisclosure	2
Income Statement	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-requiresDisclosure	3
Cash Flow Statement	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-requiresDisclosure	3.1
Changes in Equity	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-requiresDisclosure	4
Financial Highlights	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-possibleDisclosure	5
Prior Period Errors	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-possibleDisclosure	6
Variance Analysis	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-possibleDisclosure	7
Segment Revenues	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-requiresDisclosure	8
Stock Plan Activity	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-possibleDisclosure	9
Basis of Reporting	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-requiresDisclosure	10
Nature of Operations	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-requiresDisclosure	11
Revenue Recognition Policy	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-requiresDisclosure	12
Assets Roll Up	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-possibleDisclosure	21
Liabilities and Equity Roll Up	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-possibleDisclosure	21
Net Assets Roll Up	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-possibleDisclosure	22
Assets Roll Forward	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-possibleDisclosure	23
Income Statement Alternative	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-possibleDisclosure	24
Net Cash Flow Roll Up	http://xbrlsite.azurewebsites.net/2016/conceptual-model/drules-arcroles/arcrole/financialReport-possibleDisclosure	25

There are the validation results from running the reporting checklist rules against the Proof representation:

#	Disclosure	Checklist Category	Reason Disclosure Must Exist	Discovered	Expectation Met	Link to Disclosure Mechanics
0	Reporting Checklist					
1	Balance Sheet	Required disclosure	Disclosure always required, satisfied by Assets Roll Up and Liabilities and Equity Roll Up disclosures	True	CONSISTENT	Balance Sheet
2	Assets Roll Up	Part of disclosure	Satisfies Balance Sheet disclosure	True	CONSISTENT	Assets Roll Up
3	Liabilities and Equity Roll Up	Part of disclosure	Satisfies Balance Sheet disclosure	True	CONSISTENT	Liabilities and Equity Roll Up
4	Income Statement	Required disclosure	Disclosure always required	True	CONSISTENT	Income Statement
5	Cash Flow Statement	Required disclosure	Disclosure always required, satisfied by Assets Roll Forward and Net Cash Flow Roll Up disclosures	True	CONSISTENT	Cash Flow Statement
6	Assets Roll Forward	Part of disclosure	Satisfies Cash Flow Statement disclosure	True	CONSISTENT	Assets Roll Forward
7	Net Cash Flow Roll Up	Part of disclosure	Satisfies Cash Flow Statement disclosure	True	CONSISTENT	Net Cash Flow Roll Up
8	Changes in Equity	Required disclosure	Disclosure always required	True	CONSISTENT	Changes in Equity
9	Financial Highlights	Possible disclosure	Disclosure is present	True	CONSISTENT	Financial Highlights
10	Prior Period Errors	Possible disclosure	Disclosure is present	True	CONSISTENT	Prior Period Errors
11	Variance Analysis	Possible disclosure	Disclosure is present	True	CONSISTENT	Variance Analysis
12	Segment Revenues	Possible disclosure	Disclosure is present	True	CONSISTENT	Segment Revenues
13	Stock Plan Activity	Possible disclosure	Disclosure is present	True	CONSISTENT	Stock Plan Activity
14	Basis of Reporting	Required disclosure	Disclosure always required	True	CONSISTENT	Basis of Reporting
15	Nature of Operations	Required disclosure	Disclosure always required	True	CONSISTENT	Nature of Operations
16	Revenue Recognition Policy	Required disclosure	Disclosure always required	True	CONSISTENT	Revenue Recognition Policy
17	Net Assets Roll Up	Possible disclosure	Disclosure is present	True	CONSISTENT	Net Assets Roll Up
18	Income Statement Alternative	Possible disclosure	Disclosure is present	True	CONSISTENT	Income Statement Alternative

Again, while these ideas are explained to the reader using rather simple examples in order to make a basic explanation easier; these reporting checklist rules are quite sophisticated in nature. You can see a

⁴⁵ Automating Accounting and Reporting Checklists, <http://xbrl.squarespace.com/journal/2016/5/5/automating-accounting-and-reporting-checklists.html>

⁴⁶ Reporting checklist for Proof, machine-readable, <http://xbrlsite.azurewebsites.net/2020/intermediate/proof/drules-def.xml>

working prototype of Microsoft's 10-K financial report which was submitted to the SEC using a commercially available tool provided by XBRL Cloud that leverages these reporting checklist rules⁴⁷:

Disclosure Mechanics and Reporting Checklist												
Entity Registrant Name:		MICROSOFT CORPORATION (SEC Filing Page)						Document Type:		10-K		
CIK:		0000789019						Fiscal Year / Period:		2017 / FY		
Disclosures Found: 48 of 70 (69%)						Disclosures Consistent: 68 of 70 (97%)			Disclosures Inconsistent: 2 of 70 (3%)			
Show: <input checked="" type="radio"/> All <input type="radio"/> Only Consistencies <input type="radio"/> Only Inconsistencies <input type="radio"/> Only Reported <input type="radio"/> Only Not Reported											<input type="checkbox"/> Show Level 1 Note And Policy Concept Columns	
#	Disclosure	Category	Level	Pattern	Applicable	Found	Disclosure Consistent	Representation Concept [TEXT BLOCK]	Representation Concept [DETAIL]	Checklist Category	Reason	
1	Document Information (Hierarchy)	DOCUMENT	Level4Detail	HIERARCHY	True	True	CONSISTENT	NOT-EXPECTED	Document Fiscal Period Focus	Required disclosure	Disclosure always required	
2	Document and Entity Information (Hierarchy)	DOCUMENT	Level4Detail	HIERARCHY	False	True	CONSISTENT	NOT-EXPECTED	Entity Registrant Name	Alternative representation	Not necessary, satisfied by Document Information (Hierarchy) disclosure	
3	Entity Information by Legal Entity (Hierarchy)	DOCUMENT	Level4Detail	HIERARCHY	True	True	CONSISTENT	NOT-EXPECTED	Entity Registrant Name	Required disclosure	Disclosure always required	
4	Document and Entity Information (Hierarchy)	DOCUMENT	Level4Detail	HIERARCHY	False	True	CONSISTENT	NOT-EXPECTED	Entity Registrant Name	Alternative representation	Not necessary, satisfied by Entity Information, by Legal Entity (Hierarchy) disclosure	
5	Balance Sheet	STATEMENT	Level4Detail	COMPONENT	True	True	CONSISTENT	NOT-EXPECTED	NOT-EXPECTED	Required	Disclosure always required, satisfied by Assets (Roll Up) and Liabilities	

Conclusion

We began this discussion talking about getting computers to do work and how you use rules to control that work in order to effectively automate processes. This document is intended to provide you with a taste of the possibilities. For more information, please start with *Understanding Method (Abridged)*⁴⁸ which will point you in the right direction.

The new medium for exchanging complex financial information, XBRL, will undoubtedly contribute to reducing the monotonous, repetitive, mechanical tasks and processes accountants need to perform which will free these professionals up to better add value in the information age.

To further your understanding, I would encourage you to work through the analysis of the **Microsoft** 2017 10-K financial report which ties the ideas and examples used in this document to a real world XBRL-based financial report⁴⁹.

⁴⁷ Combined Disclosure Mechanics and Reporting Checklist provided by XBRL Cloud, <http://xbrl.azurewebsites.net/2017/Prototypes/Microsoft2017/Disclosure%20Mechanics%20and%20Reporting%20Checklist.html>

⁴⁸ *Understanding Method (Abridged)*, http://xbrl.azurewebsites.net/2020/Library/UnderstandingMethod_Abridged.pdf

⁴⁹ Microsoft XBRL-based Financial Report Analysis, <http://xbrl.squarespace.com/journal/2020/4/13/microsoft-xbrl-based-report-analysis.html>