# Proving Financial Reports are Properly Functioning Logical Systems

## An approach for systematically creating high-quality, high-resolution XBRL-based machine-readable general purpose and special purpose financial reports

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Last Revised – November 30, 2019 (DRAFT)

"An error does not become truth by reason of multiplied propagation, nor does truth become error because nobody sees it. Truth stands, even if there be no public support. It is self sustained." *Mahatma Gandhi* 

### **Executive summary:**

- XBRL-based digital financial reports are machine-readable logical systems<sup>1</sup>.
- Financial reports are fundamentally based on the double entry accounting model, the accounting equation, and are intentionally designed to have innate characteristics such as mathematical interrelationships to achieve the notion of articulation which is where one report element is intentionally defined on the bases of other elements in order to achieve the interconnectedness of the four primary financial statements.
- These characteristics provide significant leverage to software engineers designing computer software intended to work with XBRL-based financial reports.
- XBRL-based digital financial reports can be proven to be properly functioning logical systems that are consistent, precise, and complete using automated machine-based processes that take into account the inherent variability of financial reports.
- Poorly created XBRL taxonomies tend to obfuscate the true nature of XBRL-based financial reports and how software that will be used to interact witch such reports. Avoid making the mistake of creating software incorrectly, misguided by these poorly created XBRL taxonomies. Poorly created XBRL taxonomies is a short-term situation.
- Properly functioning digital financial report software applications will help creators of XBRL taxonomies to understand how to create those XBRL taxonomies correctly.
- Both general purpose financial statements and special purpose financial statements can leverage the capabilities of XBRL-based digital financial reporting.

<sup>&</sup>lt;sup>1</sup> Charles Hoffman, CPA, Understanding XBRL-based Digital Financial Reports in Six Images, <u>http://xbrl.squarespace.com/journal/2019/11/13/understanding-xbrl-based-digital-financial-reports-in-six-im.html</u>

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The purpose of this document is show, step-by-step, how to prove that a machine-readable XBRL-based financial report is a properly functioning logical system and the sorts of things that can impede proper functioning.

First, it is important to understand what a logical system is and how to determine that a logical system is properly functioning and that a financial report can be seen as a logical system. We provide that information at the end of this document as an appendix if you are not familiar with that information.

Once logical systems are understood, by making incremental comparisons and contrasting each increment we help the reader understand what is necessary to prove such a logical system is properly functioning.

Finally, by pointing out the specific things that can go wrong and impede proper functioning and the countermeasures that can be used to overcome those possible impediments it is easy to understand that many aspects of creating an XBRL-based financial report can be systematically automated even with the inherent variability that is characteristic of a financial report.

## **Summary Table and Comparison of Results**

The following is a table which summarizes and contrasts the results obtained by creating XBRL-based machine-readable information for each of the logical systems that were used to analyze the incremental logical systems and then synthesize an approach to controlling variability:

	Accounting Equation <sup>2</sup>	SFAC 6 <sup>3</sup>	Common Elements <sup>4</sup>	MINI Reporting Scheme⁵	Microsoft 2017 10-K <sup>6</sup>
Terms	3	10	20	126	491
Structures	1	3	4	34	194
Assertions (Rules)	1	3	4	23	???
Facts	3	13	29	183	2,234
Terms defined	3	10	20	126	491
Structures defined	1	3	4	34	194
Assertions defined	1	3	4	23	???
Facts provided	3	13	29	183	2,234

<sup>&</sup>lt;sup>2</sup> Accounting equation represented using XBRL, <u>http://xbrlsite.azurewebsites.net/2019/Core/master-ae/</u>

<sup>&</sup>lt;sup>3</sup> SFAC 6 represented using XBRL, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/</u>

<sup>&</sup>lt;sup>4</sup> Common Elements of a Financial Report represented using XBRL,

http://xbrlsite.azurewebsites.net/2019/Core/master-elements/

<sup>&</sup>lt;sup>5</sup> Mini financial reporting scheme represented using XBRL, http://xbrlsite.azurewebsites.net/2019/Prototype/mini/documentation/Index.html

<sup>&</sup>lt;sup>6</sup> Microsoft 2017 10-K submitted to SEC represented using XBRL,

http://xbrl.squarespace.com/journal/2019/3/23/summary-of-human-readable-renderings.html

The following sections provide details of each increment in the analysis process and how each increment contributes to the synthesis of an approach to overcoming specific impediments and effectively control the variability inherent in a financial report.

## **Accounting Equation Logical System Proof**

The accounting equation<sup>7</sup> is a rather simple and straight-forward logical system that no one would really dispute. The accounting equation is well documented, well understood, and has been around for hundreds of years. Because there are so few terms, structures, associations, assertions, and facts it is easy to get your head around the fact that the accounting equation is a properly functioning logical system without the help of a machine to verify that the logical system is consistent, complete, and precise.



Accounting Equation

Above you see three *terms*; "Assets", "Liabilities" and "Equity"; one *assertion* "Assets = Liabilities and Equity"; one *structure* "Balance Sheet"; and three *facts*, "5,000", "1,000", and "4,000". There are also three *associations* that explain that each of the three terms are part of the structure. All of this explained in machine-readable terms effectively using XBRL<sup>8</sup>. Human-readable and machine-readable documentation<sup>9</sup> is provided to help anyone trying to understand the representation. Each logical system provides similar documentation.

This small, simple accounting equation logical system can help one understand how logical systems function and also see and understand exactly what can go wrong within a logical system.

Below are six possible permutations and combinations of states that might possibly exist in this small accounting equation logical system:

 <sup>&</sup>lt;sup>7</sup> Wikipedia, Accounting Equation, https://en.wikipedia.org/wiki/Accounting\_equation
 <sup>8</sup> XBRL instance with connected XBRL taxonomy schema and XBRL linkbases, <u>http://xbrlsite.azurewebsites.net/2019/Core/master-ae/instance.xml</u>

<sup>&</sup>lt;sup>9</sup> Accounting Equation documentation, <u>http://xbrlsite.azurewebsites.net/2019/Core/master-ae/</u>



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**State (1)** is that the logical system is consistent, complete, and precise and therefore the system is provably properly functioning. **State (2)** shows a logical system that is incomplete because the assertion "Assets = Liabilities + Equity" is not included in the system and therefore erroneous facts could exist but you would not know they were erroneous, or at least people could disagree, because the assertion is missing. **State (3)** is complete, but both inconsistent because assets does not equal liabilities plus equity and imprecise because assets should equal liabilities plus equity in the real world per the provided assertion. **State (4)** is questionably incomplete because the fact liabilities of 1,000 is not provided within the system; however, because the assertion exists and because the other two facts assets and equity exist the fact liabilities can be deducted using the rules of logic, the other two facts, and the assertion. **State (5)** both the fact liabilities and the assertion are not provided so that it is impossible to deduce the fact liabilities using the rule because the assertion is not provided. **State (6)** is consistent in that per the assertion "Assets = Liabilities" assets and liabilities are equal; however, the assertion "Assets = Liabilities" is imprecise because in the real world "Assets = Liabilities + Equity".

All of these permutations are important to keep in the back of your mind because these are exactly the same sorts of errors that can exist in every one of these intermediate steps and more importantly within a real XBRL-based financial report.

## **SFAC 6 Logical System Proof**

SFAC 6<sup>10</sup>, which is provided by the FASB and part of the conceptual framework for US GAAP financial reporting, is used for the next incremental step. I could have used the conceptual framework that defines IFRS elements of a financial statement, in fact I did that also<sup>11</sup>. However, (a) there is no reason to include both US GAAP and IFRS because they are essentially identical, (b) the IFRS Foundation makes it hard to get to the documentation and the FASB makes it easy and free, and (c) I had to pick one so I picked US GAAP. This is documented similar to the accounting equation<sup>12</sup>.

And so here is a screen shot of the logical system explained by SFAC 6 below. Note that it is essentially identical to the accounting equation in that it defines *terms* (10 terms in this case as contrast to the accounting equation's 3 terms), *assertions* (3 assertions in this case as contrast to the accounting equation's 1 assertion), *structures* (3 structures in this case as contrast to the accounting equation's 1 assertion), *structures* (3 structures in this case as contrast to the accounting equation's 1 structure), and *facts* (13 facts in this case as contrast to the accounting equation's 3 facts). But the principles for the logical system are exactly the same.



SFAC 6

<sup>&</sup>lt;sup>10</sup> FASB, Statement of Financial Accounting Concepts No. 6, Elements of Financial Statements, <u>https://www.fasb.org/pdf/con6.pdf</u>

<sup>&</sup>lt;sup>11</sup> IFRS elements of a financial statement, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-ifrs/</u>

<sup>&</sup>lt;sup>12</sup> SFAC 6 documentation, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/</u>

I am not going to provide all the permutations and combinations of possible states that might exist for the logical system can be inconsistent, incomplete, and imprecise; all of the possibilities described by the accounting equation still exist.

However, I will introduce a new possibility of something that can go wrong. Because you now have more than one structure it is possible to use a term in the wrong structure. For example, a term defined for use within the income statement might be inadvertently used on the changes in equity instead.

And so, above you see what would be considered a properly functioning logical system. It is a bit larger than the accounting equation, you can still get your head around this and so you don't need a machine-based process to help you, but you can see that it is slightly more complicated and if you created a lot of these you might see how a machine-based system that automates the process of verifying that all the moving pieces of the puzzle are correct and that the logical system is properly functioning could be useful.

## Four Statement Model and Common Elements of Financial Statement Proof

The four statement model and common elements of a financial statement<sup>13</sup> was defined by me because neither the FASB nor IASB defined this in their conceptual framework although as you dig deeper into either US GAAP or IFRS conceptual framework you see the notion of a cash flow statement emerging. You also see the notions of "current" and "noncurrent" emerging. You also see the notion of "controlling interest" and "noncontrolling interest" emerging in the standards. I combined all of these ideas into one document.

Finally, I wanted to more formally introduce the notions of the *roll forward* with which every accountant is very familiar. The roll forward is distinguished from the better understood *roll up* in that a roll up aggregates some whole into its mathematical parts. Whereas a roll forward literally "rolls forward" a balance sheet account balance from one point in time to some other future point in time. Usually, a roll forward is used to reconcile the balance of the beginning balance sheet line item to the ending or currently reported balance sheet line item.

And so now we have the complete four statement model that is very familiar to financial analysts that analyze financial statements and the accountants that create those statements. Here is that screen shot:

<sup>13</sup> Four Statement Model and Common Elements of Financial Statement, <u>http://xbrlsite.azurewebsites.net/2019/Core/master-elements/</u>

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Four Statement Model (Common Elements of Financial Report)

Because the number of terms and therefore reported facts is increasing and because the number of structures is increasing you can see that it gets just a little more complicated to verify the four statement model and common elements of a financial report manually simply by looking at it. It is possible, but again you may begin seeing why automated machine-based approaches might be helpful.

## **MINI Financial Reporting Scheme Logical System Proof**

Inspired by a prior example<sup>14</sup>, by the notion of a special purpose financial statement<sup>15</sup> as contrast to a general purpose financial statement<sup>16</sup>, by the need to still keep things as simple as possible, but to point out what a complete financial statement looks like I created the Mini Financial Reporting Scheme<sup>17</sup>. This example combines the characteristics of other examples that I had into one complete set.

I cannot show one simple diagram that shows a financial report created using the MINI financial reporting scheme is consistent, complete, precise, and therefore properly functioning. Such a list of terms, associations, structures, assertions, facts, and images would be too large for one report. The best I can do is to show somewhat of a "dashboard" that tries to convey that same information for larger numbers of terms, structures, associations, assertions, and facts into a useful user interface with the ability to "drill down" to details you wish to view<sup>18</sup>:

Component (Network/Table)	Status	Count of Relations	XBRL Technical Syntax Rules	Model Structure Rules	Business Rules <sup>(a)</sup>	Roll Up Rules	Other Manual Review Tasks	Other Rules and Best Practice Tasks
1001 - Document - Document Information   Document Information [Hypercube]	Completed	10	ОК	ОК	ок	ок	ок	ок
1002 - Document - Entity Information   Entity Information [Hypercube]	Completed	5	ОК	ОК	ок	ок	ок	ок
1101 - Statement - Balance Sheet   Balance Sheet [Hypercube]	Completed	25	ОК	ОК	ок	ок	ок	ок
1102 - Statement - Income Statement   Income Statement [Hypercube]	Completed	17	ОК	ОК	ок	ок	ок	ок
1103 - Statement - Cash Flow Statement   Cash Flow Statement [Hypercube]	Completed	18	ОК	ОК	ок	ок	ок	ок
1104 - Statement - Statement of Changes in Equity   Statement of Changes in Equity [Hypercube]	Completed	6	ОК	ОК	ок	ок	ок	ок
2110 - Disclosure - Nature of Business Note (Level 1 Note Text Blocks)   Nature of Business [Hypercube]	Completed	3	ОК	ОК	ок	ок	ок	ок
2120 - Disclosure - Basis of Reporting Note (Level 1 Note Text Blocks)   Basis of Reporting [Hypercube]	Completed	3	ОК	ОК	ок	ок	ок	ок
2130 - Disclosure - Significant Accounting Policies Note (Level 1 Note Text Blocks)   Significant Accounting Policies [Hypercube]	Completed	3	ОК	ОК	ок	ок	ок	ок
2300 - Disclosure - Cash and Cash Equivalents Note (Level 1 Note Text Blocks)   Cash and Cash Equivalents Note [Hypercube]	Completed	3	ОК	ОК	ок	ок	ок	ок
2400 - Disclosure - Receivables Note (Level 1 Note Text Blocks)   Receivables Note	Completed	3	ок	ОK	ок	ок	0ĸ	ок

<sup>&</sup>lt;sup>14</sup> Trial balance to external financial report, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-trialbalance/</u>

<sup>&</sup>lt;sup>15</sup> XBRL-based Special Purpose Financial Statements, <u>http://xbrl.squarespace.com/journal/2019/11/26/xbrl-based-special-purpose-financial-statements.html</u>

<sup>&</sup>lt;sup>16</sup> Case for the XBRL-based General Purpose Financial Statement on One Slide,

http://xbrl.squarespace.com/journal/2019/2/10/case-for-xbrl-based-general-purpose-financial-reporting-ono.html

<sup>&</sup>lt;sup>17</sup> Mini financial reporting scheme represented using XBRL,

http://xbrlsite.azurewebsites.net/2019/Prototype/mini/documentation/Index.html

<sup>&</sup>lt;sup>18</sup> XBRL Cloud Verification Summary,

http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/mini/repository/company1/evidencepackage/contents/VerificationDashboard.html

A second application provides similar information. There are two important points that are made by pointing these two software interfaces that are essentially doing exactly the same thing. First, note that the software interfaces are completely different but essentially provide the same information. This is important because what is going on is that software uses the machine-readable terms, structures, associations, assertions, and facts to dynamically generate the user interface. Second, two software tools used the same machine-readable logically articulated rules to reach exactly the same conclusion about the consistency, completeness, and precision of the logical system that is driving the software.

Primar	imary Information									
#	Disclosure	Category	Level	Pattern	Disclosure Found	Disclosure Consistent	Applicable	Representation Concept [TEXT BLOCK]	Representation Concept DETAIL	
÷	1 Accounts Payable Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	CONSISTENT	True	Accounts Payable Roll Forward [Text Block]	Accounts Payable	
÷	2 Accounts Payable Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Accounts Payable Subclassifications [Text Block]	Accounts Payable	
÷	3 Assets Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Assets	
*	4 Balance Sheet, Classified	Statement	UNKNOWN	Component	True	CONSISTENT	True	• · · · · · · · · · · · · · · · · · · ·	<ul> <li>•</li> </ul>	
*	5 Basis of Presentation	Unknown	Level 1TextBlock	TextBlock	True	CONSISTENT	True	Basis of Reporting [Text Block]	NOT-EXPECTED	
	6 Cash and Cash Equivalents Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	CONSISTENT	True	Cash and Cash Equivalents Roll Forward [Text Block]	Cash and Cash Equivalents	
	7 Cash and Cash Equivalents Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Cash and Cash Equivalents Subclassifications [Text Block]	Cash and Cash Equivalents	
	8 Cash and Cash Equivalents Summary Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Cash and Cash Equivalents	
٠	9 Cash Flow Statement, Direct Method	Statement	UNKNOWN	Component	True	CONSISTENT	True	•	•	
÷ 1	10 Document Information	Unknown	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Balance Sheet Date	
÷ 1	11 Entity Information	Unknown	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Economic Entity Name	
± 1	12 Finished Goods Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Finished Goods Subclassifications [Text Block]	Finished Goods	
± 1	13 Income Statement	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Net Income (Loss)	
÷ 1	14 Inventories Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	N/A	False	Inventories Roll Forward [Text Block]	Inventories	
÷ 1	15 Inventories Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	N/A	False	Inventories Subclassifications [Text Block]	Inventories	
± 1	16 Liabilities and Equity Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Liabilities and Equity	
± 1	17 Long-Term Debt Maturities	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Long-term Debt Maturities [Text Block]	Long-term Debt	
± 1	18 Long-Term Debt Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	CONSISTENT	True	Long-term Debt Roll Forward [Text Block]	Long-term Debt	
E 1	19 Long-Term Debt Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Long-term Debt Subclassifications [Text Block]	Long-term Debt	
E 2	20 Nature of Entity	Unknown	Level 1TextBlock	TextBlock	True	CONSISTENT	True	Nature of Business [Text Block]	NOT-EXPECTED	
Ξ 2	21 Net Cash Flow Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Net Cash Flow	
E 2	22 Property, Plant, and Equipment, Net Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	CONSISTENT	True	Property, Plant, and Equipment Roll Forward [Text Block]	Property, Plant and Equipment	
Ξ 2	23 Property, Plant, and Equipment, Net Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Property, Plant, and Equipment Subclassifications [Text Block]	Property, Plant and Equipment	
Ξ 2	24 Receivables Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	CONSISTENT	True	Receivables Roll Forward [Text Block]	Receivables	
± 2	25 Receivables Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Receivables Subclassifications [Text Block]	Receivables	
± 2	26 Retained Earnings Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Retained Earnings	
± 2	27 Significant Accounting Policies	Unknown	Level 1TextBlock	TextBlock	False	CONSISTENT	True	NOT-FOUND	NOT-EXPECTED	
± 2	28 Statement of Changes in Equity	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Equity	
+ 2	29 Transactions Groupings	Unknown	Level4Detail	RollUp	True	N/A	False	NOT-EXPECTED	Check Sum Changes	
+ 3	30 Trial Balance	Unknown	Level4Detail	RollUp	True	N/A	False	NOT-EXPECTED	Check Sum	

There is one final aspect that is very much worth pointing out. I showed you one "dashboard" that provides an organized means if interacting with one report. So, how would that work for having an entire repository of reports? Think of something similar to the SEC EDGAR System that contains the financial reports of thousands of reporting economic entities over a period of many years?

To go along with the MINI financial reporting scheme, I created a prototype repository<sup>19</sup> into which financial reports creating using the scheme would be put and a validation dashboard for the repository of financial reports<sup>20</sup>:

<sup>&</sup>lt;sup>19</sup> MINI Financial Reporting Scheme Prototype Repository, <u>http://xbrlsite-app.azurewebsites.net/Repository2/Reports.aspx</u>

<sup>&</sup>lt;sup>20</sup> MINI Financial Reporting Scheme Validation Dashboard, <u>http://xbrlsite-app.azurewebsites.net/Repository2/Dashboard.aspx</u>

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### Validation Dashboard (MINI Repository)

Legal Entity Identifier	Economic Entity Name	View Report	XBRL Validation	Model Structure	Type/Class Relations	FAC	Disclosure Mechanics	Reporting Checklist
10810137d58f76b84aaa	Sample Company	Info	Success	Success	Success	Success	Success	Success
20710066d58f26b84bbb	Sample Company 2	Info	Success	Success	Success	Success	Success	Success
30710066d58f26b84ccc	Sample Company 3	Info	Success	Success	Success	Success	Success	Success
40710066d58f26b84ddd	Sample Company 4	Info	Success	Success	Success	Success	Success	Success
50710066d58f26b84eee	Sample Company 5	Info	Success	Success	Success	Success	Success	Success
60710066d58f26b84fff	Sample Varability Company 6	Info	Success	Warning!	Warning!	Warning!	Warning!	Warning!

The following is a summary of validation results for each report submitted to this information repository:

This MINI financial statement repository is similar to the EDGAR Dashboard<sup>21</sup> provided by XBRL Cloud for XBRL-based reports submitted by public companies to the SEC.

But there is one very big difference between my MINI financial report repository and the SEC EDGAR repository that can be explained in one word: control.

The point of the MINI financial report repository is to explain you can get 100% of reports included within the repository 100% correct consistent, complete, and precise and to accurately explain the impediments to achieving that objective. The objective is to be able to create a system that can be used with special purpose and general purpose financial reporting schemes to get Sigma Level Six<sup>22</sup> quality of 99.99966%. With that level of information quality, the information can be usable by automated machine-based processes for analysis of the information or down stream use of the information in some other manner.

But first, there is one final incremental level of proving that a financial report is a properly functioning logic system that I need to explain.

<sup>&</sup>lt;sup>21</sup> XBRL Cloud, EDGAR Dashboard, <u>https://edgardashboard.xbrlcloud.com/edgar-dashboard/</u>

<sup>&</sup>lt;sup>22</sup> Wikipedia, Six Sigma, Sigma Levels, <u>https://en.wikipedia.org/wiki/Six\_Sigma#Sigma\_levels</u>

## Microsoft 2017 10-K Financial Report Logical System Proof

It was a small leap to move from the small accounting equation logical system to the SFAC 6 elements of a financial statement logical system. It was likewise a small leap from SFAC 6 to the four statement model and common elements of a financial report that I defined. It was a bit of a larger leap from the four statement model to the MINI financial reporting scheme that I created. It is likewise a significant leap from the MINI financial reporting scheme to the actual XBRL-based 10-K financial report created by Microsoft and submitted to the U.S. Securities and Exchange Commission<sup>23</sup>.

But the leap is only in terms of the volume of terms, associations between terms, assertions between terms, structures used to organize associations and assertions, and the number of facts described by the logical system of terms, associations, assertions, structures, and facts. The **principles** and **philosophies** behind the accounting equation example, the SFAC 6 example, the four statement example, the MINI financial reporting scheme example, and the actual Microsoft 10-K report submitted to the SEC are identical.

The leap from the one Microsoft 10-K report and the entire EDGAR system repository of reports is nothing more than another increase in volume with no change in principles and philosophies.

The Microsoft 2017 10-K has exactly 194 structures. This is a breakdown of those structures by concept arrangement pattern<sup>24</sup> and by SEC reporting level:

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

Of the 194 structures in the Microsoft 10-K, I have rules that verify only 49 of those which amounts to about 100 structures<sup>25</sup>. Remember that most parts of an SEC are reported three times; once as a Level 1 Note Text Block, again as a Level 3 Disclosure Text Block, and again as a

<sup>&</sup>lt;sup>23</sup> Summary of Human Readable Renderings, bullet point 2, Microsoft, <u>http://xbrl.squarespace.com/journal/2019/3/23/summary-of-human-readable-renderings.html</u>

<sup>&</sup>lt;sup>24</sup> Concept Arrangement Pattern,

http://xbrlsite.azurewebsites.net/2019/Framework/Details/ConceptArrangementPattern.html <sup>25</sup> Microsoft Disclosure Mechanics validation result,

http://xbrlsite.azurewebsites.net/2017/Prototypes/Microsoft2017/Disclosure%20Mechanics%20and%20Reporting %20Checklist.html

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Level 4 Disclosure Detail. The exception are the document and entity information and the primary financial statements which are not provided as text blocks. Policies are reported twice; once in a Level 1 Note Text Block that contains the significant accounting policies and again as the Level 2 Policy Text Block for the individual policies. I would estimate that I am verifying 94 structures; about half of the report. Estimating precisely is tricky because it is unclear what the appropriate level of validation is necessary for Level 1 Note Text Blocks which are presentation related and Level 2 Policy Text Blocks. The only way to really find out is to actually undertake the task to verify 100% of an entire report which is on my list of things to do.

The bottom line is this: everything that I am attempting to verify is provably verifiable using machine-based automated processes. To be crystal clear, I am not saying that automated processes can be used to "audit a report" or "verify that every detail of the report is 100% correct". What I am saying is that 100% of the mathematical relations (*assertions*) can be verified as being correct using automated processes, 100% of the *structural* relations can be verified as being correct using automated processes, 100% of the *associations* can be verified as being automated processes but only if the rules have been represented appropriately in machine-readable form.

And so, what does this mean for the Microsoft 10-K logical system? It means that all that stands between the XBRL-based report as it exists now and me being able to say that the report is a provably properly functioning logical system is for me or someone else to represent about 100 sets of rules in machine-readable form. I already have software applications, two actually, that can process the rules. The *terms, associations, structures,* and *facts* all exist.

All that is missing are the assertions or rules.

## Variability Caused by Alternative Intermediate Components

While financial reports created using some financial reporting scheme must fit within the elements of a financial statement defined by the financial reporting scheme; financial reports are not forms. Specific variability consciously created, is anticipated, and is explicitly allowed in robust financial reporting schemes such as US GAAP, IFRS, IPSAS, GAS, FAS, and others<sup>26</sup>.

<sup>&</sup>lt;sup>26</sup> Comparison of Elements of Financial Statements, <u>http://xbrlsite.azurewebsites.net/2019/Core/ElementsOfFinancialStatements.pdf</u>

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By far, the most variability that exists within a set of financial statements exists on the statement of financial performance (income statement). For example, SFAS 6 discusses the notion of intermediate components<sup>27</sup> 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."

Basically, variability can be caused by choosing to report different common subtotals or by choosing to report specific line items rather than other line items. For example, a balance sheet can be classified, order of liquidity, liquidation basis reporting net assets, etc. An income statement can be single step, multi step, be specific to an accounting activity such as interest-based reporting or insurance-based reporting.

I refer to these different "subtotals and specific line items" as the notion of a reporting styles<sup>28</sup>. This variability is not random or arbitrary; it is logical. There are commonly used reporting style patterns and less commonly used patterns. In essence, each of these patterns is simply a different structure or structures which combined specific terms, associations, and assertions.

**Professional judgement** is used to determine the line items that are reported within the framework of a financial statement that has been described above. Professional judgement is used to understand what reporting style structures are permissible and when exactly it is best to use one permissible reporting style structure as opposed to some other permissible reporting style structure. Sometimes the decision can be completely arbitrary based on personal preference. The structure itself, however, is objective and subject to the rules of mathematics, mechanics, and logic and are not open to interpretation or professional judgement. Further, it is never allowable to uses a structure that is not permissible.

## **Overcoming Impediments to Properly Functioning Financial Report Logical Systems**

The best way to understand how to create a properly functioning financial report logical system is to understand the specific possible impediments to creating such a logical system and countermeasures which can be used to overcome each impediment. This section performs that function by pointing out each specific impediment and how the impediment can be overcome using automated machine-based processes.

<sup>&</sup>lt;sup>27</sup> FASB, SFAC 6, page 47, paragraph 77.

<sup>&</sup>lt;sup>28</sup> Open Framework for Implementing XBRL-based Financial Reporting, *Reporting Styles*, <u>http://xbrlsite.azurewebsites.net/2019/Framework/Details/ReportingStyle.html</u>

Note that this section does not address obvious omissions of assertions, reporting erroneous facts, imprecise assertions that are not grounded in reality, and other such obvious issues caused by incomplete, imprecise, or clearly inconsistent statements that result in an improperly functioning logical systems. Our focus here is on patterns of impediments that have been problematic but are covered by well understood and very basic knowledge engineering principles.

### Improper XBRL technical syntax

The first impediment is improper XBRL technical syntax. This impediment has been successfully overcome using automated processes by (a) XBRL International's creation of a conformance suite<sup>29</sup> that explicitly defines what is permissible XBRL technical syntax and (b) software vendors testing their software using that provided conformance suite. The results are demonstratable. XBRL-based financial reports submitted to the U.S. Securities and Exchange Commission are demonstratable 99.9% conformant with the XBRL International technical syntax conformance suites.

And so, the XBRL International XBRL technical syntax conformance suites overcome the impediment of improper XBRL technical syntax.

### Improper XBRL presentation relations associations

While XBRL calculation relations and XBRL definition relations are explicitly covered by the XBRL International conformance suite, XBRL presentation relation associations are not covered as they are not part of the XBRL technical specification. The permissible relations are logical to a very large degree but there are some relations which can be effectively reasonably disputed. However, accounting professionals should not need to have a debate about the permissible and impermissible relations. As such, overcoming this impediment simply boils down to specifying which of the following relations are permissible and which are not:

Child	Parent						
	Network	Table	Axis	Member	LineItems	Abstract	Concept
[Network]	0	0	0	0	0	0	0
[Table]	35	0	0	0	0	0	0
[Axis]	0	0	0	0	0	0	0
[Member]	0	0	0	0	0	0	0
[LineItems]	0	35	0	0	0	0	0
[Abstract]	0	0	0	0	24	15	0
[Concept]	0	0	0	0	33	142	0

It is less important which of the logically reasonable relationships are specified as permissible and more about simply putting these permissible associations, whatever they are determined to be, into machinereadable form and enforced by software applications consistently.

<sup>&</sup>lt;sup>29</sup> XBRL International, XBRL 2.1 Conformance Suite, <u>https://specifications.xbrl.org/work-product-index-group-base-spec-base-spec.html</u>

Here is an example of an extreme, even pathological, of a set of relations which would be permissible in the absence of rules making these relationships impermissible<sup>30</sup>:

#	Label	Report Element Class	Period Type	Balance	Name
1	Significant Accounting Policies [Hypercube]	[Table]			mini:SignificantAccountingPoliciesHypercube
2	Significant Accounting Policies [Line Items]	[Line Items]			mini:SignificantAccountingPoliciesLineItems
3	Cash and Cash Equivalents Policies [Text Block]	[Concept] String	For Period		mini:CashAndCashEquivalentsPoliciesTextBlock
4	Receivables Policies [Text Block]	[Concept] String	For Period		mini:ReceivablesPoliciesTextBlock
5	Inventories Policies [Text Block]	[Concept] String	For Period		mini:InventoriesPoliciesTextBlock
6	Property, Plant, and Equipment Policies [Text Block]	[Concept] String	For Period		mini:PropertyPlantAndEquipmentPoliciesTextBlock
7	Accounts Payable Policies [Text Block]	[Concept] String	For Period		mini:AccountsPayablePoliciesTextBlock
8	Long-term Debt Policies [Text Block]	[Concept] String	For Period		mini:LongtermDebtPoliciesTextBlock
9	Revenue Recognition Policies [Text Block]	[Concept] String	For Period		mini:RevenueRecognitionPoliciesTextBlock

Contrasting the pathological example above with the more commonly used example<sup>31</sup> makes it clear why the pathological example is, well, pathological:

#	Label	Report Element Class	Period Type	Balance	Name
1	Significant Accounting Policies [Hypercube]	[Table]			mini:SignificantAccountingPoliciesHypercube
2	Significant Accounting Policies [Line Items]	[Line Items]			mini:SignificantAccountingPoliciesLineItems
3	Cash and Cash Equivalents Policies [Text Block]	[Concept] String	For Period		mini:CashAndCashEquivalentsPoliciesTextBlock
4	Receivables Policies [Text Block]	[Concept] String	For Period		mini:ReceivablesPoliciesTextBlock
5	Inventories Policies [Text Block]	[Concept] String	For Period		mini:InventoriesPoliciesTextBlock
6	Property, Plant, and Equipment Policies [Text Block]	[Concept] String	For Period		mini:PropertyPlantAndEquipmentPoliciesTextBlock
7	Accounts Payable Policies [Text Block]	[Concept] String	For Period		mini:AccountsPayablePoliciesTextBlock
8	Long-term Debt Policies [Text Block]	[Concept] String	For Period		mini:LongtermDebtPoliciesTextBlock
9	Revenue Recognition Policies [Text Block]	[Concept] String	For Period		mini:RevenueRecognitionPoliciesTextBlock

If you cannot see the difference, the pathological example is a set of Level 2 Policy [Text Block]s that form an indented hierarchy whereas the more commonly used example is simply a flat list with no hierarchy within the list of [Text Block]s. The list of [Text Block]s is flat.

To think about this issue, ask yourself the question, "What is the logical difference between the first approach and the second approach?" If there is no logical explanation between two things, then it is likely the case that only one of the two alternatives are necessary.

And so, explicitly agreeing on the permissible and disallowed associations between each category of report element and then putting that information into machine-readable form will overcome this impediment.

### Improper use of a class of line item as if were some different class

FASB, in SFAC 6<sup>32</sup>, points out that the, "Elements of financial statements are the building blocks with which financial statements are constructed—the *classes* of *items* that financial statements comprise." The notion of "class" and "subclass" is well understood in knowledge engineering. Essentially,

<sup>&</sup>lt;sup>30</sup> Pathological example of XBRL presentation relations,

http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/mini/repository/company6/evidencepackage/contents/index.html#NetworkStructure-SignificantAccountingPoliciesTextBlocksmini\_SignificantAccountingPoliciesHypercube.html

<sup>&</sup>lt;sup>31</sup> More commonly used example,

http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/mini/repository/company1/evidencepackage/contents/index.html#NetworkStructure-SignificantAccountingPoliciesTextBlocksmini\_SignificantAccountingPoliciesHypercube.html

<sup>&</sup>lt;sup>32</sup> FASB, Statement of Financial Accounting Concepts No. 6, Elements of Financial Statements, page 9, https://www.fasb.org/pdf/con6.pdf

something cannot be two different things; for example, if something is an "Asset" it cannot also be a "Liability".

Again, both a positive and a negative example will make the point clear. The following is an example of what is considered a permissible cash flow statement per the MINI financial reporting scheme<sup>33</sup>:

	Period [Axis]
Cash Flow Statement [Line Items]	2018-01-01 - 2018-12-31
Cash Flow Statement [Roll Forward]	
Net Cash Flow [Roll Up]	
Net Cash Flow Operating Activities [Roll Up]	
Collection of Receivables	3,000
Payment of Accounts Payable	(2,000)
Net Cash Flow Operating Activities	1,000
Net Cash Flow Financing Activities [Roll Up]	
Additional Long-term Borrowings 2	6,000
Repayment of Long-term Borrowings 2	(1,000)
Net Cash Flow Financing Activities	5,000
Net Cash Flow Investing Activities [Roll Up]	
Capital Additions of Property, Plant and Equipment 2	(5,000)
Net Cash Flow Investing Activities	(5,000)
Net Cash Flow	1,000
Cash and Cash Equivalents, Beginning Balance	3,000
Cash and Cash Equivalents, Ending Balance	4,000

The following is not a permissible cash flow statement<sup>34</sup>:

http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/mini/repository/company6/evidencepackage/contents/index.html#Rendering-CashFlowStatement-mini CashFlowStatementHypercube.html

<sup>&</sup>lt;sup>33</sup> Permissible cash flow statement,

<sup>&</sup>lt;u>http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/mini/repository/company1/evidence-</u> package/contents/index.html#Rendering-CashFlowStatement-mini CashFlowStatementHypercube.html

package/contents/index.html#Rendering-CashFlowStatement-mini\_CashFlowStatementHypercube.html
<sup>34</sup> Not a permissible cash flow statement,

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	Period [Axis]
Coch Elevy Statement [Line Items]	2018-01-01 -
Cash Flow Statement [Line Items]	2010-12-31
Cash Flow Statement [Roll Forward]	
Net Cash Flow [Roll Up]	
Net Cash Flow Operating Activities [Roll Up]	
Collection of Receivables	3,000
Payment of Accounts Payable	(2,000)
Net Cash Flow Operating Activities	1,000
Net Cash Flow Financing Activities [Roll Up]	
Capital Additions of Property, Plant and Equipment 2	(5,000)
Net Cash Flow Financing Activities	(5,000)
Net Cash Flow Investing Activities [Roll Up]	
Additional Long-term Borrowings 2	6,000
Repayment of Long-term Borrowings 2	(1,000)
Net Cash Flow Investing Activities	5,000
Net Cash Flow	1,000
Cash and Cash Equivalents, Beginning Balance	3,000
Cash and Cash Equivalents, Ending Balance	4,000

Note the difference between the permissible and the impermissible cash flow statements; the line items in the permissible and impermissible have been switched. In the permissible version, the line items for additional long-term borrowings and repayment of long-term borrowings are rolled up into "Net cash Flow Financing Activities" whereas in the impermissible version they roll up to "Net Cash Flow Investing Activities".

So, how do you know that the first statement that I say is permissible is actually permissible and that the second is not permissible? If you go to the XBRL taxonomy<sup>35</sup> for these relations you can see that the XBRL presentation relations somewhat informally specify that additional borrowings and repayments are part of "Net Cash Flow Financing Activities":

<sup>&</sup>lt;sup>35</sup> Cash Flow Statement, <u>http://xbrlsite.azurewebsites.net/2019/Prototype/mini/base-taxonomy/viewer/CashFlowStatement\_ModelStructure.html</u>

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1103	- Statement - Cash Flow Statement	$\overline{\}$
Line	Label	
1	1103 - Statement - Cash Flow Statement	3
2	Cash Flow Statement [Hypercube]	Ŷ
3	Cash Flow Statement [Line Items]	<
4	Cash Flow Statement [Roll Forward]	Ş
5	Net Cash Flow [Roll Up]	{ ا
6	Net Cash Flow Operating Activities [Roll Up]	- 7
7	Collection of Receivables	2
8	Payment of Accounts Payable	Ĺ
9	Net Cash Flow Operating Activities	Ş
10	Net Cash Flow Financing Activities [Roll Up]	Å
11	Additional Long-term Borrowings 2	5
12	Repayment of Long-term Borrowings 2	5
13	Net Cash Flow Financing Activities	Ž
14	Net Cash Flow Investing Activities [Roll Up]	)
15	Capital Additions of Property, Plant and Equipment 2	- 5
16	Net Cash Flow Investing Activities	ڈ
17	Net Cash Flow	
18	Cash and Cash Equivalents, Beginning Balance	- 5
19	Cash and Cash Equivalents, Ending Balance	3
	man how have how	~ 1

You can more formally see these relations per the XBRL definition relations and per the XBRL calculation relations. Here are the XBRL definition relations<sup>36</sup>:

$\sim$	مس	aty man have	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	have a second and a second a
~	🕕 Ne	t Cash Flow	0	
	~ 0	Net Cash Flow Operating Activities	1	http://xbrlsite.azurewebsites.net/2016/conceptual-model/arcrole/class-subClass
		Collection of Receivables	1	http://xbrlsite.azurewebsites.net/2016/conceptual-model/arcrole/class-subClass
		Payment of Accounts Pavable	2	http://xbrlsite.azurewebsites.net/2016/conceptual-model/arcrole/class-subClass
	~ <b>0</b>	Net Cash Flow Financing Activities	2	http://xbrlsite.azurewebsites.net/2016/conceptual-model/arcrole/class-subClass
		Additional Long-term Borrowings 2	1	http://xbrlsite.azurewebsites.net/2016/conceptual-model/arcrole/class-subClass
		Repayment of Long-term Borrowings 2	2	http://xbrlsite.azurewebsites.net/2016/conceptual-model/arcrole/class-subClass
	~ U	Net Cash Flow Investing Activities	3	http://xbrlsite.azurewebsites.net/2016/conceptual-model/arcrole/class-subClass
		Capital Additions of Property, Plant and Equipment 2	1	http://xbrlsite.azurewebsites.net/2016/conceptual-model/arcrole/class-subClass
~~~ ~				

And so, the MINI financial reporting scheme XBRL taxonomy formally specifies allowed associations between terms within a structure.

These associations provide information for software applications which allows the application to determine if an error was made in the use of a line item within the wrong class of high-level financial reporting element.

The improper use of a line item to represent one thing when it is designed to represent something else is an all-to-common error found in XBRL-based financial reports submitted by public companies to the SEC. This type of error is not unique to the SEC, it is inherent in any system that allows variability. With the allowed variability it is necessary to provide rules so that the variability can be effectively controlled.

<sup>&</sup>lt;sup>36</sup> Entry Point for Viewing MINI XBRL Taxonomy, <u>http://xbrlsite.azurewebsites.net/2019/Prototype/mini/base-taxonomy/mini-entryPoint.xsd</u>

And so, the way to overcome the impediment of a reporting economic entity using a line item of one class to report a fact related to some other class of line item is to explicitly define the class-subclass or types of class associations within a base XBRL financial reporting taxonomy.

### Inconsistent or contradictory reported information

Looking at this balance sheet you will not find an error<sup>37</sup>:

	Period	[Axis]
Balance Sheet [Line Items]	2018-12-31	2017-12-31
Assets [Roll Up]		
Current Assets [Roll Up]		
Cash and Cash Equivalents	4,000	3,000
Receivables	2,000	1,000
Inventories	1,000	1,000
Current Assets	7,000	5,000
Property, Plant and Equipment	6,000	1,000
Assets	13,000	6,000
Lishilities and Equity [Poll Un]		
Liabilities [Roll Up]		
Current Liabilities [Roll Up]		
Accounts Payable	1,000	1,000
Current Liabilities	1,000	1,000
Noncurrent Liabilities [Roll Up]		
Long-term Debt	6,000	1,000
Noncurrent Liabilities	6,000	1,000
Liabilities	7,000	2.000
Equity [Roll Up]		
Retained Earnings	6,000	4,000
Equity	6,000	4,000
Liabilities and Equity	13,000	6,000

<sup>37</sup> Proper balance sheet,

http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/mini/repository/company6/evidencepackage/contents/index.html#Rendering-BalanceSheet-mini\_BalanceSheetHypercube.html

Also, if you look at this set of financial highlights, they also seem quite reasonable even though the error was designed to really stand out<sup>38</sup>:

	Period	[Axis]
Financial Highlights [Line Items]	2018-01-01 - 2018-12-31	2017-12-31
Financial Highlights [Set]		
Assets	13,000	6,000
Long-lived Assets	60,000	10,000
Sales	4,000	
Operating Income (Loss)	2,000	
Net Income (Loss)	2,000	
Net Cash Flow	1,000	
Capital Additions of Property, Plant and Equipment	5,000	

But digging in a little further, or it actually might be obvious that something is unusual about the relation between assets and long-lived assets. If you look more closely you see that the concept used to represent the line item "Long-lived Assets" is "mini:NoncurrentAssets".

Report Stand	laro Label	Long-Irved Assec	5		
Documentati	on				
Report Elema	ent Class	Concept			
Prefix (From	Taxonomy)	mini			
Balance Type	•	Debit			
Period Type		As Of (instant)			
Data Type		Monetary (xbrli:	monetaryItemType )		
Name		mini:Noncurrent	Assets		
ID		mini_Noncurrent	Assets		
Labels of R	Standard Jake	Role	Long-lived Assets	Label	Lang
	availabili labe		ung tree Asses		101

<sup>&</sup>lt;sup>38</sup> Proper looking financial highlights,

http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/mini/repository/company6/evidencepackage/contents/index.html#Rendering-FinancialHighlights-company6 FinancialHighlightsHypercube.html

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Yet, the balance sheet structure signals no error and neither does the financial highlights structure signal an error. Each of those individual structures appears correct. However, if you cross check the information between reported structures then the inconsistency becomes crystal clear.

What exacerbates this issue is when important consistency cross check rules are left out of the logical system altogether.

ſ	FAC_BS1_BalanceSheetBalances (evaluation 2)	satisfied	\$Assets=6000 = \$LiabilitiesAndEquity=6000
	FAC_BS2_AssetsEqualsCurrentPlusNoncurrentAssets (evaluation 1)	notSatisfied	\$Assets=13000 = \$AssetsCurrent=7000 + \$AssetsNoncurrent=60000
	FAC_BS2_AssetsEqualsCurrentPlusNoncurrentAssets (evaluation 2)	notSatisfied	\$Assets=6000 = \$AssetsCurrent=5000 + \$AssetsNoncurrent=10000
	FAC_BS3_LiabilitiesEqualsCurrentPlusNoncurrentLiabilities	satisfied	\$Liabilities=7000 = \$LiabilitiesCurrent=1000 + \$LiabilitiesNoncurrent=6000

If important consistency cross check rules are neglected to be included within a logical system, then manual human effort is needed to detect what can be hard to find inconsistencies and contradictions within an XBRL-based financial report. Only about 89% of public companies that submit XBRL-based financial statements to the SEC have all of their high-level financial report line items in order<sup>39</sup>. That means that about 11% have one or more inconsistencies or contradictions within their reported financial information. On a per relation basis it does not seem quite as bad with 99.24% of all high-level financial report relations being what you would expect them to be. But that .76% leads to 926 errors in the some 125,752 relations tested of 5,716 entities. While this error rate is vastly better when only manual effort was used to detect such inconsistencies and contradictions, the error rate is still to high and needs to be about 99.99966% correct, Sigma Level 6, in order for the information to be reliable for automated analysis processes.

To mitigate this impediment, consistency cross check rules need to be created. And because of reporting variability, it is not the case that one set of consistency cross check rules can be applied to every reporting economic entity. When variability exists, that variability needs to be taken into account and different assertions need to be provide based on which structures are used to report information by an economic entity<sup>40</sup>.

And so, to overcome the impediment of contradictory or inconsistent reported information, the use of fundamental accounting concept continuity cross checks can be used.

### Improper structure of disclosures

Imagine how complicated it is for an economic entity such as Microsoft to get every one of its 194 disclosure structures as is intended by the US GAAP XBRL Taxonomy. The fact that it seems like about

<sup>&</sup>lt;sup>39</sup> Quarterly XBRL-based Public Company Financial Report Quality Measurement (March 2019), http://xbrl.squarespace.com/journal/2019/3/29/quarterly-xbrl-based-public-company-financial-reportquality.html

<sup>&</sup>lt;sup>40</sup> Reporting Styles, <u>http://xbrlsite.azurewebsites.net/2019/Prototype/mini/documentation/ReportingStyles.html</u>

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89%<sup>41</sup> of all such disclosures are created correctly is a testament to the attention to detail of the professional accountants creating these reports. However, 89% is not remotely good enough. What if 100% was achievable? Well, 100% is achievable. Below you see one rule for one disclosure, Long-term Debt Maturities<sup>42</sup>:

### Rules Line of Reasoning

This disclosure: disclosures:LongTermDebtMaturities

- MUST be represented using the Hypercube/[Table] named: mini:LongtermDebtMaturitiesHypercube
- MUST be represented as using the Level 3 Disclosure Text Block: mini:LongtermDebtMaturitiesTextBlock
- MUST be represented as a Level 4 Disclosure Detail with the concept arrangement pattern: cm:RollUp
- cm:RollUp REQUIRES total: mini:LongtermDebt

- Requires the note to be reported using the Level 1 Note Text Block: mini:LongtermDebtNoteTextBlock

The above rendering was generated from the XBRL definition relations<sup>43</sup> that specify the rules for the disclosure. Different software applications can provide the rule information to users in whatever form they might desire.

Verification of each structural rule for each disclosure can be organized into an easy to understand and use dashboard for visualizing the state of consistency with or inconsistency from the expected result. Below you see disclosure rules for all 30 disclosures that are provide in the MINI financial reporting scheme reference implementation report:

Prim	nary Information									
#		Disclosure	Category	Level	Pattern	Disclosure Found	Disclosure Consistent	Applicable	Representation Concept [TEXT BLOCK]	Representation Concept DETAIL
÷	1	Accounts Payable Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	CONSISTENT	True	Accounts Payable Roll Forward [Text Block]	Accounts Payable
÷	2	Accounts Payable Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Accounts Payable Subclassifications [Text Block]	Accounts Payable
÷	3	Assets Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Assets
÷	4	Balance Sheet, Classified	Statement	UNKNOWN	Component	True	CONSISTENT	True	-	-
÷	5	Basis of Presentation	Unknown	Level 1TextBlock	TextBlock	True	CONSISTENT	True	Basis of Reporting [Text Block]	NOT-EXPECTED
÷	6	Cash and Cash Equivalents Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	CONSISTENT	True	Cash and Cash Equivalents Roll Forward [Text Block]	Cash and Cash Equivalents
÷	7	Cash and Cash Equivalents Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Cash and Cash Equivalents Subclassifications [Text Block]	Cash and Cash Equivalents
÷	8	Cash and Cash Equivalents Summary Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Cash and Cash Equivalents
÷	9	Cash Flow Statement, Direct Method	Statement	UNKNOWN	Component	True	CONSISTENT	True	-	-
÷	10	Document Information	Unknown	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Balance Sheet Date
÷	11	Entity Information	Unknown	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Economic Entity Name
÷	12	Finished Goods Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Finished Goods Subclassifications [Text Block]	Finished Goods
÷	13	Income Statement	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Net Income (Loss)
÷	14	Inventories Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	N/A	False	Inventories Roll Forward [Text Block]	Inventories
÷	15	Inventories Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	N/A	False	Inventories Subclassifications [Text Block]	Inventories
÷	16	Liabilities and Equity Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Liabilities and Equity
÷	17	Long-Term Debt Maturities	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Long-term Debt Maturities [Text Block]	Long-term Debt
÷	18	Long-Term Debt Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	CONSISTENT	True	Long-term Debt Roll Forward [Text Block]	Long-term Debt
÷	19	Long-Term Debt Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Long-term Debt Subclassifications [Text Block]	Long-term Debt
÷	20	Nature of Entity	Unknown	Level 1TextBlock	TextBlock	True	CONSISTENT	True	Nature of Business [Text Block]	NOT-EXPECTED
÷	21	Net Cash Flow Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Net Cash Flow
÷	22	Property, Plant, and Equipment, Net Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	CONSISTENT	True	Property, Plant, and Equipment Roll Forward [Text Block]	Property, Plant and Equipment
÷	23	Property, Plant, and Equipment, Net Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Property, Plant, and Equipment Subclassifications [Text Block]	Property, Plant and Equipment
÷	24	Receivables Roll Forward	Unknown	Level3TextBlock/Level4Detail	RollForward	True	CONSISTENT	True	Receivables Roll Forward [Text Block]	Receivables
÷	25	Receivables Subclassifications	Unknown	Level3TextBlock/Level4Detail	RollUp	True	CONSISTENT	True	Receivables Subclassifications [Text Block]	Receivables
÷	26	Retained Earnings Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Retained Earnings
÷	27	Significant Accounting Policies	Unknown	Level 1TextBlock	TextBlock	False	CONSISTENT	True	NOT-FOUND	NOT-EXPECTED
÷	28	Statement of Changes in Equity	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Equity
÷	29	Transactions Groupings	Unknown	Level4Detail	RollUp	True	N/A	False	NOT-EXPECTED	Check Sum Changes
÷	30	Trial Balance	Unknown	Level4Detail	RollUp	True	N/A	False	NOT-EXPECTED	Check Sum

<sup>&</sup>lt;sup>41</sup> Disclosure structure testing as of March 2019,

http://xbrlsite.azurewebsites.net/2019/Library/DisclosureMechanics ByDisclosure 2019-03-31.jpg <sup>42</sup> Disclosure Information for Long-term Debt Maturities,

http://xbrlsite.azurewebsites.net/2019/Prototype/mini/disclosures-topics/disclosures-detail/Disclosure-1373.html <sup>43</sup> XBRL definition relations for disclosure rules, <u>http://xbrlsite.azurewebsites.net/2019/Prototype/mini/disclosure-</u>mechanics/1373-rules-def.xml

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	Period [Axis]
Long-term Debt Maturities [Line Items]	2018-12-31
Long-term Debt Maturities	
Matures in One Year	1,000
Matures in Two Years	1,000
Matures in Three Years	1,000
Matures in Four Years	1,000
Matures in Five Years	1,000
Matures Thereafter	5,000

Consider the disclosure provided by an economic entity for long-term debt maturities<sup>44</sup>:

If you examine the disclosure rules you will see that this disclosure is incorrectly created because the structural and mechanical rules specify that the disclosure is (a) supposed to be a roll up and that (b) the total of that roll up should be represented using the concept "mini:LongtermDebt".

Now, this is not to say whether a US GAAP or IFRS disclosure of long-term debt maturities is required to include the total long-term debt line item and be a roll up or if it is acceptable to alternatively provide simply the set of annual maturities without the total. An analysis of all of the approximately 6,000 US public companies that report using US GAAP indicated that the best practice is, in fact, to include the line item for total long-term debt and have a roll up computation that aggregates the individual line items to the total.

If you look at the example again you might note that the total line items to not agree with the total longterm debt amount of \$6,000. What is shown is what would aggregate to a total of \$10,000 for total long-term debt. See how helpful the total is in preventing errors in a financial report? That is likely why the total line item is included as a best practice.

But suppose it was allowed for the set of items to be disclosed without the total. All that would need to be done is to create another disclosure, say "LongTermDebtMaturitiesWithoutTotal" and then to create a new set of rules and then the MINI financial reporting scheme would reflect that it is perfectly fine to provide this specific disclosure with or without the roll up total of the maturity line items.

As such, in order to provide a countermeasure to having a reporting entity to provide a disclosure incorrectly it is critically important to explicitly and clearly specify what is considered to be a permissible disclosure structure. You will note that the rules also include relations between the necessary Level 1 Note Text Block, the Level 2 Policy Text Block, and the Level 3 Disclosure Text Block to the Level 4 Disclosure detailed information that is required to be reported.

<sup>&</sup>lt;sup>44</sup> Long-term debt maturities improperly created,

http://xbrlsite.azurewebsites.net/DigitalFinancialReporting/mini/repository/company6/evidencepackage/contents/index.html#Rendering-LongTermDebtMaturities-mini LongtermDebtMaturitiesHypercube.html

### Machine-readable reporting checklist of required disclosures

An impediment to getting a properly created financial report is understanding what needs to be included within that report. Professional accountants use reporting checklists to make sure that reports that they create are consistent with statutory and regulatory reporting rules. Below you see the results of verifying that a report created using the MINI financial reporting scheme is consistent with the compliance requirements of that financial reporting scheme:

#		Disdosure	Checklist Category	Reason Disclosure Must Exist	Discovered	Expectation Met	Link to Disclosure Mechanics
~ O		Reporting Checklist					
	1	Document Information	Required disclosure	Disclosure always required	True	CONSISTENT	Document Information
	2	Entity Information	Required disclosure	Disclosure always required	True	CONSISTENT	Entity Information
~	3	Balance Sheet, Classified	Required disclosure	Disclosure always required, satisfied by Assets Roll Up and Liabilities and	True	CONSISTENT	Balance Sheet, Classified
	4	Assets Roll Up	Part of disclosure	Satisfies Balance Sheet, Classified disclosure	True	CONSISTENT	Assets Roll Up
	5	Liabilities and Equity Roll Up	Part of disclosure	Satisfies Balance Sheet, Classified disclosure	True	CONSISTENT	Liabilities and Equity Roll Up
	6	Income Statement	Required disclosure	Disclosure always required	True	CONSISTENT	Income Statement
~	7	Cash Flow Statement, Direct Method	Required disclosure	Disclosure always required, satisfied by Assets Roll Up and Liabilities and	True	CONSISTENT	Cash Flow Statement, Direct Method
	8	Assets Roll Up	Part of disclosure	Satisfies Cash Flow Statement, Direct Method disclosure	True	CONSISTENT	Assets Roll Up
	9	Liabilities and Equity Roll Up	Part of disclosure	Satisfies Cash Flow Statement, Direct Method disclosure	True	CONSISTENT	Liabilities and Equity Roll Up
	10	Cash and Cash Equivalents Summary Roll Forward	Line item exists, then disclosure required	Required because line item mini:NetCashFlow was reported	True	CONSISTENT	Cash and Cash Equivalents Summary Roll Forward
	11	Net Cash Flow Roll Up	Line item exists, then disclosure required	Required because line item mini:NetCashFlow was reported	True	CONSISTENT	Net Cash Flow Roll Up
	12	Statement of Changes in Equity	Required disclosure	Disclosure always required	True	CONSISTENT	Statement of Changes in Equity
	13	Basis of Presentation	Required disclosure	Disclosure always required	True	CONSISTENT	Basis of Presentation
	14	Nature of Entity	Required disclosure	Disclosure always required	True	CONSISTENT	Nature of Entity
	15	Significant Accounting Policies	Required disclosure	Disclosure always required	True	CONSISTENT	Significant Accounting Policies
	16	Cash and Cash Equivalents Roll Forward	Line item exists, then disclosure required	Required because line item mini:CashAndCashEquivalents was reported	True	CONSISTENT	Cash and Cash Equivalents Roll Forward
	17	Cash and Cash Equivalents Subclassifications	Line item exists, then disclosure required	Required because line item mini:CashAndCashEquivalents was reported	True	CONSISTENT	Cash and Cash Equivalents Subclassifications
	18	Receivables Roll Forward	Line item exists, then disclosure required	Required because line item mini:Receivables was reported	True	CONSISTENT	Receivables Roll Forward
	19	Receivables Subclassifications	Line item exists, then disclosure required	Required because line item mini:Receivables was reported	True	CONSISTENT	Receivables Subclassifications
	20	Property, Plant, and Equipment, Net Roll Forward	Line item exists, then disclosure required	Required because line item mini:PropertyPlantAndEquipment was reported	True	CONSISTENT	Property, Plant, and Equipment, Net Roll Forward
	21	Property, Plant, and Equipment, Net Subclassifications	Line item exists, then disclosure required	Required because line item mini:PropertyPlantAndEquipment was reported	True	CONSISTENT	Property, Plant, and Equipment, Net Subclassifications
	22	Accounts Payable Roll Forward	Line item exists, then disclosure required	Required because line item mini:AccountsPayable was reported	True	CONSISTENT	Accounts Payable Roll Forward
	23	Accounts Payable Subclassifications	Line item exists, then disclosure required	Required because line item mini:AccountsPayable was reported	True	CONSISTENT	Accounts Payable Subclassifications
	24	Retained Earnings Roll Forward	Line item exists, then disclosure required	Required because line item mini:RetainedEarnings was reported	True	CONSISTENT	Retained Earnings Roll Forward
	25	Long-Term Debt Subclassifications	Line item exists, then disclosure required	Required because line item mini:LongtermDebt was reported	True	CONSISTENT	Long-Term Debt Subclassifications
	26	Long-Term Debt Roll Forward	Line item exists, then disclosure required	Required because line item mini:LongtermDebt was reported	True	CONSISTENT	Long-Term Debt Roll Forward
	27	Long-Term Debt Maturities	Line item exists, then disclosure required	Required because line item mini:LongtermDebt was reported	True	CONSISTENT	Long-Term Debt Maturities
	28	Finished Goods Subclassifications	Line item exists, then disclosure required	Required because line item mini:FinishedGoods was reported	True	CONSISTENT	Finished Goods Subclassifications

But rather than being a paper-based or "e-paper" based memory jogger that is readable only by humans, this reporting checklist is machine-readable and therefore automatable. This is not to say that everything within today's reporting checklist memory jogger can be represented in a machine-readable form. This is to say that many things within a reporting checklist can be automated using machine-readable rules.

There are specific patterns or categories of rules that can be used within a machine-readable reporting checklist. First, required disclosures can be specified that they must exist within a report. Second, if a specific financial report line item is provided then a disclosure might be required to be reported. Third, if a disclosure is required, some alternative disclosure might be allowed. Forth, if some specific disclosure is required to be reported then some additional disclosure might also be required to be provided.

Many times, accounting rules are vague as to whether a disclosure is required or not. For example, per the Accounting Standards Codification (ASC) for US GAAP and per the AICPA technical hotline, the nature of business disclosure is always required to be provided within a financial report. Understanding whether a disclosure is or is not required should not be a guessing game.

And so, a machine-readable reporting checklist can be used to overcome the impediment of not reporting a required disclosure.

## Conclusion

This document explains that a seemingly simplistic example, the accounting equation, can be leverage to understand how an XBRL-based financial report can be proven to be a properly functioning logical system. Using several incremental steps the accounting equation example can be tied to an incrementally more complicated example of SFAC 6's elements of a financial report, and then that example to an incrementally more complicated four statement model, and then that example to an incrementally more complicated MINI financial reporting scheme example, and then that example to an incrementally more complicated actual XBRL-based financial report submitted by a public company to the SEC.

Further, if one individual report can be proven to be a properly functioning logical system then a repository of many individual reports can likewise be proven to be a set of properly functioning logical systems.

All of these incremental steps have been tested using terms, associations, structures, assertions, and facts represented using the XBRL technical syntax using two different software applications and the results are repeatable. Two of the less complicated examples, the accounting equation and SFAC 6, have been tested using the Prolog<sup>45</sup> technical syntax.

Finally, we outline the impediments to creating a provably proper functioning logical system in order to explain both that and how to create provably correct XBRL-based financial reports that are properly functioning logical systems. Impediments can be eliminated.

Either general purpose financial statements or special purpose financial statements could be represented using XBRL, Prolog, or other logic representation system which has to expressive power to represent the necessary knowledge<sup>46</sup>. Keeping in mind that an internal financial statement is essentially an internally specified special purpose financial statement, this also shows how high-quality XBRL-based reporting systems can be implemented internally within an organization.

One question that people might have is why XBRL-US Data Quality Committee<sup>47</sup> rules are not included in the set of rules necessary to prove that a logical system is properly functioning. Many of the XBRL-US rules address symptoms of the problem of incomplete logical systems. So, if these rules are leveraged and solve a problem then many of the XBRL-US rules are unnecessary. However, that said, it is also the case that additional restrictions and constraints can be leveraged to improve information quality. In this way, the XBRL-US Data Quality Committee rules are likely would be helpful.

<sup>&</sup>lt;sup>45</sup> More on Logic Programming Languages and Prolog, <u>http://xbrl.squarespace.com/journal/2019/11/11/more-on-logic-programming-and-prolog-examples.html</u>

<sup>&</sup>lt;sup>46</sup> Revisiting the Knowledge Representation Spectrum, <u>http://xbrl.squarespace.com/journal/2019/10/9/revisiting-</u> <u>the-knowledge-representation-spectrum.html</u>

<sup>&</sup>lt;sup>47</sup> XBRL US, Data Quality Committee, <u>https://xbrl.us/data-quality/center/committee/</u>

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For more information see Auditing XBRL-based Financial Reports<sup>48</sup>.

The forthcoming OMG Standard Business Report Model (SBRM)<sup>49</sup> will formally document this logical conceptualization of a business report. A financial report is a specialization of the more general business report.

## Appendix 1: Logical Systems and the Financial Report Logical System in Simple Terms

A **logical system** (logical theory)<sup>50</sup> 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.

A **financial report** is a logical system. Financial reports represent economic phenomena in words and numbers. A financial report is a faithful representation of a set of claims made by an economic entity about the financial position and financial performance of an economic entity with supporting quantitative and qualitative details. (i.e. a financial report is not arbitrary, is not random, is not illogical)

A logical system or logical theory is made up of a set of **models**, **structures**, **terms**, **associations**, **assertions**, and **facts**. In 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 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 associations and assertions of 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**: Terms are statements that define ideas used by the logical theory such as "assets", "liabilities", and "equity".

<sup>&</sup>lt;sup>48</sup> Charles Hoffman, CPA, *Auditing XBRL-based Financial Reports*, <u>http://xbrl.squarespace.com/journal/2019/10/17/auditing-xbrl-based-financial-reports.html</u>

<sup>&</sup>lt;sup>49</sup> OMG Standard Business Report Model (SBRM) Initial Submission Information, <u>http://xbrl.squarespace.com/journal/2019/11/15/omg-standard-business-report-model-sbrm-initial-submission-</u> i.html

<sup>&</sup>lt;sup>50</sup> Charles Hoffman, CPA, Explanation of a Financial Report Logical System in Simple Terms, <u>http://xbrl.squarespace.com/journal/2019/11/1/explanation-of-a-financial-report-logical-system-in-simple-t.html</u>

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- 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 "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: Assertions are statements that describe what tend to be IF...THEN...ELSE types of relationships such as "IF the economic entity is a notfor-profit THEN net assets = assets - liabilities; ELSE assets = liabilities + equity"
- **Facts**: 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.

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.

Here is the human-readable and machine-readable logical system that describes the elements of a financial report defined by SFAC 6:

### TERMS<sup>51</sup>:

#	Label	Report Element Class	Period Type	Balance	Name
1	01-Elements of Financial Statement Defined by SFAC 6 [Table]				(Implied)
2	Elements of Financial Statements Defined by FASB [Set]	[Abstract]			core:ElementsFinancialStatementsDefinedByFASBSet
3	Assets	[Concept] Monetary	As Of	Debit	core:Assets
4	Liabilities	[Concept] Monetary	As Of	Credit	core:Liabilities
5	Equity	[Concept] Monetary	As Of	Credit	core:Equity
6	Investments by Owners	[Concept] Monetary	For Period	Credit	core:InvestmentsByOwners
7	Distributions to Owners	[Concept] Monetary	For Period	Debit	core:DistributionsToOwners
8	Comprehensive Income	[Concept] Monetary	For Period	Credit	core:ComprehensiveIncome
9	Revenues	[Concept] Monetary	For Period	Credit	core:Revenues
10	Expenses	[Concept] Monetary	For Period	Debit	core:Expenses
11	Gains	[Concept] Monetary	For Period	Credit	core:Gains
12	Losses	[Concept] Monetary	For Period	Debit	core:Losses

Statements that provide additional information about a term such as labels, references to authoritative literature, properties of the term, etc.<sup>52</sup>:

<sup>&</sup>lt;sup>51</sup> Machine-readable terms, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/core.xsd</u>

<sup>&</sup>lt;sup>52</sup> Human-readable term, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/term.jpg</u>

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Report S	Randard Labo	al Assets						
Docume	ntation	Assets are p a result of p	Assets are probable future economic benefits obtained or controlled by a particular entity as a result of past transactions or events.					
Report I	lement Class	Concept	Concept					
Prefix (F	rom Taxonor	my) core						
Balance	Турс	Debit						
Period T	ype	As Of (instar	nt)					
Data Typ	pen .	Monetary (x	bri:moneteryltemType )					
		core: Assets						
PERIOR CONTRACTOR			core: Assets					
ID Labels Free	of Report I	core_Assets Element Role	Label	Lang				
ID Labels Fro	of Report I m	core_Assets Element Role and label	Label	Lang en				
Labels From core	of Report I m Standa Period	core_Assets Element Role and label end label	Label Assets Assets, Ending	Lang en en				
Labels From core core	of Report I m Standa Period Period	Core_Assets Element Role and label and label start label	Label Assets Assets, Ending Assets, Beginning	Lang en en				
Tabels From core core core Referen	of Report I Standa Penod Penod noes of Rep Beference Name	core_Assets Element Role and label and label start label port Element	Label Assets Assets, Ending Assets, Deginning Beference Information	Lang en en				
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Labels Fro core core core Referen Publisher FASD	of Report I Stands Period Period Reference Name SFAC	core_Assets Element Role and label atart label port Element Paragraph: 25 URIDate: 2019-10-22	Label Assets Assets, Ending Assets, Beginning Beference Information	Lang en en				
Labels From core core core Referen Publisher FASD	of Report I Stands Period Period Reces of Rep Reference Name SFAC	core_Assets Element Role end label end label start label port Element Paragraph: 25 URIDate: 2019-10-2; URI: https://www.fas ed=1218220132001	Label Assets Assets, Ending Assets, Ending Assets, Beginning Beference Information 2 b.org/sp/IN/SI/Document_C/DocumentPage? Assetpt=Disclaimer: True	Lang en en				

### ASSOCIATIONS<sup>53,54</sup>:

	Period [Axis]
Comprehensive Income Statement [Abstract]	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

The graphic above shows that the classes of elements revenues, expenses, gains, and losses are all part-of comprehensive income.

 <sup>&</sup>lt;sup>53</sup> Machine-readable associations, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/core-presentation.xml</u>
 <sup>54</sup> Human-readable associations, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/evidence-package/contents/index.html#Rendering-IS-Implied.html</u>

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### ASSERTIONS<sup>55,56</sup>:

ASSERTION_CORE_Equality_AccountingEquation (evaluation 1)	satisfied	\$Assets=0 = \$Liabilities=0 + \$Equity=0
ASSERTION_CORE_Equality_AccountingEquation (evaluation 2)	satisfied	\$Assets=3500 = \$Liabilities=0 + \$Equity=3500
ASSERTION_Core_ROLLUP_ComprehensiveIncome (evaluation 1)	satisfied	\$ComprehensiveIncome=3000 = (\$Revenues=7000 + \$Gains=1000 - \$Expenses=3000 - \$Losses=2000)
ASSERTION_CORE_ROLLFORWARD_Equity (evaluation 1)	satisfied	<pre>\$Equity_BalanceStart=0 + \$ComprehensiveIncome=3000 + \$InvestmentsByOwners=1000 - \$DistributionsToOwners=500 = \$Equity_BalanceEnd=3500</pre>
ASSERTION_CORE_CONCEPTUAL_FRAMEWORK_RECONCILATION (evaluation 1)	satisfied	0= ((\$Equity_BalanceStart=0 + ((\$Revenues=7000 - \$Expenses=3000) + (\$Gains=1000 - \$Losses=2000)) + (\$InvestmentsByOwners=1000 - \$DistributionsToOwners=500)) + (\$Liabilities_BalanceEnd=0 - \$Assets_BalanceEnd=3500))

The statements above are assertions that are applicable if an economic entity is a for-profit entity.

**FACTS**<sup>57,58</sup>:

#	Reporting Entity [Axis]	Period [Axis]	Concept	Fact Value	Unit	Rounding	Parenthetical Explanations
1	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Losses	2000	USD	INF	
2	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Investments by Owners	1000	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)	2019-12-31	Assets	0	USD	INF	
5	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-12-31	Assets	3500	USD	INF	
6	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Revenues	7000	USD	INF	
7	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-12-31	Equity	3500	USD	INF	
8	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2019-12-31	Equity	0	USD	INF	
9	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Comprehensive Income	3000	USD	INF	
10	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-12-31	Liabilities	0	USD	INF	
11	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2019-12-31	Liabilities	0	USD	INF	
12	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Distributions to Owners	500	USD	INF	
13	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-01-01 - 2020-12-31	Expenses	3000	USD	INF	

Facts are statements or the words and numbers reported within a financial report differentiated from one another by their distinguishable aspects.

 <sup>&</sup>lt;sup>55</sup> Machine-readable assertions, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/core-formula.xml</u>
 <sup>56</sup> Human-readable assertions, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/evidence-</u>

package/contents/index.html#BusinessRulesSummary.html <sup>57</sup> Machine-readable facts, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/instance.xml</u>

<sup>&</sup>lt;sup>58</sup> Human-readable facts, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/evidence-package/contents/index.html#FactTableSummary.html</u>

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### STRUCTURES<sup>59,60</sup>:

Component: (Network and Table)		
Network	06-Changes in Equity (http://www.xbrlsite.com/core/role/CE)	
Table	(Implied)	

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

Reporting Entity [Axis]

GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)

	Period [Axis]
Changes in Equity [Abstract]	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

The changes in equity structure is distinguishable from, say, the balance sheet structure or the income statement structure.

### MODELS:

In this particular logical system, there is only one set of structures and that set of structures is universally applicable to all economic entities. The relation between "assets" and "liabilities" and "equity" is interpreted to be "assets = liabilities + equity", there is our only interpretation provided for in this logical system.

However, SFAS 6 allows for another permissible interpretation: "net assets = assets - liabilities". But we do not use that second interpretation of the logical theory in this specific logical system of the financial report we are specifying and describing. We use the first permissible interpretation. We could add another structure to represent this permissible interpretation.

### PRECISION AND COVERAGE<sup>61</sup>:

The *precision* of the statements made by the models, structures, terms, associations, assertions, and facts in this logical theory or system we are describing is HIGH because the logical system is provably consistent with reality defined by SFAC 6. Further, the *coverage* of

 <sup>&</sup>lt;sup>59</sup> Machine-readable structures, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/core-presentation.xml</u>
 <sup>60</sup> Human-readable structures, <u>http://xbrlsite.azurewebsites.net/2019/Core/core-sfac6/evidence-presentation.xml</u>
 package/contents/index.html#RenderingSummary.html

<sup>&</sup>lt;sup>61</sup> C. Maria Keet, *An Introduction to Ontology Engineering*, pages 8-9, <u>https://people.cs.uct.ac.za/~mkeet/files/OEbook.pdf</u>

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the logical system is HIGH because we cannot think of or demonstrate that anything is missing from the system. No important *terms* seem to be missing, no *associations*, no *assertions*, no *models* seem to be causing logical problems such as errors, inconsistencies, contradictions, etc. Therefore, this logical system can be deemed to be **properly functioning**.

Showing this graphically below, the universe of discourse we are concerned with at the moment is only SFAC 6. That is represented by the GREEN circle. Because the logical representation has high precision, the representation in PINK is essentially the same size as GREEN showing that the coverage is appropriate. The description is precise because no one really can demonstrate or prove that anything in the system is imprecise. Further, the facts reported, the terms used, the assertions, the associations, the structures that make up the model are all consistent with expectations of all stakeholders that are concerned with this system.



High precision, High coverage (Very good) All important aspects of reality related to some universe of discourse necessarily to achieve some goal or objective or a set of goals/objectives have been represented.

As such, a logical system in which no logical inconsistencies or contradictions are detected, that represents the portion of reality that is important and has high coverage of the terms, associations, structures, assertions, and facts can be proven to be a properly functioning logical system.

## **Appendix 2: Double-entry Accounting.**

Single-entry accounting is how 'everyone' would do accounting. In fact, that is how accounting was done for about 4,000 years before double-entry accounting was invented. Double-entry accounting was the invention of medieval merchants in 1211 and was first documented by the

Italian mathematician and Franciscan Friar Luca Pacioli<sup>62</sup> in 1494. The section related to double-entry accounting was translated into English in 1914<sup>63</sup>.

Double-entry accounting adds an additional important property to the accounting system, that of a clear strategy to identify errors and to remove the errors from the system. Even better, double-entry accounting has a side effect of clearly firewalling errors as either accident or fraud. This then leads to an audit strategy. Double-entry accounting is how professional accountants do accounting.

Which came first, double-entry accounting or the enterprise? It is hard to overstate the impact of double-entry accounting on the evolution of the complex global enterprise<sup>64</sup>.

## Appendix 3: Foundational Mathematical Equation for Double-Entry Accounting

The foundational basis of double-entry accounting is straightforward. Quoting David Ellerman from his paper *The Math of Double-Entry Bookkeeping: Part I (scalars)*<sup>65</sup>:

"Given an equation w + ... + x = y + ... + z, it is not possible to change just one term in the equation and have it still hold. Two or more terms must be changed."

And so, the left-hand side of the equation "w + ... + x" (the DEBIT side) must always equal the right-hand side of the equation "y + ... + z" (the CREDIT side) in double-entry accounting. The reason that double-entry accounting is used, as contrast to single-entry accounting, is double-entry accounting's capability to detect errors and to distinguish an error from fraud.

Of course, there are a lot of details associated with setting up and operating an accounting system appropriately, but the fundamental feature is that DEBITS must equal CREDITS and if they don't, then something is up which needs to be investigated and corrected.

If you desire to learn more about double-entry accounting, see Colin Dodd's rap song, *Debit Credit Theory (Accounting Rap Song)*<sup>66</sup>.

<sup>62</sup> Wikipedia, Luca Pacioli, https://en.wikipedia.org/wiki/Luca Pacioli

 <sup>&</sup>lt;sup>63</sup> J. B. Geijsbeek, Ancient Double-Entry Bookkeeping, <u>https://archive.org/details/ancientdoubleent00geij/page/n3</u>
 <sup>64</sup> Ian Grigg, *Triple Entry Accounting*, <u>https://iang.org/papers/triple\_entry.html</u>

<sup>&</sup>lt;sup>65</sup> David Ellerman, *The Math of Double-Entry Bookkeeping: Part I (scalars)*, <u>http://www.ellerman.org/the-math-ofdouble-entry-bookkeeping-part-i-scalars/</u>

<sup>&</sup>lt;sup>66</sup> YouTube, Colin Dodd's rap song, Debit Credit Theory (Accounting Rap Song), https://www.youtube.com/watch?v=j71Kmxv7smk

## Appendix 4: The Accounting Equation: Framework for Financial Accounting

While the model "Debits = Credits" or the notion of basically using two single entry ledgers and synchronizing them to detect errors or fraud is useful; additional power is provided to doubleentry accounting via the accounting equation<sup>67</sup> which is:

"Assets = Liabilities + Equity"

The accounting equation within the double-entry accounting is the fundamental basis for financial accounting. By definition, every financial reporting scheme<sup>68</sup> has this high-level model at its core.

## **Appendix 5: Ledgers and Journals, Stocks and Flows**

Another important piece of double-entry accounting is explained well in David Ellerman's article, *The Math of Double-Entry Bookkeeping: Part II (vectors)*, is ledgers and journals<sup>69</sup>. Many accountants use the terms "ledger" and "journal" incorrectly. This works the same for general and special ledgers and journals. This is the relationship between a ledger and a journal:



Ledgers summarized balances. For example, the general ledger summarizes account balances.

Journals record the transactions which make up the changes between ledger balances. Other terms used for the relationship shown above are "roll forward" or "movements" or "stocks and flows" or "account analysis". All three of these terms basically explain the following equation:

"Beginning balance + Additions - Subtractions = Ending balance"

<sup>&</sup>lt;sup>67</sup> Wikipedia, Accounting Equation, <u>https://en.wikipedia.org/wiki/Accounting\_equation</u>

<sup>&</sup>lt;sup>68</sup> Charles Hoffman, CPA, *Comparison of Financial Reporting Schemes High Level Concepts*, <u>http://xbrlsite.azurewebsites.net/2018/Library/ReportingSchemes-2018-12-30.pdf</u>

<sup>&</sup>lt;sup>69</sup> David Ellerman, *The Math of Double-Entry Bookkeeping: Part II (vectors)*, <u>http://www.ellerman.org/the-math-of-double-entry-bookkeeping-part-ii-vectors/</u>

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Balance sheet accounts are stocks. Roll forwards of the beginning and ending balances of balance sheet accounts are flows. The income statement is a flow of net income (loss). The cash flow statement is a roll forward of the net change in cash and cash equivalents. The statement of changes in equity is a roll forward of equity accounts.

Many transactions, events, circumstances, and other phenomenon are recorded as transactions in a journal, make their way to a ledger, and then end up in the primary financial statements or within disclosures which detail the line items of the primary financial statements. Much of this information is part of the two trees which make up the roll ups of "Assets" and "Liabilities and Equity". However, there are other trees that can make up the complete "forest" of a financial report. For more information about the "forest" and the "trees" of a financial report, see the document *Leveraging the Theoretical and Mathematical Underpinnings of a Financial Report*<sup>70</sup>. That document also has some good information related to triple-entry accounting which I am not going to get into here.

As pointed out in the document *General Ledger Trial Balance to External Financial Report*<sup>71</sup>, each balance sheet line item has a roll forward. While perhaps not reported externally, these roll forwards can be quite helpful internally to verify that a financial report has been created correctly.

<sup>70</sup> Charles Hoffman, CPA, *Leveraging the Theoretical and Mathematical Underpinnings of a Financial Report*, <u>http://xbrlsite.azurewebsites.net/2018/Library/TheoreticalAndMathematicalUnderpinningsOfFinancialReport.pdf#</u> <u>page=6</u>

<sup>&</sup>lt;sup>71</sup> Charles Hoffman, CPA, *General Ledger Trial Balance to External Financial Report*, <u>http://xbrlsite.azurewebsites.net/2018/RoboticFinance/TrialBalanceToReport.pdf</u>