Understanding Digital

Getting your head around important aspects of "digital" related to accounting, reporting, auditing, and analysis

By

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> "It must be remembered that there is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than a new system. For the initiator has the enmity of all who would profit by the preservation of the old institution and merely lukewarm defenders in those who gain by the new ones." *Niccolò Machiavelli*

Executive summary:

- This document helps professional accountants get their heads around "digital".
- Financial reporting is a system that is comprised of many interconnected parts.
- A kluge is a term from the engineering and computer science world that refers to something that is convoluted and messy but gets the job done.
- Elegance is the quality of being pleasingly ingenious, simple, neat. Elegance is about beating down complexity.
- Creating something complex is easy. Creating something simple and elegant is hard work.
- This document strives for elegance in digital financial reporting systems in order to make them better, faster, and cheaper.

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Financial reporting is a system that is comprised of many interconnected parts. Today, many of these interconnections are missed because too many people look at financial reporting systems as silos of functionality. This expository paper helps readers understand these interconnections, describes those interconnections, and explains how to use XBRL formatted information to physically represent those interconnections in machine-readable form.

If you are reading this you are likely an adult. But computers are not like adults, they are more like babies. Not children, babies. Computer have to be led by the hand and taken where you want them to go. So, if this paper seems to state the obvious or be very detailed it is because these details are necessary to provide computers with the information, they need to automate processes.

Statements are used to describe the system. Rules provide a specification of the permissible manipulations of a system. Rules prevent anarchy. Rules lead the computer by the hand, telling the computer where you need to go.

If each part of the financial reporting system performs its role well, then the individual but interconnected parts will fit together nicely. But when information is missing from the system this makes interconnecting the parts more challenging.

For example, if a standards setter does not define the rules clearly or unambiguously then disagreements can result when it comes time to employ those rules. Accountants often confuse ambiguity with the notion of “professional judgment”. They are not the same thing. Accounting and reporting rules should be clear. When a chart of accounts used to report is defined less than optimally, it can make it more challenging to roll up a chart of accounts into a proper financial report or a set of lead schedules created by an auditor. When a financial report is not clear and then a financial analyst is forced to make assumptions about what that financial report is communicating, improper assumptions can occur.

A financial reporting system serves many different stakeholders. When the system is in harmony, then the system works effectively and the system tends to be easier to also make the system work efficiently. When there is dissonance, things tend to be harder, things tend to cost more for everyone, and friction exists within the system.

A kluge is a term from the engineering and computer science world that refers to something that is convoluted and messy but gets the job done. Elegance is the quality of being pleasingly ingenious, simple, neat. Elegance is about beating down complexity. Creating something complex is easy. Creating something simple and elegant is hard work.

This document strives for elegance in financial reporting systems.

Double Entry Accounting

Double entry accounting (a.k.a. double entry bookkeeping) is the foundation of accounting and financial reporting schemes. Double entry accounting is a simple mathematical model[1] that every accountant learns and understands[2].

Fundamentally, double entry accounting specifies a rule:

DEBITS = CREDITS

Whether an economic entity is a small sole proprietor reporting in one currency or a multinational corporation with hundreds of consolidated subsidiaries with transactions in multiple currencies amounting to billions of dollars; DEBITS = CREDITS.

Debits on the left; credits on the right! If you agree with this rule, enter the accounting equation.

The Accounting Equation

The accounting equation[3] is the fundamental basis for financial accounting. This foundation is critically important because it establishes fundamental rules for financial reporting schemes. As this video explains[4], the accounting equation is:

Stuff the business **OWNS** = Stuff the business **OWES**

Note the rule in the video, "The accounting equation balances always, always, always." Further note that the accounting equation is consistent with the double entry accounting model.

As the video goes on, it explains that "stuff the business OWNS" are called "Assets". "Stuff that business OWES" is broken down into two groups, "Liabilities" for stuff owned by third parties and "Equity" is stuff owned by the business' owner. And so, the accounting equation is:

"Assets = Liabilities + Equity"

[1] The Mathematics of Double Entry Bookkeeping, http://xbrl.squarespace.com/journal/2019/11/4/the-mathematics-of-double-entry-bookkeeping.html
[2] YouTube.com, *Colin Dodds - Debit Credit Theory (Accounting Rap Song)*, https://youtu.be/j71Kmxv7smk
[3] Wikipedia, *Accounting Equation*, https://en.wikipedia.org/wiki/Accounting_equation
[4] YouTube.com, *The ACCOUNTING EQUATION For BEGINNERS*, https://www.youtube.com/watch?v=56xscQ4viWE

Mathematics of Double Entry Accounting

Mathematics Magazine published an article written by David Ellerman, *The Mathematics of Double Entry Bookkeeping*[5], where Ellerman points out that double entry accounting is based on well-known mathematics construction from undergraduate algebra. But Ellerman laments, "Mathematics and accounting truly seem to live in disjoint universes with no trespassing between them."

When one takes the time to look, they see that the mathematics of double entry accounting relate to the mathematical concepts of *scalers*[6] and *vectors*[7]. Accountants don't use these terms; rather they use the notion "DEBITS = CREDITS" (i.e. scalers) and "BASE" (i.e. vectors). The former notion we have explained. BASE is simply the notion or acronym of a roll forward stated:

Beginning Balance + **A**dditions - **S**ubtractions = **E**nding Balance

Another term for BASE and roll forward is "movements" or "movements analysis".

Logical Theory in Simple Terms

A **system**[8] is a cohesive conglomeration of interrelated and interdependent parts that is either natural or man-made[9].

A **pattern** is any form of correlation between the states of elements within a system. A **theory** is a tool that can be used to describe a system. A theory essentially describes the patterns within a system.

As such, a logical system can be explained by a **logical theory**. A logical theory is an abstract conceptualization[10] of specific details of some domain. The logical theory provides a way of thinking about a domain by means of deductive reasoning to derive logical consequences of the theory.

A **logical theory** enables a community of stakeholders trying to achieve a specific goal or objective or a range of goals/objectives to agree on important common models, structures, and

[5] David Ellerman, *The Mathematics of Double Entry Bookkeeping*, http://www.ellerman.org/wp-content/uploads/2012/12/DEB-Math-Mag.CV_.pdf
[6] Wikipedia, *Scalers (Mathematics)*, https://en.wikipedia.org/wiki/Scalar_(mathematics)
[7] Wikipedia, Vectors (Mathematics and Physics), https://en.wikipedia.org/wiki/Vector_(mathematics_and_physics)
[8] Wikipedia, *Systems Theory*, https://en.wikipedia.org/wiki/Systems_theory
[9] Charles Hoffman, CPA, *Systems Theory: Method to my Madness*, http://xbrl.squarespace.com/journal/2019/12/29/systems-theory-method-to-my-madness.html
[10] Wikipedia, *Conceptual Model*, https://en.wikipedia.org/wiki/Conceptual_model

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

The accounting equation is, in essence, a logical theory that professional accountants subscribe to achieve some purpose. We will get to that purpose later.

A logical theory is made up statements that describe a set of *models*, *structures*, *terms*, *associations*, *rules*, 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*[11] is a set of structures that are consistent with and permissible interpretations of that model.
- **Structure**: A *structure* is a set of statements which describe the structure.
- **Statement**: A statement is a proposition, claim, assertion, belief, idea, or fact about or related to the universe of discourse to which the logical theory relates. There are four broad categories of statements:
  - **Terms**: Terms are statements that define ideas used by the logical theory such as "assets", "liabilities", "equity", and "balance sheet". Terms can be *simple* (a.k.a. primitive, atomic) or terms can be complex (a.k.a. functional, composite). Assets, liabilities, and equity are simple terms. Balance sheet is a complex term.
  - **Associations**: Associations are statements that describe permissible interrelationships between the terms such as "assets is part-of the balance sheet" or "liabilities is part-of the balance sheet" or "assets = liabilities + equity" or "an asset is a 'debit' and is 'as of' a specific point in time and is always a monetary numeric value".
  - **Rules**: Rules are statements that describe what tend to be IF…THEN…ELSE types of relationships such as "IF the economic entity is a not-for-profit THEN net assets = assets - liabilities; ELSE assets = liabilities + equity".
  - **Facts**: Facts are statements about the numbers and words that are provided by an economic entity within a business report. For example, the financial report, a type of business report, might state "assets for the consolidated legal entity Microsoft as of June 20, 2017 was $241,086,000,000 expressed in US dollars and rounded to the nearest millions of dollars.

Fundamentally, a logical theory is a set of statements. Those statements are essentially the "instructions" or "specification" of the system. Those statements can be represented in machine-readable form. Once in machine-readable form, those statements can be interrogated

[11] Wikipedia, *Model Theory*, https://en.wikipedia.org/wiki/Model_theory

using software applications and the system can be “reshaped” or “altered”. Rules specify permissible manipulations. To the extent that this can be done effectively; software tools can assist professional accountants and others working with those statements.

A financial report has a finite set of statements (structures, terms, associations, assertions, and facts) within the report. The set of statements is definite. That definite set of statements forms a model. (With any field of knowledge, the critical concepts of the field are embedded in the definitions of the field's technical terms. The term 'statement' in financial reporting is different than that same term 'statement' as is being used here.)

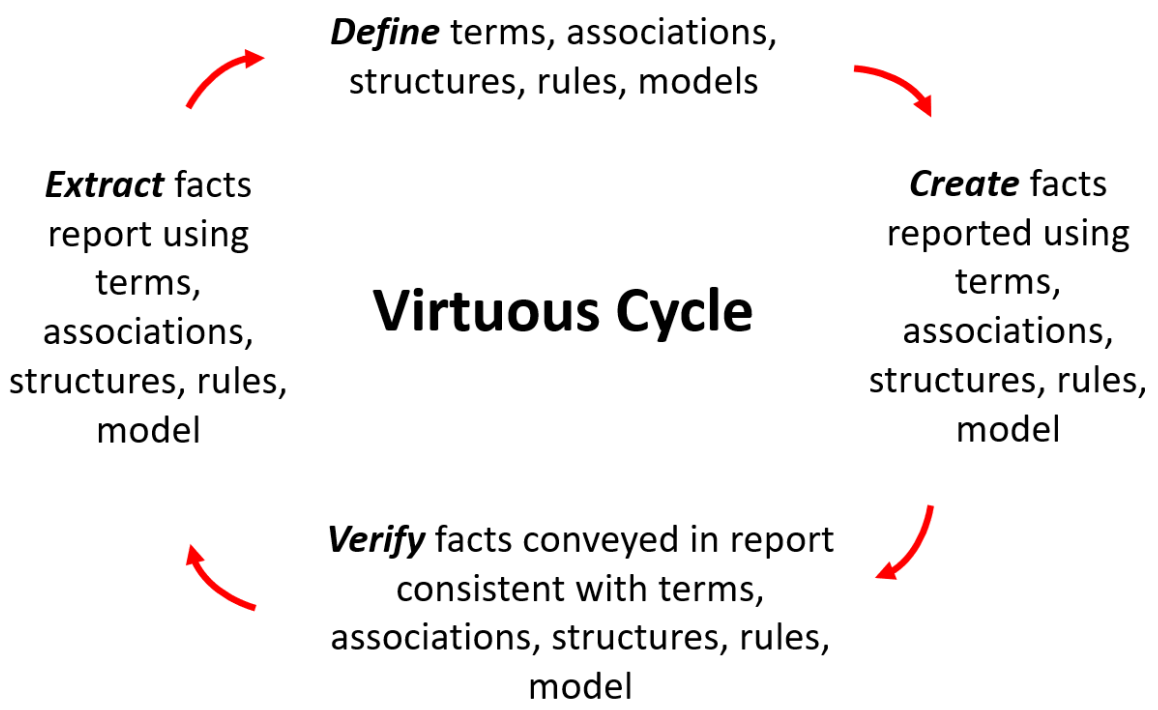
Proper Functioning Logical System

A logical theory is said to be **consistent** if there are no contradictions with respect to the statements made by the logical theory that describes the logical system (i.e. reality).

A logical theory can have high to low **precision** and high to low **coverage**. *Precision* is a measure of how precisely the information within a logical theory has been represented as contrast to reality of the logical system for the universe of discourse. *Coverage* is a measure of how completely information in a logical theory has been represented relative to the reality of the logical system for a universe of discourse.

When a logical system is consistent and it has high precision and high coverage the logical system can be considered a properly functioning logical system. When a system is working right, it creates a virtuous cycle[12].

[12] Charles Hoffman, CPA, *Virtuous Cycle*, http://xbrl.squarespace.com/journal/2020/4/29/virtuous-cycle.html



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

And so, if any of this is explained in machine-readable terms it must be done using auditable algorithms that are explainable to humans. Algorithms, including artificial intelligence, used by the enterprise or for accounting, reporting, auditing, and analysis needs to be explainable artificial intelligence. Explainable AI[13] (XAI) provides insight into how the software algorithms reached its conclusions, an understandable "line of reasoning" so to speak.

Expressing Accounting Equation as a Logical Theory

The accounting equation is a man-made logical theory. The accounting equation defines three simple **terms**:

- Assets
- Liabilities
- Equity

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

The accounting equation defines those three terms and provides the mathematical relations or associations (**rule** or **assertion**) between the three terms:

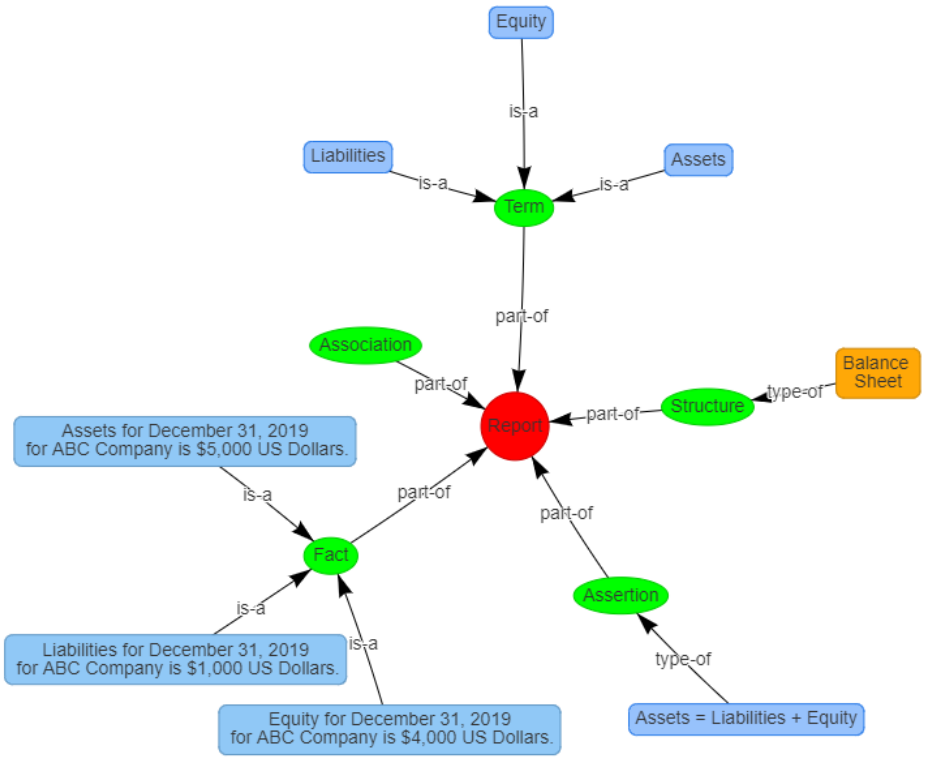
Assets = Liabilities + Equity

Depending upon how you read the definition of the accounting equation, it either explicitly says or at least implies the existence of a **structure**, the **Balance Sheet**, within which the three concepts exist. As such, the three terms, Assets, Liabilities, and Equity are **associated** with the Balance Sheet structure because they are part-of that structure.

With that information, an economic entity can create a balance sheet that communicate **facts** about that economic entity. For example, the economic entity "ABC Company" might represent their assets, liabilities, and equity as of December 31, 2019:

- Assets = $5,000
- Liabilities = $1,000
- Equity = $4,000

And so, the information that has been explained above can be represented as the following set of vertices and edges using graph theory[14] (a.k.a. knowledge graph):



[14] Wikipedia, *Graph Theory*, https://en.wikipedia.org/wiki/Graph_theory

The same logical system can be represented using the following table that shows the terms, associations, structures, rules, and facts of this logical system:

From	Role	To
Assets	Is-a	Term
Liabilities	Is-a	Term
Equity	Is-a	Term
Balance Sheet	Type-of	Structure
Assets = Liabilities + Equity	Type-of	Rule
Assets	Part-of	Balance Sheet
Liabilities	Part-of	Balance Sheet
Equity	Part-of	Balance Sheet
Assets for December 31, 2019 for ABC Company is $5,000 in US Dollars	Is-a	Fact
Liabilities for December 31, 2019 for ABC Company is $1,000 in US Dollars	Is-a	Fact
Equity for December 31, 2019 for ABC Company is $4,000 in US Dollars	Is-a	Fact
Balance Sheet	Part-of	Report

Both the knowledge graph and the table above convey the same meaning (or they try to). But, neither approach for representing the information is "standard". Enter the XBRL global standard technical syntax.

Accounting Equation Represented Using XBRL

The following is a summary of the model of the accounting equation logical system expressed in both machine-readable and human-readable terms. The machine-readable information is expressed using the XBRL technical syntax. The human-readable information is generated from the XBRL technical syntax.

One specific thing to note is that additional details are being added to the simple explanation we first provided above. We wanted to keep the simple explanation, well…simple.

For example, above we defined "Assets". But now, we define "Assets" as being a data type of "monetary", being "as of" a specific point in time (i.e. instant), and being a "Debit". Computers need this precise representation to help humans achieve what they desire to achieve from this logical system. You probably are aware that Assets is a debit, as of a point in time, and a number. But, all of those important details must be communicated to a computer software application that is making use of the information.

Note that this section assumes an understanding of XBRL; if you need to understand XBRL terminology, please see the section Logical Description Narrative in *Logical Theory Describing Financial Report*[15].

TERMS[16,17]:

Three simple terms are defined for the accounting equation logical system: Assets, Liabilities, Equity.

#	Label	Data Type	Period Type	Balance Type	Prefix	Standard label, Documentation, References, Concept name	Count
1	Assets	Monetary	As Of (instant)	Debit	ae	*Filer label:* Assets *Documentation:* *References:* Publisher: FASB; Reference Name: SFAC; Reference Information: Paragraph: 25; URIDate: 2019-10-22; URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true; Number: 6 *Name:* ae:Assets	1
2	Equity	Monetary	As Of (instant)	Credit	ae	*Filer label:* Equity *Documentation:* *References:* Publisher: FASB; Reference Name: SFAC; Reference Information: Paragraph: 49; URIDate: 2019-10-22; URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true; Number: 6 *Name:* ae:Equity	1
3	Liabilities	Monetary	As Of (instant)	Credit	ae	*Filer label:* Liabilities *Documentation:* *References:* Publisher: FASB; Reference Name: SFAC; Reference Information: Paragraph: 35; URIDate: 2019-10-22; URI: https://www.fasb.org/jsp/FASB/Document_C/DocumentPage?cid=1218220132802&acceptedDisclaimer=true; Number: 6 *Name:* ae:Liabilities	1

STRUCTURES[18,19]

In addition to the three simple terms, one functional term is defined to represent the balance sheet structure: Balance Sheet [Hypercube]:

#	Label	Prefix	Standard label, Documentation, References, Concept name	Count
1	Balance Sheet [Hypercube]	ae	*Filer label:* Balance Sheet [Hypercube] *Documentation:* *References:* NONE *Name:* ae:BalanceSheetHypercube	1

[15] Charles Hoffman, CPA, *Logical Theory Describing Financial Report*, page 14, section *Logical Description Narrative*, http://www.xbrlsite.com/2020/Theory/LogicalTheoryDescribingFinancialReport.pdf#page=14
[16] Machine-readable terms, http://xbrlsite.azurewebsites.net/2020/core/master-ae/ae.xsd
[17] Human-readable terms, http://xbrlsite.azurewebsites.net/2020/core/master-ae/evidence-package/contents/ReportElements-Concepts.html
[18] Machine-readable structures, http://xbrlsite.azurewebsites.net/2020/core/master-ae/ae.xsd
[19] Human-readable structures, http://xbrlsite.azurewebsites.net/2020/core/master-ae/evidence-package/contents/ReportElements-Tables.html

ASSOCIATIONS[20,21]:

The association between the three terms and the balance sheet structure are provided. Some additional infrastructure report elements are provided to help organize the representation:

#	Label	Report Element Class	Period Type	Balance	Name
1	**Balance Sheet [Hypercube]**	[Table]			ae:BalanceSheetHypercube
2	**Balance Sheet [Line Items]**	[Line Items]			ae:BalanceSheetLineItems
3	*Balance Sheet [Set]*	[Abstract]			ae:BalanceSheetSet
4	Assets	[Concept] Monetary	As Of	Debit	ae:Assets
5	Liabilities	[Concept] Monetary	As Of	Credit	ae:Liabilities
6	Equity	[Concept] Monetary	As Of	Credit	ae:Equity

ASSERTIONS[22,23]:

The mathematical relationship between the terms Assets, Liabilities, and Equity are represented.

#	Label	Result	Rule
1	$Assets = ($Liabilities + $Equity) (CONSISTENCY_5)	Pass	$Assets = ($Liabilities + $Equity)

FACTS[24,25]:

We can create a set of facts to exercise the logical system. Facts representing Assets of $5,000, liabilities of $1,000, and equity of $4,000 were created.

#	Reporting Entity [Axis]	Period [Axis]	Concept	Fact Value	Unit	Rounding	Parenthetical Explanations
1	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-12-31	Assets	5000	USD	INF	
2	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-12-31	Liabilities	1000	USD	INF	
3	GH259400TOMPUOLS65II (http://standards.iso.org/iso/17442)	2020-12-31	Equity	4000	USD	INF	

And so, the model above is used to explain the details of the human-readable representation that is also machine-readable below in the alternative Inline XBRL format[26]:

[20] Machine-readable associations, http://xbrlsite.azurewebsites.net/2020/core/master-ae/ae-pre.xml
[21] Human-readable associations, http://xbrlsite.azurewebsites.net/2020/core/master-ae/evidence-package/contents/NetworkStructure-N0-RE6.html
[22] Machine-readable assertions, http://xbrlsite.azurewebsites.net/2020/core/master-ae/Consistency-5-Code-BS01-formula.xml
[23] Human-readable assertions, http://xbrlsite.azurewebsites.net/2020/core/master-ae/evidence-package/contents/BusinessRulesSummary.html
[24] Machine-readable facts, http://xbrlsite.azurewebsites.net/2020/core/master-ae/instance.xml
[25] Human-readable facts, http://xbrlsite.azurewebsites.net/2020/core/master-ae/evidence-package/contents/NetworkFacts-N0-RE6.html
[26] Human-readable and machine-readable facts using Inline XBRL, http://xbrlsite.azurewebsites.net/2020/core/master-ae/instance.html

Inline XBRL Business Report

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

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

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

Balance Sheet [Line Items]	Period [Axis] 2020-12-31
Balance Sheet [Set]	
Assets	5,000
Liabilities	1,000
Equity	4,000

The logical system can be called **properly functioning** because all of the statements within the logical system are **consistent** with one another (i.e. there are no contradictions, there are no inconsistencies), it can be established that the logical system created **precisely** reflects the reality of the logical system (we just made the numbers up for ABC Company), and a **complete** set of statements seem to be included within the logical system.

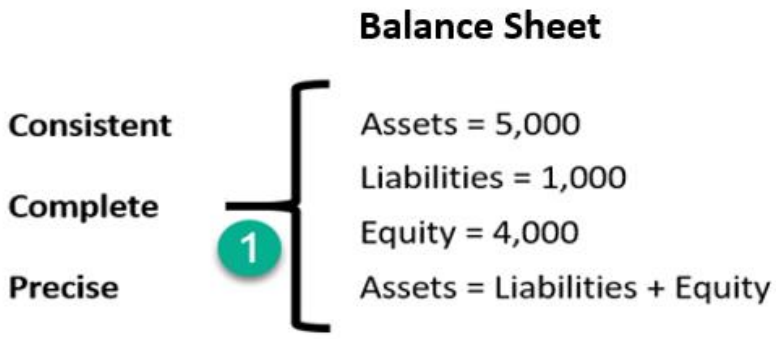
A software application can take all of the statements made within the machine-readable version of this logical system and perform work. Below you see a human-readable rendering of a Balance Sheet that was created from the XBRL-based representation of the accounting equation logical system:

Balance Sheet [Line Items]	Period [Axis] 2020-12-31
Balance Sheet [Set]	
Assets	5,000
Liabilities	1,000
Equity	4,000

Result	Rule
Pass	$Assets = $Liabilities + $Equity

The logical system of the accounting equation is therefore *consistent*, *precise*, and *complete* because all the statements are consistent with one another within the logical system, the logical system reflects the formal truths we wish to convey precisely, and a complete set of statements describe the logical system.

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



And so, above we have shown one permissible interpretation or model of the logical system that is consistent with our logical theory.

A really good way to understand logical systems is to understand the things that can go wrong with those systems.

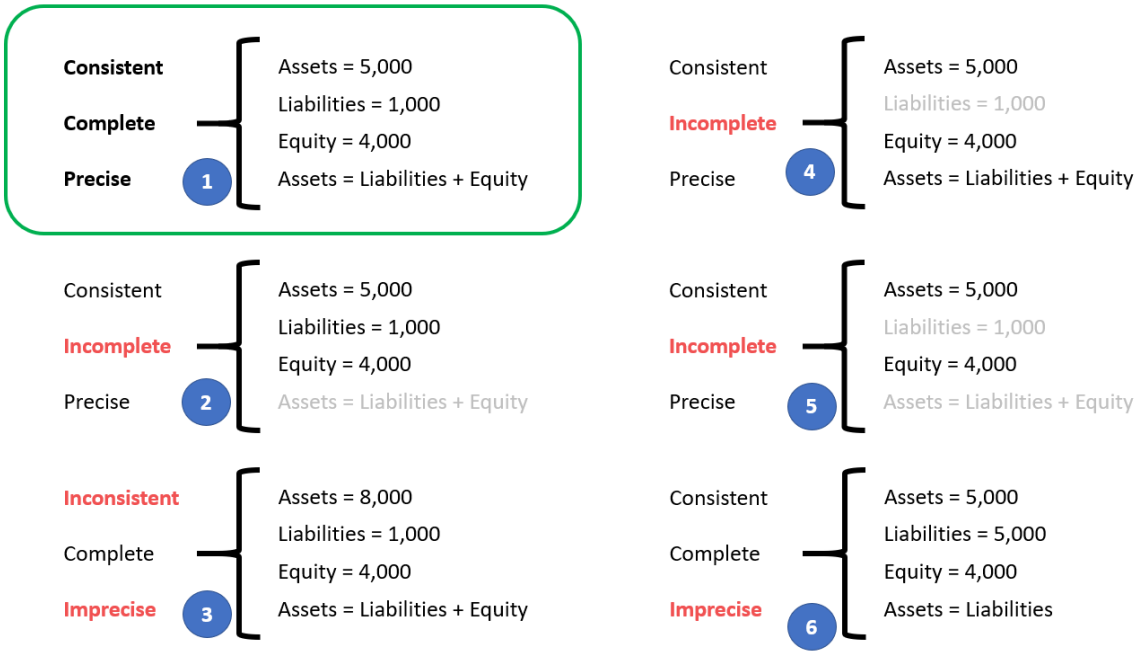
Now, we want to use this base logical system that is provably properly functioning to explain the sorts of things that can make the system inconsistent, incomplete, or imprecise. This will help you to better understand what is entailed in creating a properly functioning logical system.

Properly and Improperly Functioning Logical Systems

We are going to take a brief, but critically important, detour to hone your understanding of a logical system and the notion of a properly functioning logical system. If you understand what can go wrong, then you can understand how to prevent things from going wrong.

Below you can see examples of each of six possible states of the accounting equation logical system. For example, the logical system can be functioning improperly if a single statement is left out, if one statement contradicts another statement within the logical system, if a statement is imprecise with respect to reality; all of these situations impact (a) the logical system and (b) what information is necessary to include within the logical system.

Here is a graphic depicting the first 6 states including the first which is a properly functioning logical system:



In the following sections I want to make some adjustments to the logical system which make the logical system either inconsistent, incomplete, or imprecise and explain why the system is then not a properly functioning logical system. To the six examples above I will add three additional examples. I made videos that explain each of these impediments to a properly functioning logical system which you can see in this video playlist, Understanding the Financial Report Logical System[27].

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

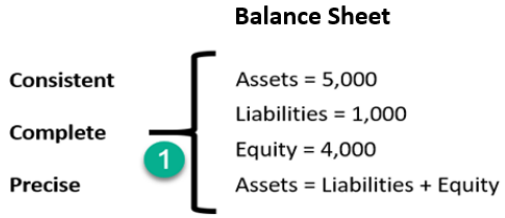
State 1: Properly Functioning Logical System

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

[27] Understanding the Financial Report Logical System, https://www.youtube.com/playlist?list=PLqMZRUzQ64B7EWamzDP-WaYbS_W0RL9nt

Balance Sheet [Abstract]	Period [Axis]
	2020-12-31
Balance Sheet [Abstract]	
Assets	5,000
Liabilities	1,000
Equity	4,000

Result	Rule
Pass	$Assets = $Liabilities + $Equity



Again, this is considered a properly functioning logical system because (a) all the statements within the system are **consistent**; (b) the set of statements that describe the system is **complete**; and (c) the information conveyed by the system is **precise** in its representation of reality. Further, we are formally declaring this "reality"[28] to be our base understanding.

Also, we need to be explicit. We defined three terms "Assets", "Liabilities", and "Equity".

Now, you may know what those three terms are; but a computer does not. You have to define what you work with relative to something that you know. Imagine our system defines four terms, "fac:Assets", "fac:Liabilities", "fac:Equity", and "fac:LiabilitiesAndEquity"[29]. You understand your system but you have to map every external system into your system[30]. Your internal system understands more that the accounting equation system (i.e. you have LiabilitiesAndEquity). You have to be able to compute that value based on some other system's information[31]. It is perfectly reasonable for our system to create a concept LiabilitiesAndEquity and compute that value even though the accounting equation logical system does not have that explicit value.

The point is that different economic entities have different models; but all models of a financial reporting scheme are reconcilable from/to one another in some manner[32].

State 2: Incomplete Coverage by Rules

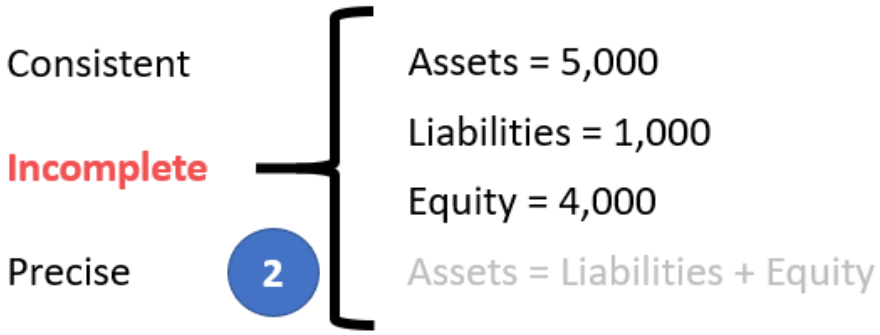
The logical system #2 below is intended to show exactly the same information as our #1 properly functioning logical system, except that #2 leaves out the rule "Assets = Liabilities and

[28] YouTube, *Reality*, https://youtu.be/eq2Jw6waaCI
[29] Fundamental accounting concepts, http://xbrlsite.azurewebsites.net/2020/core/master-ae/fac.xsd
[30] Mapping from accounting equation to fundamental accounting concepts in our system, http://xbrlsite.azurewebsites.net/2020/core/master-ae/fac-mapping-definition.xml
[31] XBRL Formula to derive the value for LiabilitiesAndEquity, http://xbrlsite.azurewebsites.net/2020/core/master-ae/fac-ImputeRule-LiabilitiesAndEquity-formula.xml
[32] Charles Hoffman, CPA, *Special Theory of Machine-based Automated Communication of Semantic Information of Financial Statements*, http://xbrl.squarespace.com/journal/2019/12/30/special-theory-of-machine-based-automated-communication-of-s.html

Equity" which is showed as grayed out (i.e. because it is assumed to be missing from the logical system.

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

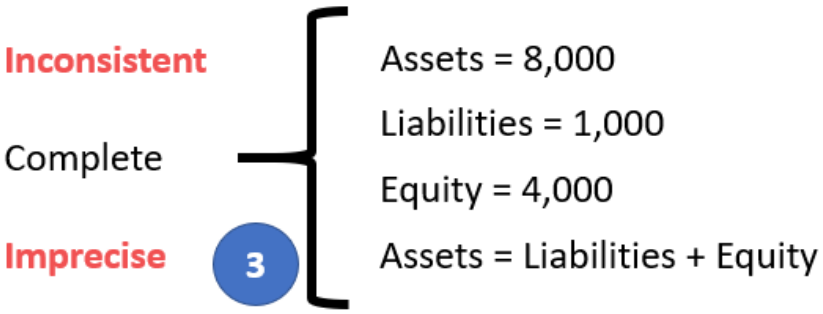
For example, if your logical system neglects to include the rule "Assets = Liabilities + Equity" or if your tools don't provide the capabilities to allow you to represent that rule; then there is the possibility that the facts being represented to be represented incorrectly and the system will not detect the inconsistency. As such, that logical system has **incomplete coverage**.



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

State 3: Inconsistent and Imprecise

All the statements in the system must be consistent for the logical system to be considered properly functioning. If statements are inconsistent, the logical system is not is not properly functioning. In this system #3, the values for Assets, Liabilities, and Equity are inconsistent with the rule "Assets = Liabilities + Equity". From looking at the information provided, it is impossible to know exactly which of the three facts are incorrect; it is only possible to understand that the statements made within the logical system is inconsistent. It could be the case that the rule is incorrect.

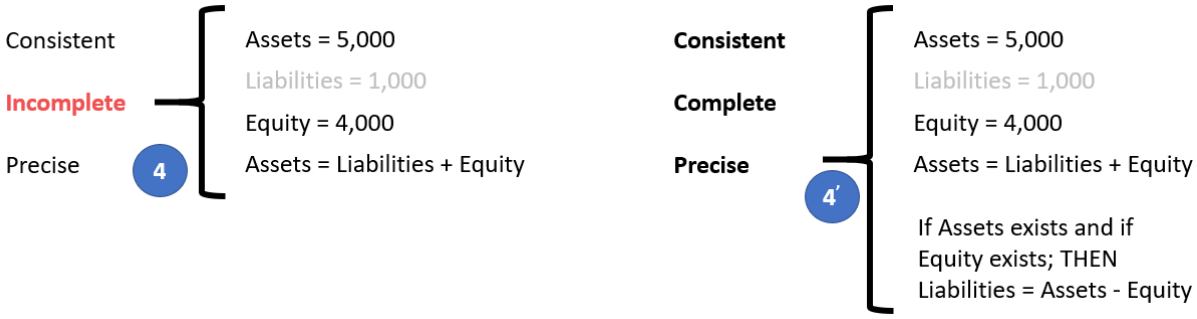


However, given that we know from state #1 that the value for Assets is 5,000 and not 8,000; the facts in this system is imprecise because the fact for Assets does not reflect reality.

State 4: Unreported Facts

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

If it is the case that it is decided that the fact "Liabilities" can be omitted if both Assets and Equity are reported; then you must provide a rule to derive the value of Liabilities when that fact is not reported. Below you see that the system has been adjusted in state #4' to add the rule "IF Assets exists and if Equity exists; THEN Liabilities = Assets - Equity"[33]. *(NOTE that this rule should actually be "IF Assets exists and if Equity exists and if not(exists) Liabilities; THEN Liabilities = Assets – Equity")*



[33] Here is the impute or derivation rule that would be added to the accounting equation logical system for this situation, http://xbrlsite.azurewebsites.net/2020/core/master-ae/ImputeRule-Key-1-Code-BS-Impute-01-formula.xml

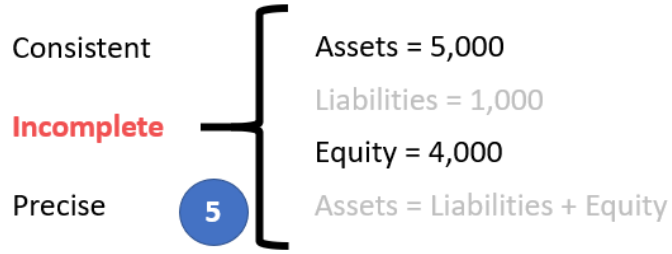
If it were likewise true that either Assets[34] or Equity[35] could also be left unreported, similarly derivation rules could be created for each of those facts. Note that XBRL Formula chaining[36] can be used to physically derive unreported facts if any one of these three facts remain unreported. Note that it is impossible to derive missing information if any two of the facts remain unreported. Adding the derivation rule makes the system complete.

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

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

State 5: Incomplete

Similar to state #4, in state #5 the logical system is incomplete because both (a) the fact Liabilities is unreported and also (b) the consistency rule "Assets = Liabilities + Equity" is missing from the logical system. Because both a fact and the rule are missing from the logical system, it would be impossible to deduce the value of Liabilities in this case. There is not enough information in the logical system to allow Liabilities to be derived. At a minimum, a consistency crosscheck rule[37] plus the derivation rule to impute Liabilities[38] would be necessary.



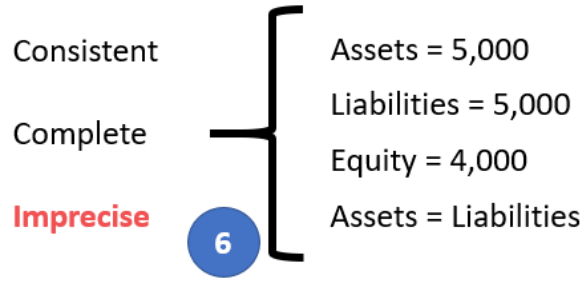
Again, consistent with state #4; Assets and Equity would require similar rules and there is no parity check of reported information.

[34] XBRL Formula rule for deriving Assets, http://xbrlsite.azurewebsites.net/2020/core/master-ae/ImputeRule-Key-3-Code-BS-Impute-03-formula.xml
[35] XBRL Formula rule for deriving Equity, http://xbrlsite.azurewebsites.net/2020/core/master-ae/ImputeRule-Key-2-Code-BS-Impute-02-formula.xml
[36] Deriving Facts Using XBRL Formula Chaining (Example), http://xbrl.squarespace.com/journal/2019/4/24/deriving-information-using-xbrl-formula-chaining-example.html
[37] XBRL Formula consistency crosscheck rule Assets = Liabilities + Equity, http://xbrlsite.azurewebsites.net/2020/core/master-ae/Consistency-5-Code-BS01-formula.xml
[38] XBRL Formula derivation rule to impute Liabilities, http://xbrlsite.azurewebsites.net/2020/core/master-ae/ImputeRule-Key-1-Code-BS-Impute-01-formula.xml

State 6: Imprecise

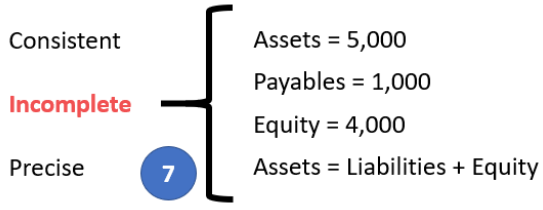
A logical system is a true and fair representation of some agreed upon realism. **Precision** is a measure of how precisely you do or can represent the information of a domain within a logical theory. The reality that we formalized in state #1 indicates that "Assets = Liabilities + Equity". Yet, in the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

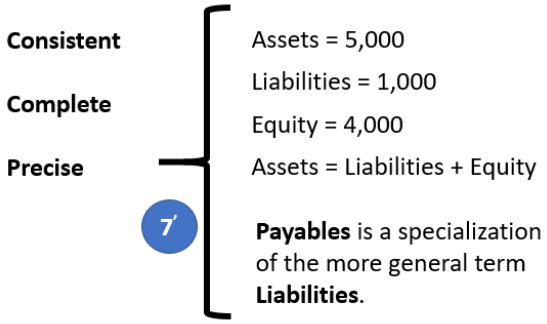
Remember that in state #1 we formalized our truth to be that "Assets = Liabilities + Equity". As such, this logical system can be described as being imprecise. To make this logical system precise, all that needs to be done is to fix the rule.



State 7: Extension Concept

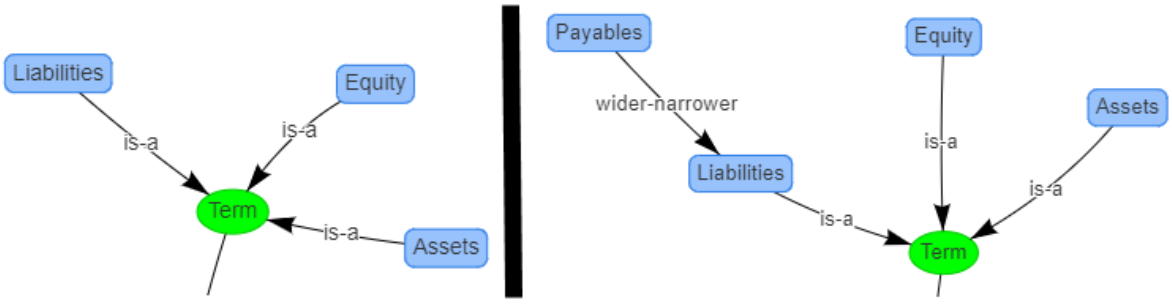
In state #7 on the left, what we are trying to convey is that the economic entity reported the fact for Liabilities using the extension concept "Payables" that it had created. If a fact is represented using an extension concept created by a reporting entity; then a "general-special" or "wider-narrower" or "class-equivalentClass" association must be created to indicate to software applications of the relationship so that information can be used correctly. State #7' on the right, the rule "Payables is a specialization of the more general term Liabilities" has been added to the logical system which allows the system to operate effectively[39].





[39] XBRL Definition relations showing example of a mapping rule, http://xbrlsite.azurewebsites.net/2020/core/master-ae/fac-mapping-definition.xml

And so, the graphic below shows a fragment of the knowledge graph on page 9 above before and after the information that "Payables is a specialization of the more general term Liabilities," was added. On the left you see State 7, the taxonomy before the information was added and on the right you see "Payable" being added as an extension concept indicating that there is a "wider-narrower" relationship between Payables and Liabilities. Therefore, a machine based process can utilize the information per State 7' because the process understands Liabilities in the taxonomy, understands the "wider-narrower" relationship therefore knowing that "Payables" is a type of Liability.



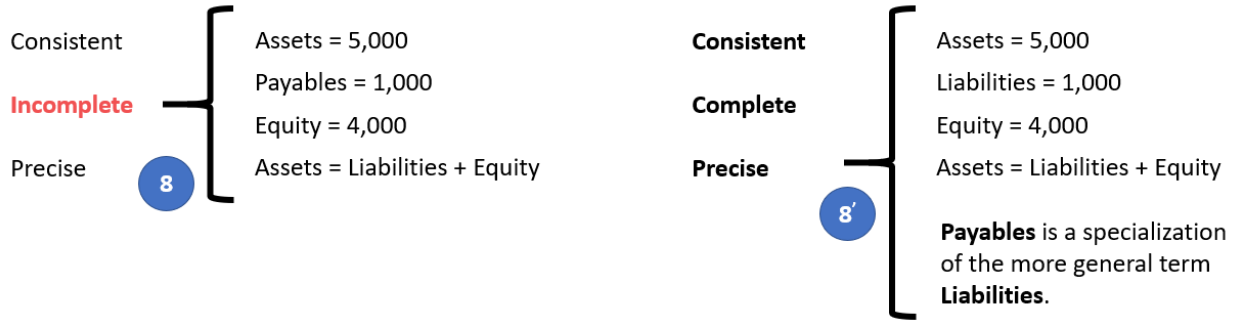
State 8: Base Taxonomy Wider/Narrower Concept Use

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

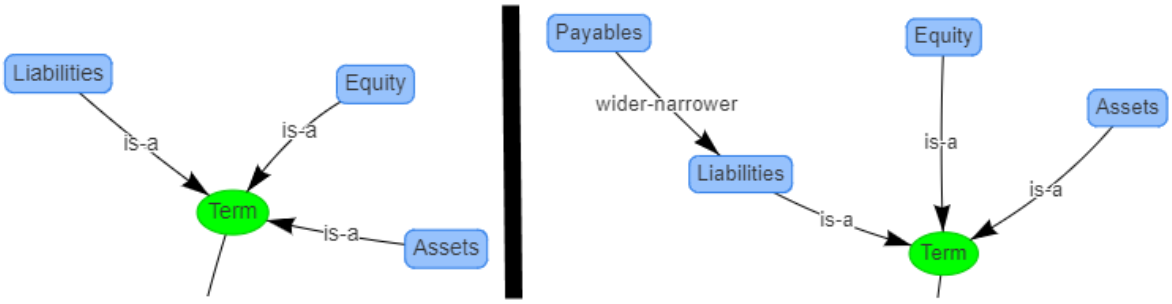
Now, our base state #1 does not have the concept "Payables"; but let's assume for a moment that it does have the concept "Payables". Also suppose that there was no information in the base logical system indicating the relationship between "Payables" and any other concept. If a fact is represented using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

State #8' on the right adds the rule "Payables is a specialization of the more general term Liabilities"[40].

[40] XBRL Definition relations showing example of a mapping rule, http://xbrlsite.azurewebsites.net/2020/core/master-ae/fac-mapping-definition.xml



And so, the graphic below shows a fragment of the knowledge graph on page 9 above before and after the information that "Payables is a specialization of the more general term Liabilities," was added. On the left you see State 8, the base taxonomy before the information was added and on the right you see "Payable" being added as an extension concept indicating that there is a "wider-narrower" relationship between Payables and Liabilities. Therefore, a machine based process can utilize the information per State 8' because the process understands Liabilities in the base taxonomy, understands the "wider-narrower" relationship therefore knowing that "Payables" is a type of Liability.



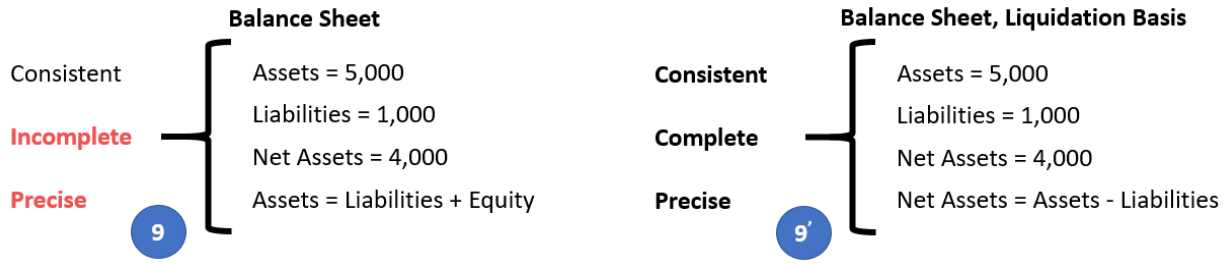
State 9: Defining a Completely New Structure

State #9 below on the left focuses on the structure as contrast all the prior examples which focused on the terms and rules. If a new structure is created, the new structure must be referenced to the base taxonomy and the new structure needs to be explained using machine-readable rules[41]. Even base taxonomy structures need to be defined in order to be referred to[42]. When you say "Balance Sheet" you know what that means. But a machine does not know.

A base taxonomy should (a) provide all necessary structures separately, not intermingle different models in the same set of associations and (b) define what each structure must look

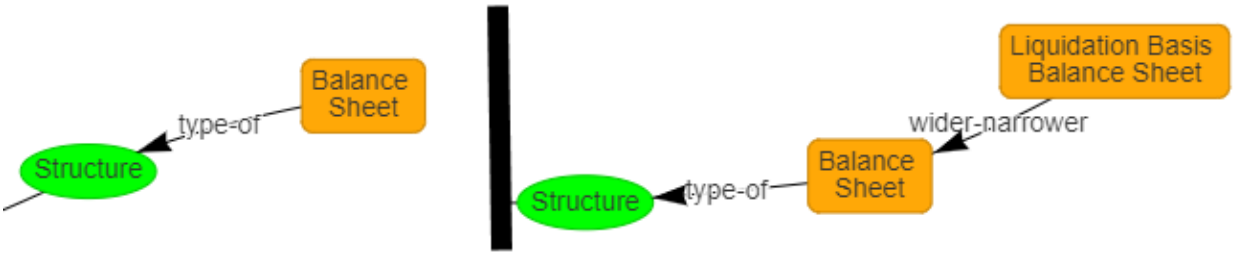
[41] XBRL Definition relations used to represent structure rules, http://xbrlsite.azurewebsites.net/2020/core/master-ae/dm-1355-rules-def.xml
[42] XBRL taxonomy schema used to define "Balance Sheet", http://xbrlsite.azurewebsites.net/2020/core/master-ae/disclosures.xsd

like. Remember, computers are like babies and need to be led by the hand in order to understand the details you need them to understand.



Finally, in our case we have only one disclosure, the Balance Sheet. In our case, the Balance Sheet is always required to be reported per this logical system. As such, that rule is stated in a machine-readable reporting checklist[43]. Other logical systems with more disclosures will have more rules relating to when a disclosure is required to be provided in a report.

Similar to how "Payables" was added as an extension of the terms in the logical system; we can extend the structures to include a "Liquidation Basis Balance Sheet" structure which is a specialization of a Balance Sheet:



And such, an automated process will be able to understand the new structure because it is related to an existing structure. Other structures could be added and only identified as a type of structure.

State 10: Organizing Disclosures Using Topics

State #10 points out that while the accounting equation logical system has one structure, the balance sheet, ultimately if a complete financial reporting scheme were represented one might have hundreds or even thousands of disclosures. Disclosures can be organized into topics[44].

[43] XBRL Definition relations used to represent a reporting checklist or disclosure rules, http://xbrlsite.azurewebsites.net/2020/core/master-ae/reporting-checklist-rules-def.xml
[44] XBRL taxonomy schema used to represent topics, http://xbrlsite.azurewebsites.net/2020/core/master-ae/topics.xsd

Then, rather than having one flat list of disclosures, they can be organized into a handy hierarchy[45].

Financial Reporting Schemes

What makes something a financial reporting scheme is that it follows the double entry accounting model and the accounting equation. Here is a high-level comparison of a number of financial reporting schemes[46]:

Reporting Scheme	US GAAP issued by FASB	IFRS issued by IASB	FRS 102 issued by FRC	FRF for SMEs issued by AICPA	IPSAS issued by IPSASB	GAS issued by GASB	AAS issued by AASB	FAS issued by FASAB
Assets	Assets	Assets	Assets	Assets	Assets; Other Resources	Assets and Deferred Inflow of Resources	Assets	Assets
Liabilities	Liabilities	Liabilities	Liabilities	Liabilities	Liabilities; Other Obligations	Liabilities and Deferred Outflow of Resources	Liabilities	Liabilities
Equity or Net Assets	Equity (or Net Assets)	Equity (or Net Assets)	Equity	Equity (or Net Assets)	Net Financial Position	Net Position	Equity (or Net Assets)	Net Position
Comprehensive Income	Comprehensive Income	Income and Expenses	Comprehensive income	Net income	Surplus or Deficit	Change in Net Position	Income and Expenses	Change in Net Position (Implied)
Investments by Owners	Investments by Owners	Contributions from Holders of Equity Claims	Total Transactions with Owners	Investments by Owners	Ownership Contributions	Increase in Net Position (Implied)	Contributions from Holders of Equity Claims	Increase in Net Position (Implied)
Distributions to Owners	Distributions to Owners	Distributions to Holders of Equity Claims	Total Transactions with Owners	Distributions to Owners	Ownership Distributions	Decrease in Net Position (Implied)	Distributions to Holders of Equity Claims	Decrease in Net Position (Implied)
Revenues	Revenues	Income	Income	Revenues	Revenues	Inflow of Resources	Income	Revenues
Expenses	Expenses	Expenses	Expenses	Expenses	Expenses	Outflow of Resources	Expenses	Expenses
Gains	Gains		Gains	Gains				
Losses	Losses		Losses	Losses				

The first thing you will note is that not ever financial reporting scheme uses the rule “Assets = Liabilities + Equity”. In fact, you have the following terms and associations in the eight different financial reporting schemes that are being compared:

1. Assets = Liabilities + Equity
2. Net Assets = Assets - Liabilities
3. Net Financial Position = Assets - Liabilities
4. Net Position = Assets - Liabilities
5. Net Position = Assets and Deferred Inflows of Resources - Liabilities and Deferred Outflow of Resources

There may even be other permissible terms and associations. Remember we discussed the notion of a “Model”. Recall that we provided a definition of a model, “A model is a set of structures that are consistent with and permissible interpretations of that model.”

Picking one reporting scheme, we know that “Assets = Liabilities + Equity” and “Net Assets = Assets - Liabilities” are both permissible interpretations per US GAAP. There are even other permissible interpretations of those higher level terms and the relations between them.

This is not a problem when representing this information digitally; we simply use different models to represent the terms, structures, associations, and rules.

[45] XBRL definition relations used to create a hierarchy of disclosures, http://xbrlsite.azurewebsites.net/2020/core/master-ae/disclosures-with-topics-def.xml
[46] Comparison of Elements of Financial Statements, http://xbrlsite.azurewebsites.net/2019/core/ElementsOfFinancialStatements.pdf

Another thing to understand is that we are not saying that, say, "Assets" is measured or defined exactly the same for each reporting scheme. We are consciously defining "Assets" very generally as being "Stuff a business OWNS". The same is true about the other terms. We are defining the terms at a level where we can agree and focusing on the mechanical aspects of the financial reporting scheme and not the critically important subtleties and nuances.

Our objective here is to figure out where we can agree as contrast to putting up hurdles that make it impossible to agree.

Finally, to achieve our objectives we need to dive into the next level of financial reporting schemes which is the definitions of the core elements of a financial reporting scheme. For example, in the United States, the Financial Accounting Standards Board (FASB) uses Statement of Financial Accounting Concepts #6 (SFAC 6), *Elements of Financial Statements*[47] to define the high-level elements that make up a financial statement, building on the accounting equation.

While each financial standards setter does so differently, each does provide this information in one way or another. Some standards setters are more through than others. Each standard setter has some excellent ideas for communicating this information (i.e. best practices) and other standard setters do a less thorough job. But each gets the job done well enough.

Our next step is to dive into the next level of detail, the element of a financial statement that expand on the accounting equation. We will do this by using the elements of financial statements defined for US GAAP by the FASB in SFAC 6 because the FASB does a pretty good job. The ideas that we will cover are applicable to each of the other financial reporting schemes high-level elements.

Elements of Financial Statements

In the conceptual framework for US GAAP the FASB defines the primitive building blocks of a financial statement. The FASB's SFAC 6, *Elements of Financial Statements*[48] states:

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

[47] FASB, SFAC 6, *Elements of Financial Statements*, https://www.fasb.org/pdf/con6.pdf
[48] FASB, SFAC 6, *Elements of Financial Statements*, Accounting Equation, https://www.fasb.org/pdf/con6.pdf

The *Elements of Financial Statements* is part of the conceptual framework[49] which defines the US GAAP financial reporting scheme[50] and has the accounting equation model at its core. The accounting equation is: "Assets = Liabilities + Equity"

SFAC 6 defines 10 interrelated elements of US GAAP financial statements (**terms**) that are directly related to measuring performance and status of an economic entity and used in the preparation of a general purpose financial report:

- Assets
- Liabilities
- Equity
- Comprehensive income
- Investments by Owners
- Distributions to Owners
- Revenues
- Expenses
- Gains
- Losses

The FASB uses the analogy of a "photograph" and a "motion picture" to differentiate the two types of elements[51]. Three elements that are like a photograph are "Assets", "Liabilities" and "Equity" and are for a point in time. In XBRL terms, these "photograph" type elements or "stocks" are instants or "as of" a specific point in time. The others elements are like "motion pictures" or "flows" over a period of time, in XBRL terms they are durations or "for period".

The FASB explicitly states the components of comprehensive income which include: revenues, expenses, gains, and losses[52].

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

Note the term "interrelated". If you read the definitions you can implicitly understand the specific interrelations. The FASB uses the term "**articulation**" to describe the notion that

[49] FASB, *Conceptual Framework*, https://www.fasb.org/jsp/FASB/Page/BridgePage&cid=1176168367774
[50] Charles Hoffman, CPA, *Comparison of Financial Reporting Schemes High Level Concepts*, http://xbrlsite.azurewebsites.net/2018/Library/ReportingSchemes-2018-12-30.pdf
[51] FASB, SFAC 6, page 21, paragraph 20
[52] FASB, SFAC 6, page 21, paragraph 20

financial statements are fundamentally interrelated[53]. They result in financial statements that are fundamentally interrelated and connected mathematically.

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

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

The equation above defines the relationship between comprehensive income and its components. The equation below[54] defines the relations between the other concepts and uses the components of "Comprehensive Income" as defined above.

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

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

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

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

Assets = Liabilities + Equity

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

SFAC 6 states explicitly that economic entities creating financial reports will define their report line items based on these financial statement elements[55],

> "Particular economic things and events, such as cash on hand or selling merchandise, that may meet the definitions of elements are not elements as the term is used in this Statement. Rather, they are called ***items*** or other descriptive names. This Statement

[53] FASB, SFAC 6, page 21 and 22, paragraph 21
[54] Note that T0 means prior balance sheet date, P1 means current income statement period, and T1 means current balance sheet date.
[55] FASB, SFAC 6, page 14, paragraph 5

> focuses on the broad classes and their characteristics instead of defining particular assets, liabilities, or other items."

While financial reports must fit within the elements of a financial report defined by a financial reporting scheme; financial reports are not forms. Specific variability in these items, subtotals, and totals is anticipated between reporting economies entities and allowed by financial reporting schemes such as US GAAP[56]. By far, the most variability that exists within a set of financial statements exists on the income statement. SFAC 6 discusses the notion of intermediate components[57] of comprehensive income:

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

Practices exist for determining the items, subtotals, and totals that make up a financial statement. Basically, variability can be caused by choosing to report different common subtotals or not or by choosing to report specific line items rather than other line items. I refer to these different totals, subtotals, and specific line items as the notion of **reporting styles**[58]. This variability is by no means random or completely arbitrary. There are common reporting style patterns. And all must ultimately be reducible to and consistent with the 10 elements of financial statements. Essentially, reporting styles are **models**[59].

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

Finally, while not explicitly defined in SFAC 6, the FASB is certainly strongly implying the existence of "financial statements" that provide information about the "status" and

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[56] Charles Hoffman, CPA, *Comparison of Elements of Financial Statements*, http://xbrlsite.azurewebsites.net/2019/Core/ElementsOfFinancialStatements.pdf
[57] FASB, SFAC 6, page 47, paragraph 77.
[58] Open Framework for Implementing XBRL-based Financial Reporting, *Reporting Styles*, http://xbrlsite.azurewebsites.net/2019/Framework/Details/ReportingStyle.html
[59] *Stanford Encyclopedia of Philosophy, First-order Model Theory*, https://plato.stanford.edu/entries/modeltheory-fo/

"performance" of an economic entity and as we pointed out before that the status and performance are intertwined per the notion of articulation. This at least implies the structures:

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

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

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

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

Shell of a **balance sheet**[60] which measures status:

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

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

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

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

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

Shell of a **comprehensive income** statement[61] which measures performance:

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

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

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

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

Shell of **changes in equity**[62] which connects the income statement to the balance sheet:

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

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

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

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

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

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

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

id	satisfied	message
CONSISTENCY_5 (evaluation 1)	satisfied	$Assets=3500 = ($Liabilities=0 + $Equity=3500)
CONSISTENCY_5 (evaluation 2)	satisfied	$Assets=0 = ($Liabilities=0 + $Equity=0)
CONSISTENCY_6 (evaluation 1)	satisfied	$ComprehensiveIncome=3000 = ($Revenues=7000 - $Expenses=3000 + $Gains=1000 - $Losses=2000)
RollForward_1 (evaluation 1)	satisfied	$Equity_BalanceStart=0 + $ComprehensiveIncome=3000 + $InvestmentsByOwners=1000 - $DistributionsToOwners=500 = $Equity_BalanceEnd=3500
ASSERTION_SFAC6_CONCEPTUAL_FRAMEWORK_RECONCILATION (evaluation 1)	satisfied	0= (($Equity_BalanceStart=0 + (($Revenues=7000 - $Expenses=3000) + ($Gains=1000 - $Losses=2000)) + ($InvestmentsByOwners=1000 - $DistributionsToOwners=500)) + ($Liabilities_BalanceEnd=0 - $Assets_BalanceEnd=3500))

I am not going to provide a cash flow statement yet because SFAC 6 does not discuss the cash flow statement but we all know there are four primary financial statements rather than three. See the next iteration which will include the cash flow statement.

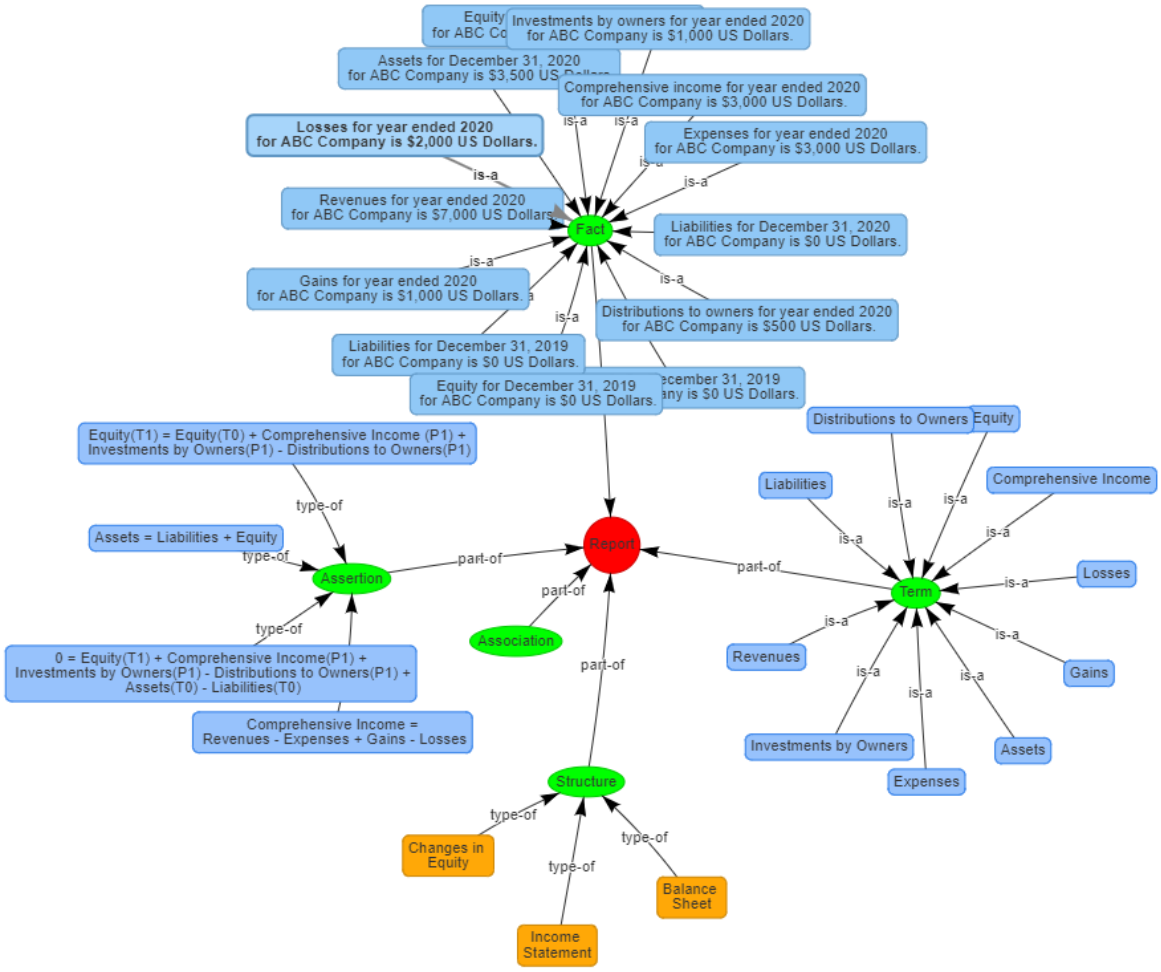
The four statement (we are using three of the four) model shows the explicitly created **articulation** or the interrelationships between the three primary financial statements defined by the FASB in SFAC 6. However, since net cash flow is not defined by SFAC 6 we can only represent the interrelationships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

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

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

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

And so, the information that has been explained above can be represented[63] as the following set of vertices and edges using graph theory[64]:



[63] Visualization using graph theory, http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/Visualization.html
[64] Wikipedia, *Graph Theory*, https://en.wikipedia.org/wiki/Graph_theory

SFAC 6 is essentially a simple man-made logical system[65] that builds on the mathematical model of double entry accounting and the accounting equation. To see a representation of SFAC 6 in XBRL, see this representation[66] as we will not be delving into those details here.

Common Elements of Financial Statements (Four Statement Model)

In order to better create a full set of financial statements it is important to further enhance the core elements of a financial statement with a few more details. As such, the additional 16 core elements were added to this model SFAC 6 Elements of Financial Statements model:

- Current Assets
- Noncurrent Assets
- Current Liabilities
- Noncurrent Liabilities
- Equity Attributable to Controlling Interests
- Equity Attributable to Noncontrolling Interests
- Liabilities and Equity
- Net Cash Flow
- Net Cash Flow from Operating Activities
- Net Cash Flow from Investing Activities
- Net Cash Flow from Financing Activities
- Net Assets
- Net Income
- Income from Ordinary Activities of Entity
- Income from Peripheral or Incidental Transactions of Entity
- Other Comprehensive Income

With these additional elements of a financial statements it is possible to create the four primary financial statements such that they resemble at least shell statements.

While these financial statement elements are not explicitly defined by SFAC 6, they are often implied, they are defined elsewhere in the Accounting Standards Codification (ASC), and it is not really a stretch to claim that these concepts are used in financial reporting. They tend to be indisputable.

[65] YouTube, *Understanding the Financial Report Logical System*, https://www.youtube.com/playlist?list=PLqMZRUzQ64B7EWamzDP-WaYbS_W0RL9nt
[66] SFAC 6, *Elements of Financial Statements*, http://xbrlsite.azurewebsites.net/2020/master/sfac6/index.html

Common Structures of Financial Statements

Given the 26 common elements of a financial statement (10 defined by FASB/IASB and the 16 that I added to complete the set), there are six structures that are apparent.

- Statement of Financial Position (**Balance sheet**)
- Statement of Net Assets (**Net Assets**)
- Statement of Comprehensive Income (**Comprehensive Income**)
- Statement of Financial Performance (**Income Statement**)
- Statement of Cash Flow (**Cash Flow**)
- Statement of Changes in Equity (**Changes in Equity**)

These structures are explicitly defined in this common elements of financial statements model.

Four Statement Model with Shell Statements

As such, we can now create the four statements that make up a set of financial statements. Note that these are not yet intended to resemble actual financial statements but they are getting closer. The purpose of working at this level is to make it simpler to communicate some basic ideas.

Remember, this step is to create the smallest but the most meaningful representation within XBRL to communicate several key points. One key point is to show the connections between the four core financial statements which we will do now.

Balance Sheet[67]:

[67] Balance Sheet, Human Readable, http://xbrlsite.azurewebsites.net/2020/core/master-common/evidence-package/contents/index.html#Rendering-BalanceSheet-common_BalanceSheetHypercube.html

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

Comprehensive Income[68]:

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

Cash Flow[69]:

[68] Comprehensive Income, Human Readable, http://xbrlsite.azurewebsites.net/2020/core/master-common/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-common_ComprehensiveIncomeStatementHypercube.html

[69] Cash Flow, Human Readable, http://xbrlsite.azurewebsites.net/2020/core/master-common/evidence-package/contents/index.html#Rendering-CashFlow-common_CashFlowHypercube.html

Cash Flow [Line Items]	Period [Axis] 2020-01-01 - 2020-12-31
Net Cash Flow [Roll Up]	
Net Cash Flow Operating Activities	1,500
Net Cash Flow Investing Activities	1,000
Net Cash Flow Financing Activities	1,000
Net Cash Flow	3,500
Assets Roll Forward [Roll Up]	
Assets, Beginning Balance	0
Net Cash Flow	3,500
Assets, Ending Balance	3,500

Note that on a cash flow statement normally the roll forward is for Cash and Cash Equivalents. As we are not yet down to that level of detail, we are using Assets to provide the roll forward and the connection to the balance sheet.

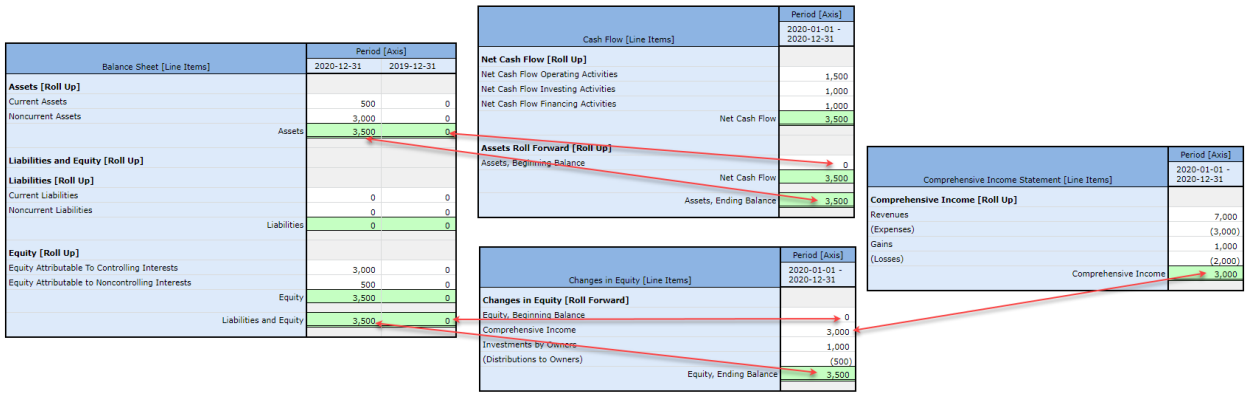
Changes in Equity[70]:

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

The four statements above show the details of the statement line items; the graphic below shows the interrelationships between the four primary financial statements and demonstrates the notion of articulation that exists in every set of financial statements[71]:

[70] Changes in Equity, Human Readable, http://xbrlsite.azurewebsites.net/2020/core/master-common/evidence-package/contents/index.html#Rendering-ChangesInEquity-common_ChangesInEquityHypercube.html

[71] Articulation and the Four Core Statement Model, http://xbrlsite.azurewebsites.net/2020/core/master-common/ArticulationFourStatementModel.jpg



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

Cash Flow [Line Items]	Period [Axis] 2020-01-01 - 2020-12-31
Net Cash Flow [Roll Up]	
Net Cash Flow Operating Activities	1,500
Net Cash Flow Investing Activities	1,000
Net Cash Flow Financing Activities	1,000
Net Cash Flow	3,500
Assets Roll Forward [Roll Up]	
Assets, Beginning Balance	0
Net Cash Flow	3,500
Assets, Ending Balance	3,500

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

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

The details and the relationships can be tested by running the supporting XBRL taxonomy and XBRL instance that define the elements, the associations between the elements, and the assertions which show mathematical relations between the elements processed by an XBRL formula processor[72]:

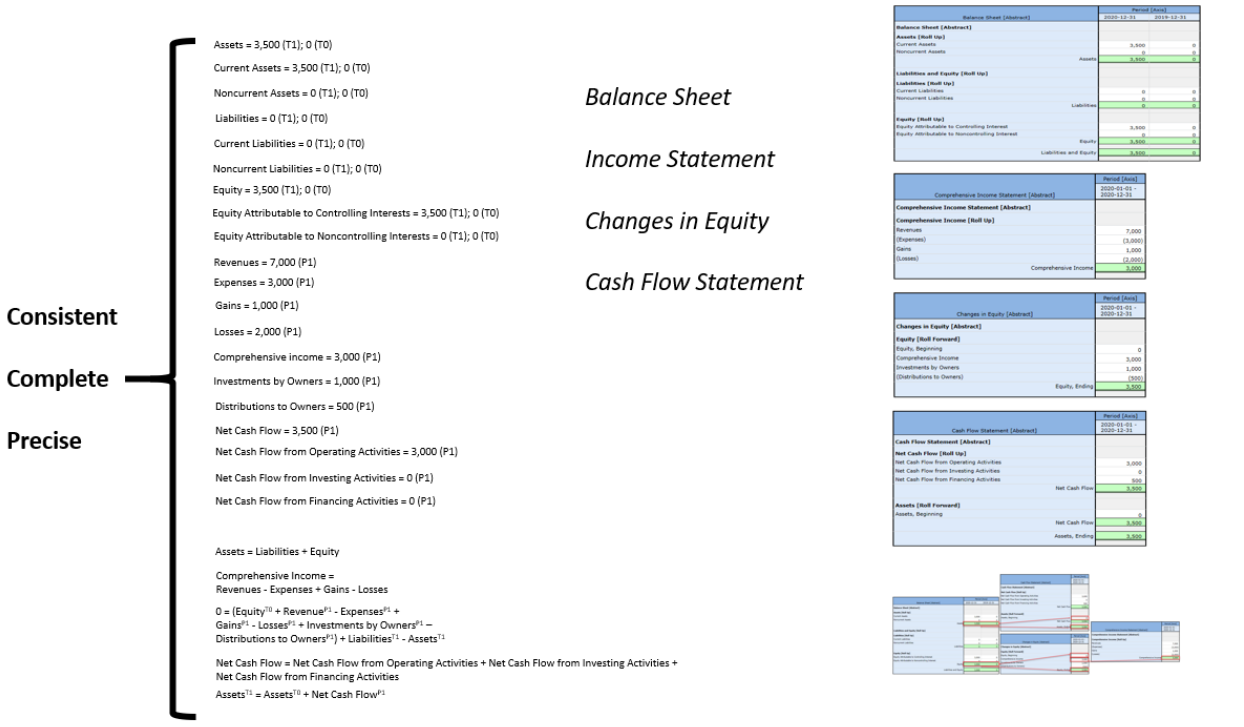
id	satisfied	message
Arithmetic_BS01 (evaluation 1)	satisfied	$Assets=0 = ($Liabilities=0 + $Equity=0)
Arithmetic_BS01 (evaluation 2)	satisfied	$Assets=3500 = ($Liabilities=0 + $Equity=3500)
Arithmetic_BS02 (evaluation 1)	satisfied	$Assets=0 = ($CurrentAssets=0 + $NoncurrentAssets=0)
Arithmetic_BS02 (evaluation 2)	satisfied	$Assets=3500 = ($CurrentAssets=500 + $NoncurrentAssets=3000)
Arithmetic_BS03 (evaluation 1)	satisfied	$Liabilities=0 = ($CurrentLiabilities=0 + $NoncurrentLiabilities=0)
Arithmetic_BS03 (evaluation 2)	satisfied	$Liabilities=0 = ($CurrentLiabilities=0 + $NoncurrentLiabilities=0)
Arithmetic_BS04 (evaluation 1)	satisfied	$Equity=0 = ($EquityAttributableToControllingInterests=0 + $EquityAttributableToNoncontrollingInterests=0)
Arithmetic_BS04 (evaluation 2)	satisfied	$Equity=3500 = ($EquityAttributableToControllingInterests=3000 + $EquityAttributableToNoncontrollingInterests=500)
Arithmetic_CF01 (evaluation 1)	satisfied	$NetCashFlow=3500 = ($NetCashFlowOperatingActivities=1500 + $NetCashFlowFinancingActivities=1000 + $NetCashFlowInvestingActivities=1000)
Arithmetic_IS01 (evaluation 1)	satisfied	$ComprehensiveIncome=3000 = ($Revenues=7000 - $Expenses=3000 + $Gains=1000 - $Losses=2000)
Arithmetic_IS02 (evaluation 1)	satisfied	$ComprehensiveIncome=3000 = ($IncomeFromNormalActivitiesOfEntity=2000 + $IncomeFromPeripheralOrIncidentalTransactionsOfEntity=1000)
Arithmetic_IS03 (evaluation 1)	satisfied	$ComprehensiveIncome=3000 = ($NetIncome=3000 + $OtherComprehensiveIncome=0)
Arithmetic_NA01 (evaluation 1)	satisfied	$NetAssets=3500 = ($Assets=3500 - $Liabilities=0)
Arithmetic_NA01 (evaluation 2)	satisfied	$NetAssets=0 = ($Assets=0 - $Liabilities=0)
RollForward_CF01 (evaluation 1)	satisfied	$Assets_BalanceStart=0 + $NetCashFlow=3500 = $Assets_BalanceEnd=3500
RollForward_SHE01 (evaluation 1)	satisfied	$Equity_BalanceStart=0 + $ComprehensiveIncome=3000 + $InvestmentsByOwners=1000 - $DistributionsToOwners=500 = $Equity_BalanceEnd=3500
CONSISTENCY_AccountingEquation (evaluation 1)	satisfied	$Assets=0 = ($Liabilities=0 + $Equity=0)
CONSISTENCY_AccountingEquation (evaluation 2)	satisfied	$Assets=3500 = ($Liabilities=0 + $Equity=3500)
CONSISTENCY_SFAC6_ElementsOfFinancialStatement (evaluation 1)	satisfied	0= (($Equity_BalanceStart=0 + (($Revenues=7000 - $Expenses=3000) + ($Gains=1000 - $Losses=2000)) + ($InvestmentsByOwners=1000 - $DistributionsToOwners=500)) + ($Liabilities_BalanceEnd=0 - $Assets_BalanceEnd=3500))

[72] Rules validation results, http://xbrlsite.azurewebsites.net/2020/core/master-common/RulesValidationResult.jpg

This verifies that the XBRL-based report and the logical relations articulated via that report are as would be expected. Further, other structures that are not part of the four common statements also proven to be correct and do not conflict with or contradict the four core financial statements.

Proper Functioning = Consistent, Precise, Complete

Similar to the accounting equation and SFAS 6, the common elements of financial statement; this system can be proven to be properly functioning. Again, the number of terms, structures, assertions, and facts increases but the logical system still fundamentally functions like the accounting equation logical system and the SFAC 6 logical system. The types of things that can go wrong are similar to the accounting equation and SFAC 6 logical systems.



Four Statement Model (Common Elements of Financial Report)

Intermediate Components

We introduced the notion of “intermediate components” which are essentially totals and subtotals that are provided within a financial statement. The intermediate components within a balance sheet, statement of changes in equity, and a statement of cash flow tends to be less. There is some.

For example, balance sheets could be classified (i.e. current and noncurrent breakdown) or unclassified which provide information abouts assets and liabilities in order of liquidity. Further, a statement of financial position could be provided for an economic entity that is not a going concern on a liquidity basis, reporting "Net Assets" as opposed to "Equity".

The income statement is another story. The most variability, or intermediate components defined, tend to be on the income statement. Economic entities don't tend to report the line items "Revenues", "Expenses", "Gains", or "Losses"; or "Income from Normal Activities of Entity" or "Income from Incidental or Peripheral Activities of Entity". Economic entities may actually use those terms, but the meaning behind the term used by two different reporting economic entities could be very different.

The two SFAC 6 breakdowns of Comprehensive Income ('Revenues', 'Expenses', 'Gains', 'Losses'; and 'Income from Normal Activities of Entity' or 'Income from Incidental or Peripheral Activities of Entity') are two completely different dimensions of disaggregation of that total.

"Revenue" could be from normal activities or from incidental/peripheral activities. Same for "Expenses" or other line items.

There are patterns of totals and subtotals used by economic entities. Those patterns can be quantified and documented. For example, I have done so for both US GAAP and IFRS based financial reports that have been submitted to the U.S. Securities and Exchange Commission (SEC). I call these reporting styles and they will be discussed in more detail later.

For now, understand that a detailed analysis of 100% of economic entities that report to the SEC using US GAAP shows that[73]:

- 96% of entities report using either a classified or unclassified balance sheet
- 98% of entities report using one of two different cash flow statement reporting styles
- 87% of entities use one of 9 reporting styles to create their income statement; 95% entities use identifiable reporting styles; up to about 245 different reporting styles could exist for the income statement.

What is the point here? Financial reports have observable patterns. The point is that financial statements are not random, they follow rules. It is highly likely that either (a) there really are perhaps 245 different income statement reporting styles or (b) some economic entities are reporting using reporting styles that are not actually permitted per US GAAP. That question can be easily answered by looking at the reporting style of each and every economic entity.

[73] US GAAP Reporting Styles Summary, http://www.xbrlsite.com/2018/10K/US-GAAP-Reporting-Styles.pdf

Variability Enabled Using Structures

As is explained in SFAS 6[74], the elements of financial statements are appropriate for economic entities that are enterprises (businesses) or not-for-profit organizations. While some financial report elements might be appropriate for one type of economic entity, they might not be appropriate for another economic entity. The conceptual frameworks of both US GAAP and IFRS anticipates these differences. For example, here are two alternative balance sheet shell formats; one is a classified balance sheet and the other is a net assets style statement of financial position:

Balance sheet alternative 1[75]:

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

Balance sheet alternative 2[76]:

[74] SFAC 6, http://xbrlsite.azurewebsites.net/2020/core/master-sfac6/

[75] Balance Sheet, http://xbrlsite.azurewebsites.net/2020/core/master-common/evidence-package/contents/index.html#Rendering-BalanceSheet-common_BalanceSheetHypercube.html

[76] Net Assets, http://xbrlsite.azurewebsites.net/2020/core/master-common/evidence-package/contents/index.html#Rendering-NetAssets-common_NetAssetsHypercube.html

Net Assets [Line Items]	Period [Axis]	
	2020-12-31	2019-12-31
Net Assets [Roll Up]		
Assets	3,500	0
Liabilities	0	0
Net Assets	3,500	0

Note that another alternative that is very likely to be necessary is the order of liquidity or unclassified balance sheet. That could have just as well been represented in these common elements of a financial statement representation.

Typically, one financial report will not use both of the above structures within the same report. Typically, one permissible model is used or some other permissible model is used.

Financial statements are not arbitrary or random. Some permissible model is used to represent a financial report within the boundaries specified by some reporting scheme. But any financial statement can both have the appropriate variability that they need but at the same time conform to the conceptual framework of the reporting scheme.

I refer to the approaches an economic entity organizes the elements of a financial statement reporting styles. An analysis of public companies that report to the SEC reveal reporting style[77] patterns used by economic entities that report using US GAAP.

Variability Caused by Alternative Intermediate Components of Comprehensive Income

By far, the most variability that exists within a set of financial statements exists on the income statement. SFAS 6 discusses the notion of intermediate components[78] 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. Again, this variability is not random or completely arbitrary. There are patterns.

[77] US GAAP Reporting Styles, http://www.xbrlsite.com/2018/10K/US-GAAP-Reporting-Styles.pdf
[78] FASB, SFAC 6, page 47, paragraph 77.

Of the four concepts “revenues”, “expenses”, “gains”, and “losses” there are themes. One them is the notion of something related to an “entity’s ongoing major or central operations” (i.e. revenues, expenses) and something “from peripheral or incidental transactions” (i.e. gains, losses). The following are three income statement structures.

Comprehensive income[79]:

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

Comprehensive income 2[80]:

Comprehensive Income Statement [Line Items]	Period [Axis] 2020-01-01 - 2020-12-31
Comprehensive Income [Roll Up]	
Income from Normal Activities of Entity	2,000
Income from Peripheral or Incidental Transactions of Entity	1,000
Comprehensive Income	3,000

Comprehensive income 3[81]:

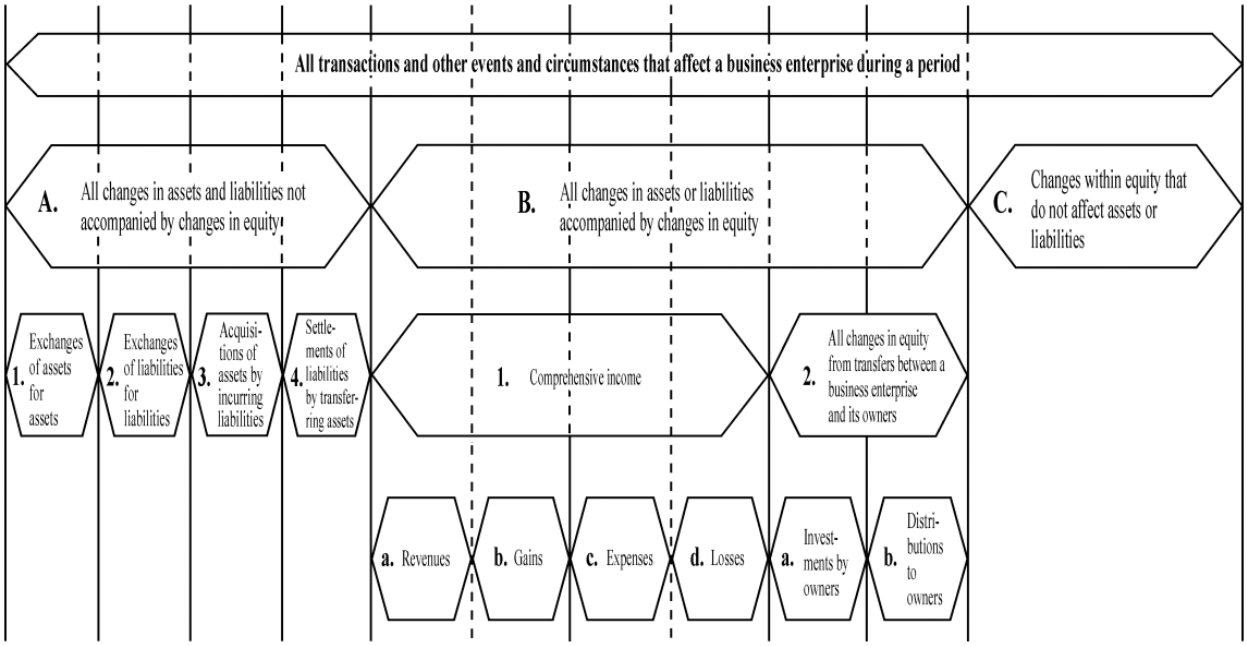
[79] Comprehensive Income, Human Readable, http://xbrlsite.azurewebsites.net/2020/core/master-common/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-common_ComprehensiveIncomeStatementHypercube.html
[80] Comprehensive Income 2, Human Readable, http://xbrlsite.azurewebsites.net/2020/core/master-common/evidence-package/contents/index.html#Rendering-ComprehensiveIncome2-common_ComprehensiveIncomeStatementHypercube.html
[81] Comprehensive Income 3, Human Readable, http://xbrlsite.azurewebsites.net/2020/core/master-common/evidence-package/contents/index.html#Rendering-ComprehensiveIncome3-common_ComprehensiveIncomeStatementHypercube.html

Comprehensive Income Statement [Line Items]	Period [Axis] 2020-01-01 - 2020-12-31
Comprehensive Income [Roll Up]	
Net Income [Roll Up]	
Income from Normal Activities of Entity	2,000
Income from Peripheral or Incidental Transactions of Entity	1,000
Net Income	3,000
Other Comprehensive Income	0
Comprehensive Income	3,000

As I explained in my description of a financial report logical system, a **structure** is a set of statements which describe the associations and assertions of the structure. A structure provides context[82]. The financial report **model** is a set of structures that are permissible interpretations of and consistent with the logical theory.

Transactions

SFAC 6 provides the following diagram[83] which essentially breaks transactions down into a number of specific categories based on the impact of the transaction.

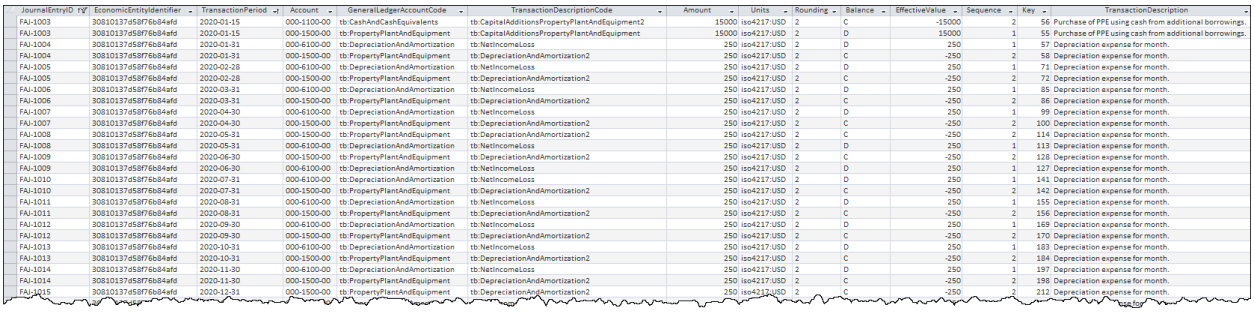


[82] Explanation of a Financial Report Logical System in Simple Terms, http://xbrl.squarespace.com/journal/2019/11/1/explanation-of-a-financial-report-logical-system-in-simple-t.html

[83] FASB, SFAC 6, page 41, paragraph 64.

All transactions, events, circumstances, and other phenomenon follow the patterns described in that SFAC 6 diagram. These transactions could be less complex or more complex based on the complexity of the reporting economic entity. The volume of the transactions could be smaller or larger. The scope of the chart of accounts could be smaller or larger. But every transaction of economic entity has a core set of qualities such as a transaction date, an account, an amount, currency, etc.

Here is a basic example of transactions as they might exist within an accounting system[84]:



JournalEntryID	EconomicEntityIdentifier	TransactionPeriod	Account	GeneralLedgerAccountCode	TransactionDescriptionCode	Amount	Units	Rounding	Balance	EffectiveValue	Sequence	Key	TransactionDescription
FAJ-1003	30810137d58f76b84afd	2020-01-15	000-1100-00	tb:CashAndCashEquivalents	tb:CapitalAdditionsPropertyPlantAndEquipment2	15000	iso4217:USD	2	C	-15000	2	56	Purchase of PPE using cash from additional borrowings.
FAJ-1003	30810137d58f76b84afd	2020-01-15	000-1500-00	tb:PropertyPlantAndEquipment	tb:CapitalAdditionsPropertyPlantAndEquipment	15000	iso4217:USD	2	D	15000	1	55	Purchase of PPE using cash from additional borrowings.
FAJ-1004	30810137d58f76b84afd	2020-01-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	57	Depreciation expense for month.
FAJ-1004	30810137d58f76b84afd	2020-01-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	58	Depreciation expense for month.
FAJ-1005	30810137d58f76b84afd	2020-02-28	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	71	Depreciation expense for month.
FAJ-1005	30810137d58f76b84afd	2020-02-28	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	72	Depreciation expense for month.
FAJ-1006	30810137d58f76b84afd	2020-03-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	85	Depreciation expense for month.
FAJ-1006	30810137d58f76b84afd	2020-03-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	86	Depreciation expense for month.
FAJ-1007	30810137d58f76b84afd	2020-04-30	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	99	Depreciation expense for month.
FAJ-1007	30810137d58f76b84afd	2020-04-30	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	100	Depreciation expense for month.
FAJ-1008	30810137d58f76b84afd	2020-05-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	114	Depreciation expense for month.
FAJ-1008	30810137d58f76b84afd	2020-05-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	113	Depreciation expense for month.
FAJ-1009	30810137d58f76b84afd	2020-06-30	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	128	Depreciation expense for month.
FAJ-1009	30810137d58f76b84afd	2020-06-30	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	127	Depreciation expense for month.
FAJ-1010	30810137d58f76b84afd	2020-07-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	141	Depreciation expense for month.
FAJ-1010	30810137d58f76b84afd	2020-07-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	142	Depreciation expense for month.
FAJ-1011	30810137d58f76b84afd	2020-08-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	155	Depreciation expense for month.
FAJ-1011	30810137d58f76b84afd	2020-08-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	156	Depreciation expense for month.
FAJ-1012	30810137d58f76b84afd	2020-09-30	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	169	Depreciation expense for month.
FAJ-1012	30810137d58f76b84afd	2020-09-30	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	170	Depreciation expense for month.
FAJ-1013	30810137d58f76b84afd	2020-10-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	183	Depreciation expense for month.
FAJ-1013	30810137d58f76b84afd	2020-10-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	184	Depreciation expense for month.
FAJ-1014	30810137d58f76b84afd	2020-11-30	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	197	Depreciation expense for month.
FAJ-1014	30810137d58f76b84afd	2020-11-30	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	198	Depreciation expense for month.
FAJ-1015	30810137d58f76b84afd	2020-12-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	212	Depreciation expense for month.

Think of every transaction from every journal (i.e. sales, payables, cash receipts, fixed assets, general) being put into one journal. Every transaction will flow through a **journal** and into a **ledger** fits this same pattern.

Every transaction impacts a real (i.e. balance sheet) account in the chart of accounts which is an Asset, Liability, or Equity directly or indirectly. Note that nominal accounts (i.e. income statement) are closed to the income summary which is then flowed through retained earnings, a real account on the balance sheet. After closing entries are posted to a journal for a reporting period, only balance sheet (i.e. real) accounts remain. And so, ultimately, every transaction ends passing through a real account in the general ledger trial balance[85]:

Trial Balance [Roll Up]	Period [Axis]	
	2018-12-31	2017-12-31
Trial Balance [Roll Up]		
Cash and Cash Equivalents	4,000	3,000
Receivables	2,000	1,000
Inventories	1,000	1,000
Property, Plant and Equipment	6,000	1,000
Accounts Payable	(1,000)	(1,000)
Long-term Debt	(6,000)	(1,000)
Retained Earnings	(6,000)	(4,000)
Check Sum	0	0

[84] Automation, see section General Journal Entries Import/Export formats, http://xbrlsite.azurewebsites.net/2020/master/automation/index.html

[85] Trial balance, http://xbrlsite.azurewebsites.net/2019/core/core-trialbalance/evidence-package/contents/index.html#Rendering-TrialBalance-Implied.html

As such, a roll forward (i.e. BASE) can be created that reconciles the beginning balance of each real account to the ending balance of that real account. The difference between the beginning and ending balances is the sum of the transactions that flowed through each specific balance sheet account. Further, every such transaction that flows through some balance sheet account can be grouped or categorized. For example, below you see the roll forward of "Cash and Cash Equivalents" and the categories of transactions such as "Collection of Receivables" or "Payment of Accounts Payable" that flow though the real general ledger account "Cash and Cash Equivalents"[86]:

Cash and Cash Equivalents [Roll Forward]	Period [Axis] 2018-01-01 - 2018-12-31
Cash and Cash Equivalents [Roll Forward]	
Cash and Cash Equivalents, Beginning Balance	3,000
Collection of Receivables	3,000
Payment of Accounts Payable	(2,000)
Additional Long-term Borrowings	6,000
Repayment of Long-term Borrowings	(1,000)
Capital Additions of Property, Plant and Equipment	(5,000)
Proceeds from Sale of Property, Plant, and Equipment	0
Cash and Cash Equivalents, Ending Balance	4,000

This is likewise true for each account in the trial balance. For example, here is the roll forward of "Receivables"[87]:

Receivables [Roll Forward]	Period [Axis] 2020-01-01 - 2020-12-31
Receivables [Roll Forward]	
Receivables, Beginning Balance	1,000.00
Sales 2	4,000.00
Collection of Receivables 2	(3,000.00)
Additions to Allowance for Bad Debts	.00
Bad Debts Written Off	.00
Receivables, Ending Balance	2,000.00

This process repeats for each and every real balance sheet account after the accounts have been closed. The categories of transactions are different for different balance sheet accounts. But, it is possible to create a summary of these transaction grouping categories, list each out, put all transactions for all grouping codes together and the total of all transaction grouping code category amounts would equal

[86] Roll Forward of Cash and Cash Equivalents, http://xbrlsite.azurewebsites.net/2020/master/automation/evidence-package/contents/index.html#Rendering-CashAndCashEquivalents-Implied.html

[87] Roll Forward of Receivables, http://xbrlsite.azurewebsites.net/2020/master/automation/evidence-package/contents/index.html#Rendering-Receivables-Implied.html

zero. This is similar to how all transactions running through the chart of accounts would aggregate to zero.

The following is a representation of the aggregate of transactions that flow through each transaction grouping code that is used in the journal we are using[88]:

Changes Summary [Roll Up]	Period [Axis] 2018-01-01 - 2018-12-31
Changes Summary [Roll Up]	
Collection of Receivables	3,000
Payment of Accounts Payable	(2,000)
Additional Long-term Borrowings 2	6,000
Repayment of Long-term Borrowings 2	(1,000)
Capital Additions of Property, Plant and Equipment 2	(5,000)
Sales 2	4,000
Collection of Receivables 2	(3,000)
Additions to Allowance for Bad Debts	0
Bad Debts Written Off	0
Purchases of Inventory for Sale	2,000
Costs of Sales 2	(2,000)
Inventory Written Off	0
Capital Additions of Property, Plant and Equipment	5,000
Depreciation and Amortization 2	0
Property, Plant and Equipment Written Off	0
Purchases of Inventory for Sale 2	(2,000)
Payment of Accounts Payable 2	2,000
Additional Long-term Borrowings	(6,000)
Repayment of Long-term Borrowings	1,000
Net Income (Loss)	(2,000)
Check Sum Changes	0

And so, transactions can be grouped by these two ways: chart of accounts code, transaction grouping category code. Ultimately, transactions can be traced back to a journal entry. (This is detailed information for the examples used in this section)[89].

In order to create a proper financial statement, all of the information that is contained in the report must either be (a) already in the accounting system transaction information or (b) added to the existing information in order to create the report correctly.

For example, consider the cash flow statement. The line items “Collection of Receivables”, “Payment of Accounts Payable”, Additional Long-term Borrowings”, “Repayment of Long-term Borrowings”, and “Capital Additions to Property, Plant and Equipment” must somehow be determined from the journal

[88] Transactions aggregated by transaction grouping code, http://xbrlsite.azurewebsites.net/2020/master/automation/evidence-package/contents/index.html#Rendering-Transactions-Implied.html

[89] Automation, http://xbrlsite.azurewebsites.net/2020/master/automation/index.html

entries. If there is no transaction grouping code which allows the cash flow statement to be automatically generated; then it cannot be autogenerated, rather then information needs to somehow be added by some supplemental process or task:

Cash Flow Statement [Roll Forward]	Period [Axis] 2020-01-01 - 2020-12-31
Cash Flow Statement [Roll Forward]	
Net Cash Flow [Roll Up]	
Net Cash Flow Operating Activities [Roll Up]	
Collection of Receivables	3,000.00
Payment of Accounts Payable	(2,000.00)
Net Cash Flow Operating Activities	1,000.00
Net Cash Flow Financing Activities [Roll Up]	
Additional Long-term Borrowings 2	6,000.00
Repayment of Long-term Borrowings 2	(1,000.00)
Net Cash Flow Financing Activities	5,000.00
Net Cash Flow Investing Activities [Roll Up]	
Capital Additions of Property, Plant and Equipment 2	(5,000.00)
Net Cash Flow Investing Activities	(5,000.00)
Net Cash Flow	1,000.00
Cash and Cash Equivalents, Beginning Balance	3,000.00
Cash and Cash Equivalents, Ending Balance	4,000.00

Patterns

As explained in the document *Understanding and Leveraging Fact Sets*[90] and the blog post *Breaking Down the Pieces of an XBRL-based Digital Financial Report*[91] financial reports are not one big thing; they are lots of little things. The analysis of a set of 6,023 XBRL-based financial reports submitted to the SEC by public companies revealed:

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

[90] *Understanding and Leveraging Fact Sets*, http://xbrlsite.azurewebsites.net/2019/Library/UnderstandingAndLeveragingFactSets.pdf

[91] *Breaking Down the Pieces of an XBRL-based Digital Financial Report*, http://xbrl.squarespace.com/journal/2019/4/9/breaking-down-the-pieces-of-an-xbrl-based-digital-financial.html

- Average number of fact sets per network: 1.6
- Average facts per network: 18
- Average facts per fact set: 11

So, the actual average size of the pieces of a report are quite small. Information is skewed a bit by the relatively large number of Level 1, Level 2, and Level 3 text blocks. Of the **754,430** fact sets there are:

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

What is more, which we will get to elsewhere in these documents, each of the concept arrangement patterns can be associated with a specific disclosure. See these US GAAP disclosures[92] and these IFRS disclosures[93].

In addition, another analysis of 6,244 reports prepared using US GAAP and submitted to the SEC indicated that 5,028 of the report, 80.5% used one of 12 reporting styles:

#	Reporting style	Filings Count	Filings With No Errors	Sum Errors (all filings)	Percent Without Error	Cum	Cum %
1	COMID-BSC-CF1-ISM-IEMIB-OILY-SPEC6	1,947	1,645	454	84%	1,947	31.2%
2	COMID-BSC-CF1-ISS-IEMIB-OILY-SPEC1	874	745	214	85%	2,821	45.2%
3	COMID-BSC-CF1-ISS-IEMIB-OILY-SPEC2	786	692	127	88%	3,607	57.8%
4	INTBX-BSU-CF1-ISS-IEMIX-OILN	480	426	71	89%	4,087	65.5%
5	COMID-BSC-CF1-ISS-IEMIB-OILY	178	162	30	91%	4,265	68.3%
6	COMID-BSC-CF1-ISM-IEMIX-OILY-PARK	163	149	18	91%	4,428	70.9%
7	COMID-BSC-CF1-IS3-IEMIB-OILN	130	93	49	72%	4,558	73.0%
8	COMID-BSC-CF1-ISM-IEMIB-OILY-SPEC9	124	106	20	85%	4,682	75.0%
9	COMID-BSC-CF1-IS6-IEMIX-OILN	108	92	24	85%	4,790	76.7%
10	INSBX-BSU-CF1-ISS-IEMIX-OILN	95	87	9	92%	4,885	78.2%
11	COMID-BSC-CF1-IS8-IEMIB-OILN	78	56	35	72%	4,963	79.5%
12	COMID-BSC-CF1-ISM-IEMIT-OILY-SPEC6	65	44	27	68%	5,028	80.5%

For example, #4 above shows the reporting style used by financial institutions (i.e. banks). The other 19.5% used somewhere between 87 and 245 different reporting styles.

These patterns allow for 100% of US GAAP based financial reports to be categorized into different models, to identify structures, to identify associations that define structures, etc.

[92] US GAAP Disclosures, http://xbrlsite-app.azurewebsites.net/DisclosureBestPractices/DisclosureBestPractices.aspx?DisclosureName=BalanceSheet

[93] IFRS Disclosures, http://xbrlsite-app.azurewebsites.net/DisclosureBestPractices_IFRS/DisclosureBestPractices.aspx?DisclosureName=BalanceSheet

Accounting, Reporting, Auditing, and Analysis

The tasks and processes related to accounting, reporting, auditing, and analysis can be combined into one automated process to the extent that all these processes can be effectively interconnected using machine-readable information and controlled to manage quality. This next section walks you through examples of a successfully interconnected process.

Accounting

Get journal transaction information from accounting information system(s) “CJ” (cash journal), “FAJ” (fixed assets journal), “IJ” (inventories journal), “PJ” (purchases journal), “SJ” (sales journal) and “JE” (general journal). INPUT is information from multiple journals. OUTPUT XBRL-GL syntax that then gets IMPORTED into some other accounting system thus moving information into ONE journal.

This was simulated using three difference sources for journal transactions: accounting system “hledger”, accounting system “Ledger”, and a Microsoft Access database application based accounting system prototype. Could also get information from Excel, SQL server, CSV file, or literally any technical syntax that has all the necessary information:

JournalEntryID	EconomicEntityIdentifier	TransactionPeriod	Account	GeneralLedgerAccountCode	TransactionDescriptionCode	Amount	Units	Rounding	Balance	EffectiveValue	Sequence	Key	TransactionDescription
FAJ-1003	30810137d58f76b84afd	2020-01-15	000-1100-00	tb:CashAndCashEquivalents	tb:CapitalAdditionsPropertyPlantAndEquipment2	15000	iso4217:USD	2	C	-15000	2	56	Purchase of PPE using cash from additional borrowings.
FAJ-1003	30810137d58f76b84afd	2020-01-15	000-1500-00	tb:PropertyPlantAndEquipment	tb:CapitalAdditionsPropertyPlantAndEquipment	15000	iso4217:USD	2	D	15000	1	55	Purchase of PPE using cash from additional borrowings.
FAJ-1004	30810137d58f76b84afd	2020-01-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	57	Depreciation expense for month.
FAJ-1004	30810137d58f76b84afd	2020-01-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	58	Depreciation expense for month.
FAJ-1005	30810137d58f76b84afd	2020-02-28	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	71	Depreciation expense for month.
FAJ-1005	30810137d58f76b84afd	2020-02-28	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	72	Depreciation expense for month.
FAJ-1006	30810137d58f76b84afd	2020-03-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	85	Depreciation expense for month.
FAJ-1006	30810137d58f76b84afd	2020-03-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	86	Depreciation expense for month.
FAJ-1007	30810137d58f76b84afd	2020-04-30	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	99	Depreciation expense for month.
FAJ-1007	30810137d58f76b84afd	2020-04-30	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	100	Depreciation expense for month.
FAJ-1008	30810137d58f76b84afd	2020-05-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	114	Depreciation expense for month.
FAJ-1008	30810137d58f76b84afd	2020-05-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	113	Depreciation expense for month.
FAJ-1009	30810137d58f76b84afd	2020-06-30	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	128	Depreciation expense for month.
FAJ-1009	30810137d58f76b84afd	2020-06-30	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	127	Depreciation expense for month.
FAJ-1010	30810137d58f76b84afd	2020-07-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	141	Depreciation expense for month.
FAJ-1010	30810137d58f76b84afd	2020-07-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	142	Depreciation expense for month.
FAJ-1011	30810137d58f76b84afd	2020-08-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	155	Depreciation expense for month.
FAJ-1011	30810137d58f76b84afd	2020-08-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	156	Depreciation expense for month.
FAJ-1012	30810137d58f76b84afd	2020-09-30	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	169	Depreciation expense for month.
FAJ-1012	30810137d58f76b84afd	2020-09-30	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	170	Depreciation expense for month.
FAJ-1013	30810137d58f76b84afd	2020-10-31	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	183	Depreciation expense for month.
FAJ-1013	30810137d58f76b84afd	2020-10-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	184	Depreciation expense for month.
FAJ-1014	30810137d58f76b84afd	2020-11-30	000-6100-00	tb:DepreciationAndAmortization	tb:NetIncomeLoss	250	iso4217:USD	2	D	250	1	197	Depreciation expense for month.
FAJ-1014	30810137d58f76b84afd	2020-11-30	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	198	Depreciation expense for month.
FAJ-1015	30810137d58f76b84afd	2020-12-31	000-1500-00	tb:PropertyPlantAndEquipment	tb:DepreciationAndAmortization2	250	iso4217:USD	2	C	-250	2	212	Depreciation expense for month.

Note that for this purpose the XBRL concept that is to be used is included in the journal transaction. This would not generally be the case today because most accounting systems do not support providing XBRL concepts. However, hledger and Ledger does allow these codes to be included as part of the transaction. It is not necessary to have both the Account codes from the chart of accounts and the XBRL concept (i.e. GeneralLedgerAccountCode in the table above). A mapping file would allow for conversion between account code and XBRL concept.

All transactions entered into any journal would use a **Chart of Accounts** to provide a valid Account code. Alternatively, or in addition, that chart of accounts could include an XBRL concept to which that account is “mapped”. Accounting systems have different schemes for indicating and distinguishing between the accounts in a chart of accounts. For example, information about whether an account is “real” (permanent) or “nominal” (temporary) is provided. Information about which account is used to close the income summary information

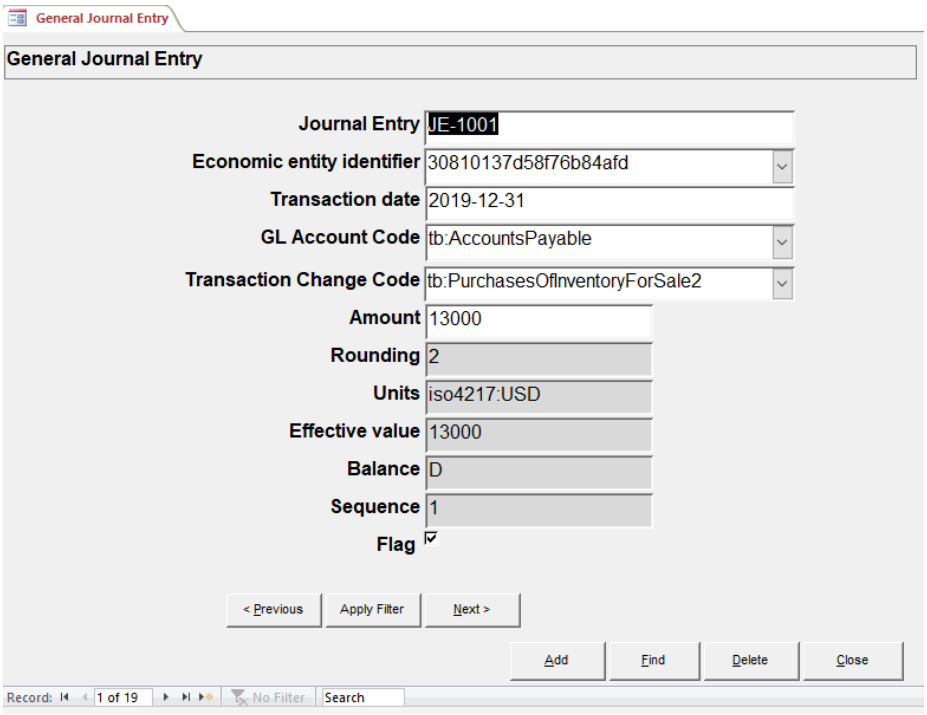
(i.e. net income). This information is used by an accounting system to close the accounting system, otherwise manage the accounting cycle, and in some cases to generate reports.

Below you see the chart of accounts used for this working proof of concept which DOES include the XBRL concept:

AccountType	FullAccount	AccountDescription	XBRLConcept	Active	Type	Type2	Type3
account	000-1100-00	Cash and Cash Equivalents	tb:CashAndCashEquivalents	true	Real	Assets	Assets:CurrentAssets
account	000-1200-00	Trade Receivables	tb:Receivables	true	Real	Assets	Assets:CurrentAssets
account	000-1500-00	Property, Plant and Equipment	tb:PropertyPlantAndEquipment	true	Real	Assets	Assets:NoncurrentAssets
account	000-2150-00	Accounts Payable	tb:AccountsPayable	true	Real	Liabilities	Liabilities:CurrentLiabilities
account	000-2300-00	Long Term Debt - Net of Current Portion	tb:LongtermDebt	true	Real	Liabilities	Liabilities:NoncurrentLiabilities
account	000-3200-00	Retained Earnings	tb:RetainedEarnings	true	Real	Equity	Equity
account	000-4100-00	Revenues	tb:Sales	true	Temporary	Revenue	Revenues
account	000-5100-00	Cost of Sales	tb:CostsOfSales	true	Temporary	Expense	Expenses:OperatingExpenses
account	000-1300-00	Inventories	tb:Inventories	true	Real	Assets	Assets:CurrentAssets
account	000-7100-00	Income Tax Expense (Benefit)	tb:IncomeTaxExpenseBenefit	true	Temporary	Expense	Expenses:NonoperatingExpenses
account	000-5500-00	Nonoperating income (expenses)	tb:NonoperatingIncomeExpenses	true	Temporary	Expense	Expenses:NonoperatingExpenses
account	000-6100-00	Depreciation and Amortization	tb:DepreciationAndAmortization	true	Temporary	Expense	Expenses:OperatingExpenses
account	000-1501-00	PPE Writeoff	tb:PropertyPlantAndEquipmentWrittenOff	true	Temporary	Expense	Expenses:NonoperatingExpenses

In addition to the chart of accounts code which indicates what account a transaction would go to; in order to create a proper financial statement one additional piece of information is necessary. That information is called the **Transaction Description Code**. The transaction description code is used to indicate what type of transaction the journal entry is making. Generally, this information is either (a) never entered into an accounting system or (b) some sort of scheme is used to provide this information when a financial statement is created. In the case of this prototype the transaction grouping code was entered and managed upon entry of each transaction.

Transaction entry;



Note that these transaction description codes or transaction grouping codes are XBRL taxonomy concepts. The following is the database table that contains the transaction description or grouping codes:

TransactionDescriptionCode	TransactionDescriptionCodeLabel	Description
tb:CollectionReceivables	Collection of accounts receivable	Cash is received, posted to check register as a deposit.
tb:PaymentOfAccountsPayable	Payment of accounts payable	A check is written to pay an accounts payable invoice.
tb:AdditionalLongtermBorrowings2	Additional long term borrowings	A loan agreement is signed with the bank.
tb:RepaymentLongtermBorrowings2	Repayment of long term borrowings	A check is written to make a payment on long-term debt.
tb:CapitalAdditionsPropertyPlantAndEquipment2	Capital purchases of property, plant, and equipment	Property, plant, and equipment is purchased.
tb:Sales2	Sales	A sales receipt is issued and recorded in the point of sale system.
tb:CollectionReceivables2	Collection of accounts receivable	Cash is received, posted to check register as a deposit.
tb:AdditionsToAllowanceForBadDebts	Additions to allowance for bad debts	An entry is made in the Excel spreadsheet that computes the allowance for bad
tb:BadDebtsWrittenOff	Bad debts written off	An accounts receivable balance is written off.
tb:PurchasesOfInventoryForSale	Purchases of inventory for sale	Inventory is purchased per a PURCHASE ORDER and has been received per a bill o
tb:CostsOfSales2	Cost of sales	The direct cost of an inventory item is expensed per sale of that item and issuan
tb:InventoryWrittenOff	Inventory written off	An inventory item is written off per physical inventory count.
tb:CapitalAdditionsPropertyPlantAndEquipment	Capital purchases of property, plant, and equipment	Property, plant, and equipment is purchased.
tb:DepreciationAndAmortization2	Depreciation and amortization expense	Depreciation expense is recorded for an asset in the fixed assets ledger.
tb:PropertyPlantAndEquipmentWrittenOff	Property, plant, and equipment written off	An item from the fixed assets ledger is removed and written off.
tb:PurchasesOfInventoryForSale2	Purchases of inventory for sale	Inventory is purchased per a PURCHASE ORDER and has been received per a bill o
tb:PaymentOfAccountsPayable2	Payment of accounts payable	A check is written to pay an accounts payable invoice.
tb:AdditionalLongtermBorrowings	Additional long term borrowings	A loan agreement is signed with the bank.
tb:RepaymentLongtermBorrowings	Repayment of long term borrowings	A check is written to make a payment on long-term debt.
tb:NetIncomeLoss	Net income (loss)	Net income (loss) is closed to retained earnings.

Both the XBRL concepts and the transaction description or grouping codes are formally defined within an XBRL taxonomy. Below you see a fragment of that XBRL taxonomy (human readable[94]; machine-readable[95]). A simple to understand human-readable representation of that XBRL taxonomy can be found here:

Line	Label	Object Class	Period Type	Balance	Report ElementName
1	1110 - Statement - Balance Sheet	Network			http://www.xbrlsite.com/tb/role/BalanceSheet
2	Balance Sheet [Abstract]	Abstract			tb:BalanceSheetAbstract
3	Assets [Roll Up]	Abstract			tb:AssetsRollUp
4	Current Assets [Roll Up]	Abstract			tb:CurrentAssetsRollUp
5	Cash and Cash Equivalents	Concept (Monetary)	As Of	Debit	tb:CashAndCashEquivalents
6	Receivables	Concept (Monetary)	As Of	Debit	tb:Receivables
7	Inventories	Concept (Monetary)	As Of	Debit	tb:Inventories
8	Current Assets	Concept (Monetary)	As Of	Debit	tb:CurrentAssets
9	Noncurrent Assets [Roll Up]	Abstract			tb:NoncurrentAssetsRollUp
10	Property, Plant and Equipment	Concept (Monetary)	As Of	Debit	tb:PropertyPlantAndEquipment
11	Noncurrent Assets	Concept (Monetary)	As Of	Debit	tb:NoncurrentAssets
12	Assets	Concept (Monetary)	As Of	Debit	tb:Assets
13	Liabilities and Equity [Roll Up]	Abstract			tb:LiabilitiesAndEquityRollUp
14	Liabilities [Roll Up]	Abstract			tb:LiabilitiesRollUp
15	Current Liabilities [Roll Up]	Abstract			tb:CurrentLiabilitiesRollUp
16	Accounts Payable	Concept (Monetary)	As Of	Credit	tb:AccountsPayable
17	Current Liabilities	Concept (Monetary)	As Of	Credit	tb:CurrentLiabilities
18	Noncurrent Liabilities [Roll Up]	Abstract			tb:NoncurrentLiabilitiesRollUp
19	Long-term Debt	Concept (Monetary)	As Of	Credit	tb:LongtermDebt
20	Noncurrent Liabilities	Concept (Monetary)	As Of	Credit	tb:NoncurrentLiabilities
21	Liabilities	Concept (Monetary)	As Of	Credit	tb:Liabilities
22	Equity [Roll Up]	Abstract			tb:EquityRollUp
23	Retained Earnings	Concept (Monetary)	As Of	Credit	tb:RetainedEarnings
24	Equity	Concept (Monetary)	As Of	Credit	tb:Equity
25	Liabilities and Equity	Concept (Monetary)	As Of	Credit	tb:LiabilitiesAndEquity
26	1120 - Statement - Income Statement 2	Network			http://www.xbrlsite.com/tb/role/IncomeStatement2
27	Net Income (Loss) [Roll Up]	Abstract			tb:NetIncomeLossRollUp
28	Income (Loss) from Continuing Operations Before Tax [Roll Up]	Abstract			tb:IncomeLossFromContinuingOperationsBeforeTaxRollUp
29	Operating Income (Loss) [Roll Up]	Abstract			tb:OperatingIncomeLossRollUp
30	Gross Profit [Roll Up]	Abstract			tb:GrossProfitRollUp
31	Sales	Concept (Monetary)	For Period	Credit	tb:Sales
32	Costs of Sales	Concept (Monetary)	For Period	Debit	tb:CostsOfSales
33	Gross Profit (Loss)	Concept (Monetary)	For Period	Credit	tb:GrossProfitLoss

[94] Human readable XBRL taxonomy, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/tb_ModelStructure.html

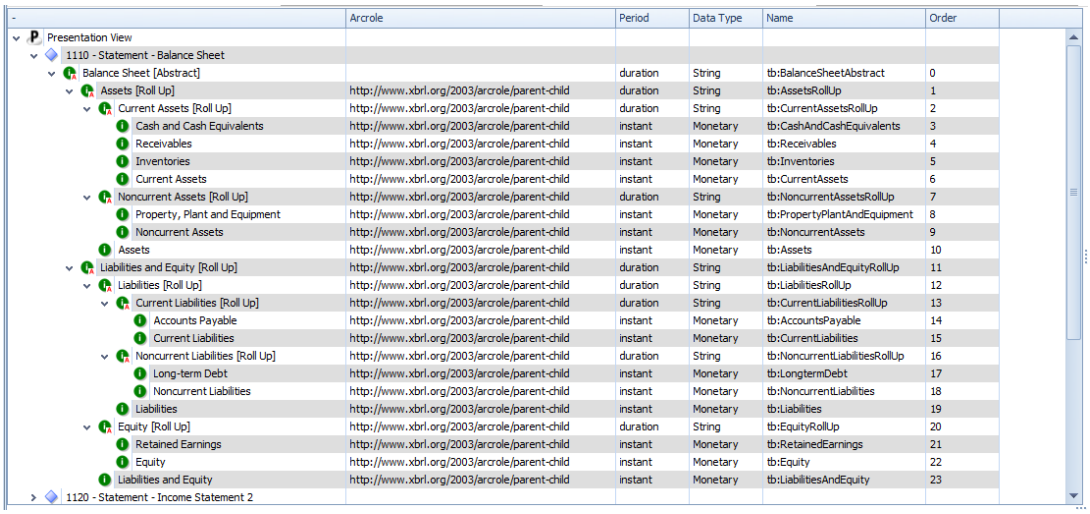
[95] Machine readable XBRL taxonomy, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/tb.xsd

A more comprehensive and sophisticated representation of the XBRL taxonomy in human readable form is provided by the XBRL Cloud Evidence Package[96]. (note that you can CLICK on the "Name" to get detailed information about the XBRL taxonomy concept.

Component: (Network and Table)	
Network	1110 - Statement - **Balance Sheet** (http://www.xbrlsite.com/tb/role/BalanceSheet)
Table	(Implied)

#	Label	Report Element Class	Period Type	Balance	Name
1	**Balance Sheet [Table]**				(Implied)
2	*Balance Sheet [Abstract]*	[Abstract]			tb:BalanceSheetAbstract
3	*Assets [Roll Up]*	[Abstract]			tb:AssetsRollUp
4	*Current Assets [Roll Up]*	[Abstract]			tb:CurrentAssetsRollUp
5	Cash and Cash Equivalents	[Concept] Monetary	As Of	Debit	tb:CashAndCashEquivalents
6	Receivables	[Concept] Monetary	As Of	Debit	tb:Receivables
7	Inventories	[Concept] Monetary	As Of	Debit	tb:Inventories
8	Current Assets	[Concept] Monetary	As Of	Debit	tb:CurrentAssets
9	*Noncurrent Assets [Roll Up]*	[Abstract]			tb:NoncurrentAssetsRollUp
10	Property, Plant and Equipment	[Concept] Monetary	As Of	Debit	tb:PropertyPlantAndEquipment
11	Noncurrent Assets	[Concept] Monetary	As Of	Debit	tb:NoncurrentAssets
12	Assets	[Concept] Monetary	As Of	Debit	tb:Assets
13	*Liabilities and Equity [Roll Up]*	[Abstract]			tb:LiabilitiesAndEquityRollUp
14	*Liabilities [Roll Up]*	[Abstract]			tb:LiabilitiesRollUp
15	*Current Liabilities [Roll Up]*	[Abstract]			tb:CurrentLiabilitiesRollUp
16	Accounts Payable	[Concept] Monetary	As Of	Credit	tb:AccountsPayable
17	Current Liabilities	[Concept] Monetary	As Of	Credit	tb:CurrentLiabilities
18	*Noncurrent Liabilities [Roll Up]*	[Abstract]			tb:NoncurrentLiabilitiesRollUp
19	Long-term Debt	[Concept] Monetary	As Of	Credit	tb:LongtermDebt
20	Noncurrent Liabilities	[Concept] Monetary	As Of	Credit	tb:NoncurrentLiabilities
21	Liabilities	[Concept] Monetary	As Of	Credit	tb:Liabilities
22	*Equity [Roll Up]*	[Abstract]			tb:EquityRollUp
23	Retained Earnings	[Concept] Monetary	As Of	Credit	tb:RetainedEarnings
24	Equity	[Concept] Monetary	As Of	Credit	tb:Equity
25	Liabilities and Equity	[Concept] Monetary	As Of	Credit	tb:LiabilitiesAndEquity

Alternatively, the machine-readable XBRL[97] can be read by off-the-shelf XBRL software such as Pesseract, UBmatrix Taxonomy Designer, CoreFiling's SpiderMonkey, Fujitsu's XWand, etc. Here is the machine-readable XBRL taxonomy and a rendering of that XBRL Taxonomy in Pesseract (which is free to download and use).



-	Arcrole	Period	Data Type	Name	Order
Presentation View					
1110 - Statement - Balance Sheet					
Balance Sheet [Abstract]		duration	String	tb:BalanceSheetAbstract	0
Assets [Roll Up]	http://www.xbrl.org/2003/arcrole/parent-child	duration	String	tb:AssetsRollUp	1
Current Assets [Roll Up]	http://www.xbrl.org/2003/arcrole/parent-child	duration	String	tb:CurrentAssetsRollUp	2
Cash and Cash Equivalents	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:CashAndCashEquivalents	3
Receivables	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:Receivables	4
Inventories	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:Inventories	5
Current Assets	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:CurrentAssets	6
Noncurrent Assets [Roll Up]	http://www.xbrl.org/2003/arcrole/parent-child	duration	String	tb:NoncurrentAssetsRollUp	7
Property, Plant and Equipment	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:PropertyPlantAndEquipment	8
Noncurrent Assets	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:NoncurrentAssets	9
Assets	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:Assets	10
Liabilities and Equity [Roll Up]	http://www.xbrl.org/2003/arcrole/parent-child	duration	String	tb:LiabilitiesAndEquityRollUp	11
Liabilities [Roll Up]	http://www.xbrl.org/2003/arcrole/parent-child	duration	String	tb:LiabilitiesRollUp	12
Current Liabilities [Roll Up]	http://www.xbrl.org/2003/arcrole/parent-child	duration	String	tb:CurrentLiabilitiesRollUp	13
Accounts Payable	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:AccountsPayable	14
Current Liabilities	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:CurrentLiabilities	15
Noncurrent Liabilities [Roll Up]	http://www.xbrl.org/2003/arcrole/parent-child	duration	String	tb:NoncurrentLiabilitiesRollUp	16
Long-term Debt	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:LongtermDebt	17
Noncurrent Liabilities	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:NoncurrentLiabilities	18
Liabilities	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:Liabilities	19
Equity [Roll Up]	http://www.xbrl.org/2003/arcrole/parent-child	duration	String	tb:EquityRollUp	20
Retained Earnings	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:RetainedEarnings	21
Equity	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:Equity	22
Liabilities and Equity	http://www.xbrl.org/2003/arcrole/parent-child	instant	Monetary	tb:LiabilitiesAndEquity	23
1120 - Statement - Income Statement 2					

[96] Human readable, XBRL Cloud Evidence Package, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/evidence-package/contents/ModelSummary.html

[97] Machine readable XBRL taxonomy, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/tb.xsd

This is the XBRL format of the journal entries[98] as they are transferred between accounting systems in STEP 1. In reality, ANY FORMAT can be used to transfer the journal transactions from one accounting system to another. The **MOST IMPORTANT THING TO UNDERSTAND** is that *IF the logical information is not provided by the accounting system; THEN you cannot transfer that information from one accounting system to the other*. *If the information DOES exist in some form, then it CAN be transferred*.

For example, if the transaction description or grouping information is not provided, then it cannot be transferred from one system or step to another: (NOTE that another version of the journal entries was tested that were represented using XBRL dimensions and typed-members[99].)

XBRL Global Ledger:

```
<!--  CJ-1001 - Collection of receivables for January.  -->
▼<gl-cor:entryHeader>
  <gl-cor:enteredBy contextRef="now">Charles Hoffman, CPA</gl-cor:enteredBy>
  <gl-cor:enteredDate contextRef="now">2020-01-01</gl-cor:enteredDate>
  <gl-cor:sourceJournalID contextRef="now">gj</gl-cor:sourceJournalID>
  <gl-bus:sourceJournalDescription contextRef="now">JE</gl-bus:sourceJournalDescription>
  <gl-cor:entryType contextRef="now">standard</gl-cor:entryType>
  <gl-cor:entryNumber contextRef="now">CJ-1001</gl-cor:entryNumber>
  <gl-cor:entryComment contextRef="now">Collection of receivables for January.</gl-cor:entryComment>
 ▼<gl-cor:entryDetail>
    <!--  CJ-1001  -->
    <!--  Seq-1  -->
    <gl-cor:lineNumber contextRef="now">1</gl-cor:lineNumber>
   ▼<gl-cor:account>
      <gl-cor:accountMainID contextRef="now">tb:CashAndCashEquivalents</gl-cor:accountMainID>
      <gl-cor:accountMainDescription contextRef="now">tb:CashAndCashEquivalents</gl-cor:accountMainDescription>
      <gl-cor:accountTypeDescription contextRef="now">tb:CollectionReceivables</gl-cor:accountTypeDescription>
    </gl-cor:account>
    <gl-cor:amount contextRef="now" decimals="2" unitRef="usd">4000</gl-cor:amount>
    <gl-cor:debitCreditCode contextRef="now">D</gl-cor:debitCreditCode>
    <gl-cor:postingDate contextRef="now">2020-01-01</gl-cor:postingDate>
    <gl-cor:documentType contextRef="now">other</gl-cor:documentType>
    <gl-cor:postingStatus contextRef="now">posted</gl-cor:postingStatus>
  </gl-cor:entryDetail>
 ▼<gl-cor:entryDetail>
```

Here are various other formats that can be used to better understand the transactions in the XBRL if (a) you cannot read the XBRL file or (b) you don't have a software application that can read the XBRL file: PDF[100], Excel[101], Plain Text Accounting[102].

The next step is to take the journal transactions, summarize them by account, review the transactions to be sure the transaction information is complete and correct, and then close the books in preparation for creating a financial report. This can be done by any accounting

[98] XBRL Global Ledger representation of journal entries, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/xbrl-all-JournalEntries-Instance.xml

[99] XBRL type-member approach to representing journal entries, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/xbrl-typedMembers-JournalEntries-Instance.xml

[100] Journal Entries, PDF, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/New_AccountRollForward.pdf

[101] Journal Entries, Excel, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/New_JournalEntries.zip

[102] Journal Entries, Plain Text Accounting format, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/combined.journal.txt

system. In our case, hledger, Ledger, and a Microsoft Access database was used. The following is the pre-close trial balance from Microsoft Access[103]:

Account	GeneralLedgerAccountCode	SumOfEffectiveValue
000-1100-00	tb:CashAndCashEquivalents	26,900.00
000-1200-00	tb:Receivables	1,000.00
000-1300-00	tb:Inventories	1,000.00
000-1500-00	tb:PropertyPlantAndEquipment	13,000.00
000-1501-00	tb:PropertyPlantAndEquipmentWrittenOff	0.00
000-2150-00	tb:AccountsPayable	(1,000.00)
000-2300-00	tb:LongtermDebt	(5,900.00)
000-3200-00	tb:RetainedEarnings	(14,000.00)
000-4100-00	tb:Sales	(48,000.00)
000-5100-00	tb:CostsOfSales	24,000.00
000-5500-00	tb:NonoperatingIncomeExpenses	0.00
000-6100-00	tb:DepreciationAndAmortization	3,000.00
000-7100-00	tb:IncomeTaxExpenseBenefit	0.00
		0.00

The following is a trial balance output from the journal transactions post-closing entries which was generated by XBRL Cloud[104]:

Trial Balance [Roll Up]	Period [Axis]	
	2020-12-31	2019-12-31
Trial Balance [Roll Up]		
Cash and Cash Equivalents	26,900.00	13,000.00
Receivables	1,000.00	1,000.00
Inventories	1,000.00	1,000.00
Property, Plant and Equipment	13,000.00	1,000.00
Accounts Payable	(1,000.00)	(1,000.00)
Long-term Debt	(5,900.00)	(1,000.00)
Retained Earnings	(35,000.00)	(14,000.00)
Check Sum	.00	.00

In addition to the trial balance (above) which is common; the following is a summary below which is less common is exactly the same transactions except rather than being summarized by the general ledger account code they are summarized by the transaction grouping code. There are several benefits to having that transaction description/grouping code within the journal entries. First, you can actually generate this report. Second, you can auto-generate a roll

[103] ZIP archive containing Microsoft Access database, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/tb-database.zip

[104] Trial balance, Human Readable, XBRL Cloud, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/evidence-package/contents/index.html#Rendering-TrialBalance-Implied.html

forward of each and every balance sheet account (real accounts) which can be used in the analysis of the information and contributes to creating a correct financial statement. Second, you can effectively auto-generate the financial report as you will see in future steps. Here is a human readable version of the summary of transaction grouping codes[105]:

Changes Summary [Roll Up]	Period [Axis] 2020-01-01 - 2020-12-31
Changes Summary [Roll Up]	
Collection of Receivables	48,000.00
Payment of Accounts Payable	(24,000.00)
Additional Long-term Borrowings 2	6,000.00
Repayment of Long-term Borrowings 2	(1,100.00)
Capital Additions of Property, Plant and Equipment 2	(15,000.00)
Sales 2	48,000.00
Collection of Receivables 2	(48,000.00)
Additions to Allowance for Bad Debts	.00
Bad Debts Written Off	.00
Purchases of Inventory for Sale	24,000.00
Costs of Sales 2	(24,000.00)
Inventory Written Off	.00
Capital Additions of Property, Plant and Equipment	15,000.00
Depreciation and Amortization 2	(3,000.00)
Property, Plant and Equipment Written Off	.00
Purchases of Inventory for Sale 2	(24,000.00)
Payment of Accounts Payable 2	24,000.00
Additional Long-term Borrowings	(6,000.00)
Repayment of Long-term Borrowings	1,100.00
Net Income (Loss)	(21,000.00)
Check Sum Changes	.00

Something to remember. If these transaction grouping codes are not within the accounting system; then the information they provide must be added to the financial report in some manner at a later time.

Once all of the information is correct, the closing entries have been made then we can move on to the next step. Part of this analysis is analyzing accounts to make certain information from the transactions is correct. Below you see two roll forwards of the total of seven from the real accounts that show up on the trial balance. Only TWO of the SEVEN are shown, one current

[105] Transaction grouping codes, human readable, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/evidence-package/contents/index.html#Rendering-Transactions-Implied.html

and one noncurrent account. You are encouraged to go through each of the SEVEN roll forwards to see how useful they are in analyzing account transactions:

Cash and cash equivalents[106]:

Cash and Cash Equivalents [Roll Forward]	Period [Axis] 2020-01-01 - 2020-12-31
Cash and Cash Equivalents [Roll Forward]	
Cash and Cash Equivalents, Beginning Balance	13,000.00
Collection of Receivables	48,000.00
Payment of Accounts Payable	(24,000.00)
Additional Long-term Borrowings 2	6,000.00
Repayment of Long-term Borrowings 2	(1,100.00)
Capital Additions of Property, Plant and Equipment 2	(15,000.00)
Cash and Cash Equivalents, Ending Balance	26,900.00

Long-term debt[107]:

Long-term Debt [Roll Forward]	Period [Axis] 2020-01-01 - 2020-12-31
Long-term Debt [Roll Forward]	
Long-term Debt, Beginning Balance	1,000.00
Additional Long-term Borrowings	6,000.00
Repayment of Long-term Borrowings	(1,100.00)
Long-term Debt, Ending Balance	5,900.00

Finally, don't be fooled by this simple example with only seven accounts. This simple example is only used to manage the complexity of this working proof of concept. These same ideas would work if there were any number of accounts that would need to be analyzed. We will assume that all of our account balances and transactions have been checked against supporting documentation and such (i.e. everything "ticks and ties"; "cross-castes and foots"). We are ready to create the financial report.

[106] Cash and cash equivalents roll forward, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/evidence-package/contents/index.html#Rendering-CashAndCashEquivalents-Implied.html

[107] Long-term debt roll forward, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/evidence-package/contents/index.html#Rendering-LongTermDebt-Implied.html

Spreadsheet Linking Accounting and Reporting

Spreadsheets are a common tool that are used to link an accounting system and a financial reporting system. When an accounting system is missing information, it is impossible to autogenerate a report unless the missing information is added. To achieve that, spreadsheets are commonly used[108]. The following provides a brief overview of the spreadsheet used.

GL and TB:

ABC Company
Trial Balance
December 31, 2020

Account	Account Description	Beginning Balance	Debits	Credits	Ending Balance	BS Mapping for Pivot	IS Mapping for Pivot
000-1100-00	Cash and Cash Equivalents	13,000	54,000	(40,100)	26,900	Cash and Cash Equivalents	
000-1200-00	Receivables	1,000	48,000	(48,000)	1,000	Receivables	
000-1300-00	Inventories	1,000	24,000	(24,000)	1,000	Inventories	
000-1500-00	Property, Plant and Equipment, Net	1,000	15,000	(3,000)	13,000	Property, Plant and Equipment, Net	
000-1501-00	Property, Plant and Equipment Written Off	-	-	-	-	Property, Plant and Equipment Written Off	
000-2150-00	Accounts Payable	(1,000)	24,000	(24,000)	(1,000)	Accounts Payable	
000-2300-00	Long-term Debt	(1,000)	1,100	(6,000)	(5,900)	Long-term Debt	
000-3200-00	Retained Earnings	(14,000)	-	-	(14,000)	Retained Earnings	
000-4100-00	Sales	-	-	(48,000)	(48,000)	Net Income	Sales
000-5100-00	Cost of Sales	-	24,000	-	24,000	Net Income	Cost of Sales
000-5500-00	Non-operating Income (Expense)	-	-	-	-	Net Income	Non-operating Income (Expense)
000-6100-00	Depreciation and Amortization Expense	-	3,000	-	3,000	Net Income	Depreciation and Amortization Expense
000-7100-00	Income Tax Expense (Benefit)	-	-	-	-	Net Income	Income Tax Expense (Benefit)
	Total	-	193,100	(193,100)	-		

PIVOTS:

Balance Sheet

Values

BS Mapping for Pivot	Sum of Ending Balance	Sum of Beginning Balance
Cash and Cash Equivalents	26,900	13,000
Receivables	1,000	1,000
Inventories	1,000	1,000
Property, Plant and Equipment, Net	13,000	1,000
Property, Plant and Equipment Written Off	-	-
Accounts Payable	(1,000)	(1,000)
Long-term Debt	(5,900)	(1,000)
Retained Earnings	(14,000)	(14,000)
Net Income	(21,000)	-
Grand Total	-	-

Income Statement

Row Labels	Sum of Ending Balance	Sum of Beginning Balance
Sales	(48,000)	-
Cost of Sales	24,000	-
Depreciation and Amortization Expense	3,000	-
Non-operating Income (Expense)	-	-
Income Tax Expense (Benefit)	-	-
Grand Total	**(21,000)**	-

General Ledger Detail by Journal Entry Number

Row Labels	Journal Entry Description	Account	Account Description	Sum of Debits	Sum of Credits
JE-001	Sales 2	000-1200-00	Receivables	48,000	-
JE-001	Sales 2	000-4100-00	Sales	-	(48,000)
JE-002	Collection of Receivables	000-1100-00	Cash and Cash Equivalents	48,000	-
JE-002	Collection of Receivables	000-1200-00	Receivables	-	(48,000)
JE-003	Purchases of Inventory for Sale	000-1300-00	Inventories	24,000	
JE-003	Purchases of Inventory for Sale	000-2150-00	Accounts Payable	-	(24,000)
JE-004	Payment of Accounts Payable	000-1100-00	Cash and Cash Equivalents	-	(24,000)
JE-004	Payment of Accounts Payable	000-2150-00	Accounts Payable	24,000	
JE-005	Cost of Sales 2	000-1300-00	Inventories	-	(24,000)
JE-005	Cost of Sales 2	000-5100-00	Cost of Sales	24,000	-
JE-006	Additional Long-term Borrowings 2	000-1100-00	Cash and Cash Equivalents	6,000	-
JE-006	Additional Long-term Borrowings 2	000-2300-00	Long-term Debt	-	(6,000)
JE-007	Repayment of Long-term Borrowings 2	000-1100-00	Cash and Cash Equivalents	-	(1,100)
JE-007	Repayment of Long-term Borrowings 2	000-2300-00	Long-term Debt	1,100	-
JE-008	Capital Addtions of Property, Plant and Equipment 2	000-1100-00	Cash and Cash Equivalents	-	(15,000)
JE-008	Capital Addtions of Property, Plant and Equipment 2	000-1500-00	Property, Plant and Equipment, Net	15,000	-
JE-009	Depreciation and Amortization 2	000-1500-00	Property, Plant and Equipment, Net	-	(3,000)
JE-009	Depreciation and Amortization 2	000-6100-00	Depreciation and Amortization Expense	3,000	-
(blank)	(blank)	000-1501-00	Property, Plant and Equipment Written Off	-	-
(blank)	(blank)	000-3200-00	Retained Earnings	-	-
(blank)	(blank)	000-5500-00	Non-operating Income (Expense)	-	-
(blank)	(blank)	000-7100-00	Income Tax Expense (Benefit)	-	-
Grand Total				**193,100**	**(193,100)**

REPORTS: (BS, IS, SSE, SCF)

ABC Company
Balance Sheets

	December 31, 2020	December 31, 2019
Assets		
Current Assets		
Cash and cash equivalents	$ 26,900	$ 13,000
Receivables	1,000	1,000
Inventories	1,000	1,000
Total Current Assets	28,900	15,000
Noncurrent Assets		
Property, plant and equipment, net	13,000	1,000
Total Noncurrent Assets	13,000	1,000
Total Assets	**$ 41,900**	**$ 16,000**
Liabilities and Equity		
Current liabilities:		
Accounts payable	$ 1,000	$ 1,000
Total Current Liabilities	1,000	1,000
Noncurrent liabilities:		
Long-term debt	5,900	1,000
Total Noncurrent Liabilities:	5,900	1,000
Total Liabilities	**6,900**	**2,000**
Retained earnings	35,000	14,000
Total Equity	**35,000**	**14,000**
Total Liabilities and Equity	**$ 41,900**	**$ 16,000**
Check	-	-

[108] Reporting Spreadsheet, http://xbrlsite.azurewebsites.net/2020/Library/UnderstandingDigital-ABCCompany.zip

Journal entries are summarized into the GL sheet and the reorganized in the TB sheet that is linked to the GL sheet. Pivot tables are created (PIVOTS). Pivot table information is then linked into the balance sheet (BS sheet), income statement (IS sheet), statement of changes in stockholders equity (SSE sheet), and cash flow statement (SCF sheet). Again, explaining exactly how to use this spreadsheet is beyond the scope of this document but you can see how the accounting information flows from the journal entries to the financial report line items.

The spreadsheet and the XBRL-based approach are doing exactly the same thing and get the exact same result. XBRL links information logically whereas the spreadsheet is linking information via the sheets, rows, and columns of the spreadsheet.

Reporting

Once the transactions are verified to be correct, the next step is to generate the facts that will be represented within the financial statement. This process is 100% automated using (a) the journal entries which provides information for the accounts; (b) the XBRL taxonomy which provides information about which account rolls up into which report line item, report subtotals and totals; (c) where summarized transaction information provided by the transaction description/grouping codes goes where in the financial report; (d) information that is used by automated processes to verify that the report “ticks and ties”, “cross-casts and foots”, is consistent and without contradiction, and the mathematical relationships are otherwise consistent with our expectation; and finally (e) provides information about the organization of the financial report that is generally provided by something like a report writer (i.e. the report representation model).

The first part of this step is to generate the facts which will go into the XBRL-based report. To generate the facts, you also need to generate the contexts and the units information that supports the facts within the XBRL instance. Because we are keeping this example simple, all the facts have the same dimensions and therefore they can be visualized using one fact table. Here is what the facts that are generated look like[109]:

[109] Facts, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/evidence-package/contents/FactTableSummary.html

#	Reporting Entity [Axis]	Period [Axis]	Concept	Fact Value	Unit	Rounding	Parenthetical Explanations
1	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2020-12-31	Long-term Debt	5900	USD	2	
2	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2019-12-31	Long-term Debt	1000	USD	2	
3	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2019-12-31	Current Assets	15000	USD	2	
4	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2020-12-31	Current Assets	28900	USD	2	
5	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2020-12-31	Current Liabilities	1000	USD	2	
6	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2019-12-31	Current Liabilities	1000	USD	2	
7	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2019-12-31	Noncurrent Assets	1000	USD	2	
8	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2020-12-31	Noncurrent Assets	13000	USD	2	
9	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2019-12-31	Assets	16000	USD	2	
10	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2020-12-31	Assets	41900	USD	2	
11	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2020-12-31	Noncurrent Liabilities	5900	USD	2	
12	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2019-12-31	Noncurrent Liabilities	1000	USD	2	
13	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2020-12-31	Retained Earnings	35000	USD	2	
14	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2019-12-31	Retained Earnings	14000	USD	2	
15	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2019-12-31	Cash and Cash Equivalents	13000	USD	2	
16	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2020-12-31	Cash and Cash Equivalents	26900	USD	2	
17	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2019-12-31	Equity	14000	USD	2	
18	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2020-12-31	Equity	35000	USD	2	
19	30810137d58f76b84afd (http://standards.iso.org/iso/17442)	2020-12-31	Liabilities and Equity	41900	USD	2	

Using the facts and report model, the entire financial report can be auto-generated. The human readable representation that you see was created using off-the-shelf XBRL software provided by XBRL Cloud which is called the "Evidence Package" and is not generally used for viewing reports but rather for verifying the reports to be sure they are correct. This software is used today by many public companies that submit XBRL-based information to the U.S. Securities and Exchange Commission[110]:

Component Perspective | Overview Perspective

Statements - Detail (4)

1110 - Statement - **Balance Sheet**
Rendering | Model Structure | Fact Table
Business Rules | Combined

1120 - Statement - **Income Statement 2**
Rendering | Model Structure | Fact Table
Business Rules | Combined

1130 - Statement - **Cash Flow Statement**
Rendering | Model Structure | Fact Table
Business Rules | Combined

1140 - Statement - **Statement of Changes in Equity**
Rendering | Model Structure | Fact Table
Business Rules | Combined

Notes - Level 4 Detail (9)

All Components (13)

Rendering

Component: (Network and Table)	
Network	1110 - Statement - **Balance Sheet** (http://www.xbrlsite.com/tb/role/BalanceSheet)
Table	(Implied)

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

Reporting Entity [Axis]	30810137d58f76b84afd (http://standards.iso.org/iso/17442)

Balance Sheet [Abstract]	Period [Axis] 2020-12-31	2019-12-31
Balance Sheet [Abstract]		
Assets [Roll Up]		
Current Assets [Roll Up]		
Cash and Cash Equivalents	26,900.00	13,000.00
Receivables	1,000.00	1,000.00
Inventories	1,000.00	1,000.00
Current Assets	28,900.00	15,000.00
Noncurrent Assets [Roll Up]		
Property, Plant and Equipment	13,000.00	1,000.00
Noncurrent Assets	13,000.00	1,000.00
Assets	41,900.00	16,000.00
Liabilities and Equity [Roll Up]		
Liabilities [Roll Up]		
Current Liabilities [Roll Up]		
Accounts Payable	1,000.00	1,000.00
Current Liabilities	1,000.00	1,000.00

[110] Rendering of Balance Sheet, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/evidence-package/contents/index.html#Rendering-BalanceSheet-Implied.html

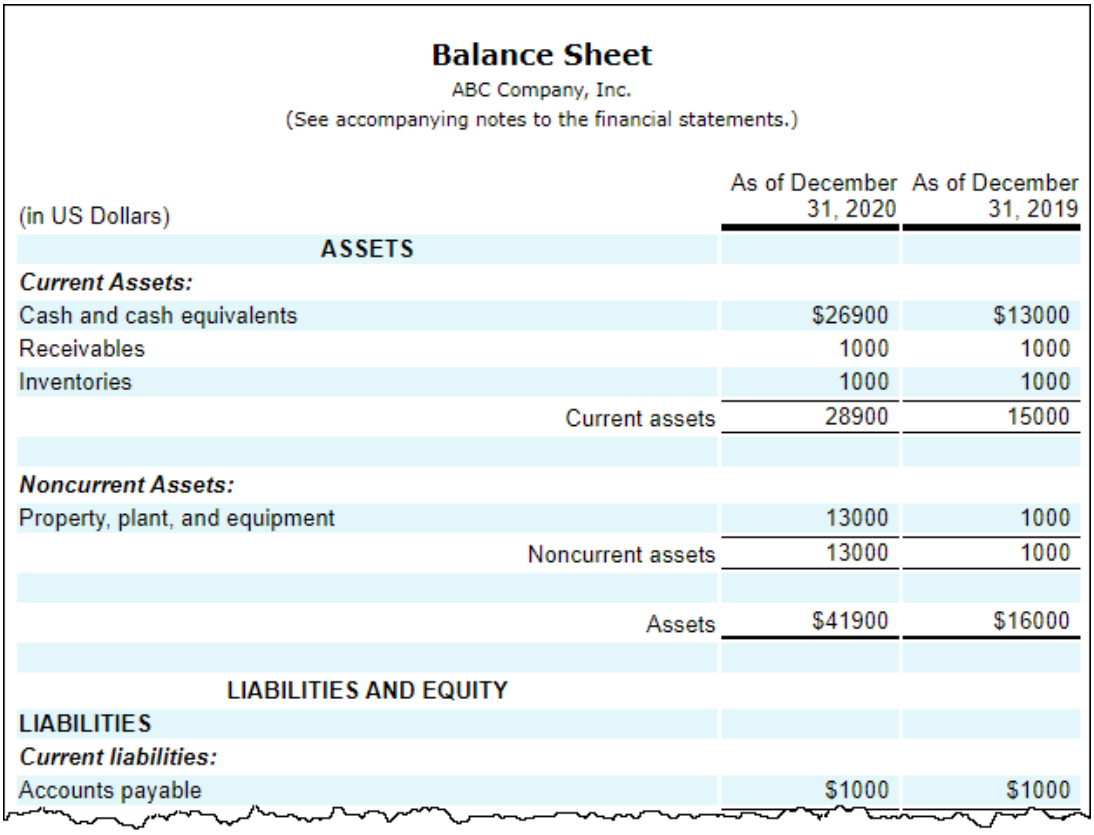
You are encouraged to go through each fragment of the report so you can see the extent of the report and how the report pieces are connected together.

In addition, Inline XBRL can be auto-generated from the XBRL instance and XBRL taxonomy information[111]. Note this Inline XBRL below that mimics the auto-generated of the XBRL Cloud Evidence Package rendering. The formatting of this information could be changed to follow any specified formatting scheme. Such a "pixel perfect" results can be achieved if certain flexibility is given up which could satisfy many formatting needs:

Balance Sheet [Abstract]	Period [Axis]	
	2020-12-31	2019-12-31
Balance Sheet [Abstract]		
Assets [Roll Up]		
Current Assets [Roll Up]		
Cash and Cash Equivalents	26,900.00	13,000.00
Receivables	1,000.00	1,000.00
Inventories	1,000.00	1,000.00
Current Assets	28,900.00	15,000.00
Noncurrent Assets [Roll Up]		
Property, Plant and Equipment	13,000.00	1,000.00
Noncurrent Assets	13,000.00	1,000.00
Assets	41,900.00	16,000.00
Liabilities and Equity [Roll Up]		
Liabilities [Roll Up]		
Current Liabilities [Roll Up]		
Accounts Payable	1,000.00	1,000.00
Current Liabilities	1,000.00	1,000.00
Noncurrent Liabilities [Roll Up]		
Long-term Debt	5,900.00	1,000.00

In order to achieve true "pixel perfect" rendering additional formatting metadata must be specified. While Inline XBRL can be made "pixel perfect" to the extent that HTML and CSS can be used to format documents; XHTML and CSS do not have functionality for things like page breaks and other such page flow features. But, XSL-FO, DITA, DocBook does provide that level of functionality. But, the following is an example of what is achievable using Inline XBRL[112]:

[111] Auto-generated Inline XBRL of report, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/instance.html
[112] Pixel-perfect Inline XBRL, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/instance-RENDERED.html



Balance Sheet

ABC Company, Inc.

(See accompanying notes to the financial statements.)

(in US Dollars)	As of December 31, 2020	As of December 31, 2019
ASSETS		
Current Assets:		
Cash and cash equivalents	$26900	$13000
Receivables	1000	1000
Inventories	1000	1000
Current assets	28900	15000
Noncurrent Assets:		
Property, plant, and equipment	13000	1000
Noncurrent assets	13000	1000
Assets	$41900	$16000
LIABILITIES AND EQUITY		
LIABILITIES		
Current liabilities:		
Accounts payable	$1000	$1000

NOTE that it is worth looking at the PROOF example Inline XBRL document[113] and some Inline XBRL documents submitted to the SEC to understand the rendering possibilities which are quite good. While this example focuses on numbers, policies and disclosures in the form of words can likewise be rendered well.

Multidimensional Model

The multidimensional model[114] is the fundamental approach that is being used to represent and render information represented by the structures which provide information. For more information, please see *Structures*[115] and *Representing Structures using Hypercubes*[116].

Reports can be broken down into fragments. Each fragment has a set of fact sets that make up that fragment. A fact set is made up of individual facts.

It is important to keep in mind that we are representing information, not presenting information. The representation of information is based on the logic of the reported

[113] Pixel-perfect Inline XBRL, Proof example, http://xbrlsite.azurewebsites.net/2020/master/proof-common-render/instance-RENDERED.html

[114] YouTube.com, *Multidimensional Model*, https://youtu.be/JHIEoUp-06s

[115] Mastering XBRL-based Digital Financial Reporting, Structures, http://www.xbrlsite.com/mastering/Part02_Chapter05.E_Structures.pdf

[116] Mastering XBRL-based Digital Financial Reporting, Representing Structures using Hypercubes, http://www.xbrlsite.com/mastering/Part02_Chapter05.H_RepresentingStructuresUsingHypercubes.pdf

information. The presentation of information tends to be based on arbitrary personal preferences which can differ from person to person.

Definition	My Term	US GAAP Financial Reporting Taxonomy Term
A **report** is information published by a reporting entity at some point in time for some purpose.	Report	Financial Report
A **fragment** is a set of one to many fact sets which go together for some specific purpose within a report.	Fragment	Report Fragment
A **fact set** is a set of facts which go together (tend to be cohesive and share a certain common nature) for some specific purpose within a report.	Fact Set	Schedule
A **fact** is reported. A fact defines a single, observable, reportable piece of information contained within a report contextualized for unambiguous interpretation or analysis by one or more distinguishing aspects.	Fact	Fact

Concept Arrangement Patterns

The facts that are represented within a fact set are not organized arbitrarily; they have patterns. Those patterns include:

- **Set**: A set of facts with no mathematical relations.
- **Roll up**: A roll up which follows the mathematical pattern "Total = Item 1 + Item 2 + Item 3.
- **Roll forward**: A roll forward which follows the BASE mathematical pattern described earlier, "Beginning Balance + Additions – Subtractions = Ending Balance".
- **Adjustment**: An adjustment which follows the mathematical pattern, "Originally stated balance + adjustments = Restated balance.

These patterns of the arrangement of line items are referred to as concept arrangement patterns. A complete discussion is beyond the scope of what we need to achieve; for more information please refer to Concept Arrangement Patterns[117].

[117] Mastering XBRL-based Digital Financial Reporting, *Concept Arrangement Patterns*, http://www.xbrlsite.com/mastering/Part02_Chapter05.I_ConceptArrangementPatterns.pdf

Disclosure Mechanics

Facts that make up a fact set represent something. Information is not provided willy-nilly, rather information is provided for a specific reason. We call this reason a "disclosure". We give each disclosure a name. For more information about disclosure mechanics, please refer to Disclosure Mechanics[118].

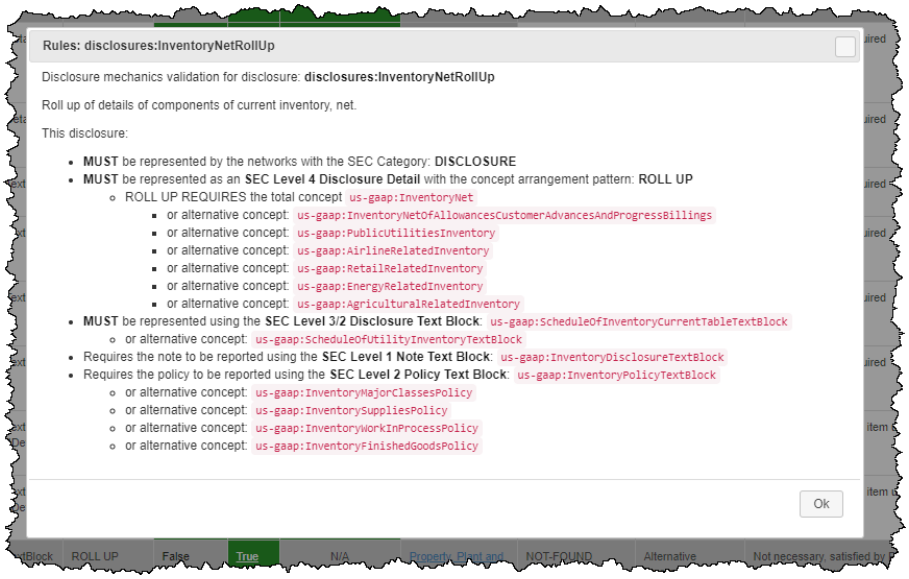
Disclosure mechanics rules are used to make sure that the report model being created is consistent with expectation. Disclosure mechanics rules[119] are provided for each and every disclosure contained within a report. The following graphic shows the results of verifying that the disclosure mechanics rule of every report fragment is consistent with expectation:

Show more information

Primary Information

#	Disclosure	Category	Level	Pattern	Disclosure Found	Disclosure Consi...	Applicable	Representation Concept [TEXT BLOCK]	Representation Concept DETAIL
1	Accounts Payable Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Accounts Payable
2	Assets Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Assets
3	Balance Sheet	Statement	UNKNOWN	Component	True	CONSISTENT	True	-	-
4	Cash and Cash Equivalents Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Cash and Cash Equivalents
5	Cash Flow Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Cash and Cash Equivalents
6	Cash Flow Statement	Statement	UNKNOWN	Component	True	CONSISTENT	True	-	-
7	Changes in Equity	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Equity
8	Comprehensive Income 2	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Net Income (Loss)
9	Inventories Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Inventories
10	Liabilities and Equity Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Liabilities and Equity
11	Long Term Debt Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Long-term Debt
12	Net Cash Flow Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Net Cash Flow
13	Property, Plant, and Equipment Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Property, Plant and Equipment
14	Receivables Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Receivables
15	Retained Earnings Roll Forward	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Retained Earnings
16	Transactions Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Check Sum Changes
17	Trial Balance Roll Up	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Check Sum

The following is an example of disclosure mechanics rules from US GAAP:

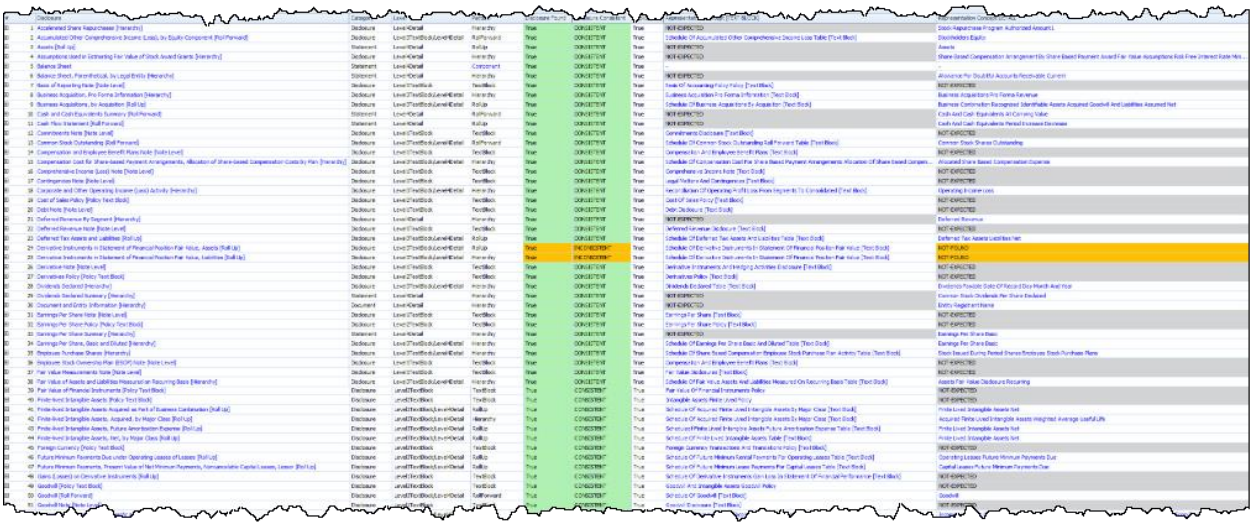


[118] Mastering XBRL-based Digital Financial Reporting, Disclosure Mechanics, http://www.xbrlsite.com/mastering/Part02_Chapter05.M_DisclosureMechnics.pdf

[119] Machine-readable disclosure mechanics rules, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/dm-rules.xsd

This is a set of disclosure mechanics rules for the Microsoft 10-K, XBRL Cloud[120]: (can be viewed and used on line)

This is a set of disclosure mechanics rules for the Microsoft 10-K, Pesseract, covers 94.8% of all 194 disclosures in that 10-K report[121]. Note that issues are highlighted in orange.



Disclosure Rules

Disclosure rules (a.k.a. reporting checklist) provides information about what needs to be disclosed within a report. For more information see Disclosure Rules[122].

Disclosure rules (i.e. reporting checklist rules) are used to verify that all anticipated disclosures that should be provided are, in fact, provided per the specified rules (similar to how a reporting checklist is used as a "memory jogger" except that here the rules are machine-readable and enforced by automated machine-based processes)[123]:

[120] Disclosure Mechanics, Microsoft 10-K, provided by XBRL Cloud, http://xbrlsite.azurewebsites.net/2017/Prototypes/Microsoft2017/Disclosure%20Mechanics%20and%20Reporting%20Checklist.html

[121] Disclosure Mechanics, Microsoft 10-K, provided by Pesseract, http://xbrlsite.azurewebsites.net/2020/Prototype/Microsoft/Microsoft2017_Discovery.jpg

[122] Mastering XBRL-based Financial Reporting, Disclosure Rules (a.k.a. Reporting Checklist, http://www.xbrlsite.com/mastering/Part02_Chapter05.N_DisclosureRules.pdf

[123] Disclosure Rules (a.k.a. reporting checklist), http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/dr-rules-def.xml

#		Disclosure	Checklist Category	Reason Disclosure Must Exist	Discovered	Expectation Met	Link to Disclosure Mechanics
0		Reporting Checklist					
	1	Balance Sheet	Required disclosure	Disclosure always required, satisfied by Assets Roll Up and Liabilities and Equity Roll Up disclosures	True	CONSISTENT	Balance Sheet
	2	Assets Roll Up	Part of disclosure	Satisfies Balance Sheet disclosure	True	CONSISTENT	Assets Roll Up
	3	Liabilities and Equity Roll Up	Part of disclosure	Satisfies Balance Sheet disclosure	True	CONSISTENT	Liabilities and Equity Roll Up
	4	Changes in Equity	Required disclosure	Disclosure always required	True	CONSISTENT	Changes in Equity
	5	Comprehensive Income 2	Required disclosure	Disclosure always required	True	CONSISTENT	Comprehensive Income 2
	6	Cash Flow Statement	Required disclosure	Disclosure always required, satisfied by Net Cash Flow Roll Up and Cash Flow Roll Forward disclosures	True	CONSISTENT	Cash Flow Statement
	7	Net Cash Flow Roll Up	Part of disclosure	Satisfies Cash Flow Statement disclosure	True	CONSISTENT	Net Cash Flow Roll Up
	8	Cash Flow Roll Forward	Part of disclosure	Satisfies Cash Flow Statement disclosure	True	CONSISTENT	Cash Flow Roll Forward
	9	Cash and Cash Equivalents Roll Forward	Possible disclosure	Disclosure is present	True	CONSISTENT	Cash and Cash Equivalents Roll Forward
	10	Receivables Roll Forward	Possible disclosure	Disclosure is present	True	CONSISTENT	Receivables Roll Forward
	11	Inventories Roll Forward	Possible disclosure	Disclosure is present	True	CONSISTENT	Inventories Roll Forward
	12	Property, Plant, and Equipment Roll Forward	Possible disclosure	Disclosure is present	True	CONSISTENT	Property, Plant, and Equipment Roll Forward
	13	Accounts Payable Roll Forward	Possible disclosure	Disclosure is present	True	CONSISTENT	Accounts Payable Roll Forward
	14	Accounts Payable Roll Forward	Possible disclosure	Disclosure is present	True	CONSISTENT	Accounts Payable Roll Forward
	15	Long Term Debt Roll Forward	Possible disclosure	Disclosure is present	True	CONSISTENT	Long Term Debt Roll Forward
	16	Retained Earnings Roll Forward	Possible disclosure	Disclosure is present	True	CONSISTENT	Retained Earnings Roll Forward
	17	Trial Balance Roll Up	Possible disclosure	Disclosure is present	True	CONSISTENT	Trial Balance Roll Up
	18	Transactions Roll Up	Possible disclosure	Disclosure is present	True	CONSISTENT	Transactions Roll Up

Reporting Styles

Financial reports are not "forms" that economic entities fill in. Financial reports are likewise not "random". Rather, there are patterns in how financial reports are prepared. These patterns are called reporting styles[124]. Reporting styles are permissible interpretations of reporting rules. US GAAP[125] and IFRS[126] have different reporting styles, but they have some similarities. Here is information about US GAAP Reporting Styles:

#	Reporting style	Filings Count	Filings With No Errors	Sum Errors (all filings)	Average Errors per Filing	Percent Without Error	Cum	Cum %
1	COMID-BSC-CF1-ISM-IEMIB-OILY-SPEC6	1,947	1,645	454	.2	84%	1,947	31.2%
2	COMID-BSC-CF1-ISS-IEMIB-OILY-SPEC1	874	745	214	.2	85%	2,821	45.2%
3	COMID-BSC-CF1-ISS-IEMIB-OILY-SPEC2	786	692	127	.2	88%	3,607	57.8%
4	INTBX-BSU-CF1-ISS-IEMIX-OILN	480	426	71	.1	89%	4,087	65.5%
5	COMID-BSC-CF1-ISS-IEMIB-OILY	178	162	30	.2	91%	4,265	68.3%
6	COMID-BSC-CF1-ISM-IEMIX-OILY-PARK	163	149	18	.1	91%	4,428	70.9%
7	COMID-BSC-CF1-IS3-IEMIB-OILN	130	93	49	.4	72%	4,558	73.0%
8	COMID-BSC-CF1-ISM-IEMIB-OILY-SPEC9	124	106	20	.2	85%	4,682	75.0%
9	COMID-BSC-CF1-IS6-IEMIX-OILN	108	92	24	.2	85%	4,790	76.7%
10	INSBX-BSU-CF1-ISS-IEMIX-OILN	95	87	9	.1	92%	4,885	78.2%
11	COMID-BSC-CF1-IS8-IEMIB-OILN	78	56	35	.4	72%	4,963	79.5%
12	COMID-BSC-CF1-ISM-IEMIT-OILY-SPEC6	65	44	27	.4	68%	5,028	80.5%
13	Limited2	64	64	0	.0	100%	5,092	81.6%
14	COMID-BSC-CF1-IS4-IEMIB-OILN	61	45	20	.3	74%	5,153	82.5%
15	COMID-BSU-CF1-ISS-IEMIB-OILY-SPEC1	60	48	19	.3	80%	5,213	83.5%
16	COMID-BSC-CF1-ISM-IEMIX-OILY-SPEC7	60	37	38	.6	62%	5,273	84.4%
17	Lim	58	58	0	.0	100%	5,331	85.4%
95	SECBX-BSC-CF1-ISS-IEMIB-OILN	1	1	0	.0	100%	6,240	99.9%
96	SECBX-BSU-CF1-ISM-IEMIX-OILN-CITI	1	1	0	.0	100%	6,241	100.0%
97	COMID-BSC-CF1-ISM-IEMIT-OILN	1	0	3	3.0		6,242	100.0%
98	COMID-BSC-CF2-ISS-IEMIT-OILY	1	0	2	2.0		6,243	100.0%
99	COMID-BSU-CF2-IS6-IEMIX-OILN	1	0	1	1.0		6,244	100.0%
		6,244	5,249	1,463	.2			

Percent of all filings conforming to all FAC relations		84.1%
Total filings NOT conforming	995	
Total tests	137,368	100.00%
Total inconsistent	1,463	1.07%
Total consistent	**135,905**	**98.93%**

[124] YouTube.com, Reporting Styles, https://youtu.be/SfvEeKLgAxs

[125] US GAAP Reporting Styles, http://www.xbrlsite.com/2018/10K/US-GAAP-Reporting-Styles.pdf

[126] IFRS Reporting Styles, http://www.xbrlsite.com/2018/IFRS/IFRS-Reporting-Styles.pdf

Approximately 80.5% of public companies that report to the SEC using US GAAP use one of 12 different reporting styles. For more information on reporting styles please see Fundamental Accounting Concepts and Reporting Styles[127].

Fundamental Accounting Concept Relations

Reporting styles are defined by the totals, subtotals, and line items that a report uses to represent a particular primary financial statement. The patterns of the high-level totals and subtotals used are referred to as fundamental accounting concepts. Those fundamental accounting concepts have specific permissible relations. The following is an example of fundamental accounting concept relations for US GAAP based financial reports[128].

#	Category	Test Number	Fundamental accounting concept consistency check description	Consistent	Consistent %	Inconsistent	Inconsistent %
1	BS	usfac:BS1	Equity = Equity Attributable to Parent + Equity Attributable to Noncontrolling Interest	5,698	100.00%	18	0.00%
2	BS	usfac:BS2	Assets = Liabilities and Equity	5,706	100.00%	10	0.00%
3	BS	usfac:BS3	Assets = Current Assets + Noncurrent Assets	5,668	99.32%	48	0.68%
4	BS	usfac:BS4	Liabilities = Current Liabilities + Noncurrent Liabilities	5,691	99.81%	25	0.19%
5	BS	usfac:BS5	Liabilities and Equity = Liabilities + Commitments and Contingencies + Temporary Equity + Equity	5,643	99.42%	73	0.58%
6	CF	usfac:CF1	Net Cash Flow = Net Cash Flows, Operating + Net Cash Flows, Investing + Net Cash Flows, Financing + Exchange Gains (Losses)	5,586	97.96%	130	2.04%
7	CF	usfac:CF2	Net Cash Flows, Continuing = Net Cash Flows, Operating, Continuing + Net Cash Flows, Investing, Continuing + Net Cash Flows, Financing, Continuing	5,690	99.71%	26	0.29%
8	CF	usfac:CF3	Net Cash Flows, Discontinued = Net Cash Flows, Operating, Discontinued + Net Cash Flows, Investing, Discontinued + Net Cash Flows, Financing, Discontinued	5,706	99.71%	10	0.29%
9	CF	usfac:CF4	Net Cash Flows, Operating = Net Cash Flows, Operating, Continuing + Net Cash Flows, Operating, Discontinued	5,705	99.81%	11	0.19%
10	CF	usfac:CF5	Net Cash Flows, Investing = Net Cash Flows, Investing, Continuing + Net Cash Flows, Investing, Discontinued	5,697	99.90%	19	0.10%
11	CF	usfac:CF6	Net Cash Flows, Financing = Net Cash Flows, Financing, Continuing + Net Cash Flows, Financing, Discontinued	5,712	99.90%	4	0.10%
12	IS	usfac:IS1	Gross Profit = Revenues - Cost Of Revenue	5,648	98.64%	68	1.36%
13	IS	usfac:IS2	Operating Income (Loss) = Gross Profit - Operating Expenses + Other Operating Income (Expenses)	5,557	98.35%	159	1.65%
14	IS	usfac:IS3	Income (Loss) from Continuing Operations Before Equity Method Investments = Operating Income (Loss) + Nonoperating Income (Loss) - Interest And Debt Expense	5,715	100.00%	1	0.00%
15	IS	usfac:IS4	Income (Loss) from Continuing Operations Before Tax = Income (Loss) from Continuing Operations Before Equity Method Investments + Income (Loss) from Equity Method Investments	5,605	99.03%	111	0.97%
16	IS	usfac:IS5	Income (Loss) from Continuing Operations after Tax = Income (Loss) from Continuing Operations Before Tax - Income Tax Expense (Benefit)	5,635	98.64%	81	1.36%
17	IS	usfac:IS6	Net Income (Loss) = Income (Loss) from Continuing Operations After Tax + Income (Loss) from Discontinued Operations, Net of Tax + Extraordinary Items, Gain (Loss)	5,628	98.54%	88	1.46%
18	IS	usfac:IS7	Net Income (Loss) = Net Income (Loss) Attributable to Parent + Net Income (Loss) Attributable to Noncontrolling Interest	5,536	96.70%	180	3.30%
19	IS	usfac:IS8	Net Income (Loss) Available to Common Stockholders, Basic = Net Income (Loss) Attributable to Parent - Preferred Stock Dividends and Other Adjustments	5,691	99.22%	25	0.78%
20	SCI	usfac:IS9	Comprehensive Income (Loss) = Comprehensive Income (Loss) Attributable to Parent + Comprehensive Income (Loss) Attributable to Noncontrolling Interest	5,672	99.32%	44	0.68%
21	SCI	usfac:IS10	Comprehensive Income (Loss) = Net Income (Loss) + Other Comprehensive Income (Loss)	5,571	97.67%	145	2.33%

[127] Mastering XBRL-based Digital Financial Reports, *Fundamental Accounting Concepts and Reporting Styles*, http://www.xbrlsite.com/mastering/Part02_Chapter05.L_FundamentalAccountingConceptAndReportingStyles.pdf

[128] 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-report-quality.html

When there are no missing high-level fundamental accounting concepts it is trivial to check fundamental accounting concept relations. Here are XBRL formulas that represent **fundamental accounting concept relations consistency cross checks** are used to verify that there are no inconsistencies and/or contradictions between high-level reported facts.

- Assets = Liabilities + Equity[129]
- Assets = Current Asset + Noncurrent Assets[130]
- Liabilities = Current Liabilities + Noncurrent Liabilities[131]
- Net Cash Flow = Net Cash Flow from Operating Activities + Net Cash Flow from Investing Activities + Net Cash Flow from Financing Activities[132]

Here are the results from validating this example per the machine-readable rules described above:

id	satisfied	message
Arithmetic_BS01 (evaluation 1)	satisfied	$Assets=16000 = ($Liabilities=2000 + $Equity=14000)
Arithmetic_BS01 (evaluation 2)	satisfied	$Assets=41900 = ($Liabilities=6900 + $Equity=35000)
Arithmetic_BS02 (evaluation 1)	satisfied	$Assets=16000 = ($CurrentAssets=15000 + $NoncurrentAssets=1000)
Arithmetic_BS02 (evaluation 2)	satisfied	$Assets=41900 = ($CurrentAssets=28900 + $NoncurrentAssets=13000)
Arithmetic_BS03 (evaluation 1)	satisfied	$Liabilities=2000 = ($CurrentLiabilities=1000 + $NoncurrentLiabilities=1000)
Arithmetic_BS03 (evaluation 2)	satisfied	$Liabilities=6900 = ($CurrentLiabilities=1000 + $NoncurrentLiabilities=5900)
Arithmetic_CF01 (evaluation 1)	satisfied	$NetCashFlow=13900 = ($NetCashFlowOperatingActivities=24000 + $NetCashFlowFinancingActivities=4900 + $NetCashFlowInvestingActivities=-15000)

When an important high-level total or subtotal is not explicitly reported then it must be derived. For example, it is common for an economic entity to not include the subtotal "Noncurrent Assets" and/or "Noncurrent Liabilities" explicitly within their financial report. But, because other information is reported then information can be reliably derived (a.k.a. imputed) if the right information exists. For example, if "Assets" is reported and "Current Assets" is reported and the rule "Assets = Current Assets + Noncurrent Assets" is provided (as above); then "Noncurrent Assets" can be logically derived using that information. Here are derivation rules that go with this example:

- Liabilities = Assets - Equity[133]
- Equity = Assets - Liabilities[134]

[129] XBRL Formula, Consistency rule, Assets = Liabilities + Equity, http://xbrlsite.azurewebsites.net/2020/master/workflow/Rule-Consistency-Code-BS01-formula.xml

[130] XBRL Formula, Consistency rule, Assets = Current Assets + Noncurrent Assets, http://xbrlsite.azurewebsites.net/2020/master/workflow/Rule-Consistency-Code-BS02-formula.xml

[131] XBRL Formula, Consistency rule, Liabilities = Current Liabilities + Noncurrent Liabilities, http://xbrlsite.azurewebsites.net/2020/master/workflow/Rule-Consistency-Code-BS03-formula.xml

[132] XBRL Formula, Consistency rule, Net Cash Flow = Net Cash Flow from Operating Activities + Net Cash Flow from Investing Activities + Net Cash Flow from Financing Activities, http://xbrlsite.azurewebsites.net/2020/master/workflow/Rule-Consistency-Code-CF01-formula.xml

[133] XBRL Formula, Derivation rule, Liabilities = Assets – Equity, http://xbrlsite.azurewebsites.net/2020/master/workflow/Rule-Derivation-Code-BS-Impute-01-formula.xml

[134] XBRL Formula, Derivation rule, Equity = Assets – Liabilities, http://xbrlsite.azurewebsites.net/2020/master/workflow/Rule-Derivation-Code-BS-Impute-02-formula.xml

- Assets = Liabilities + Equity[135]

For more information please see *Fundamental Accounting Concept Relations and Reporting Styles*[136]. For more examples of fundamental accounting concept relations consistency cross checks, please see *Quarterly XBRL-based Public Company Financial Report Quality (March 2019)*[137].

Type-subtype Associations

Concepts can be related to other concepts. For example, "Cash" is a type of "Cash and Cash Equivalents" or "Finished Goods" is a type of "Inventories". Other names used to describe this category of association is the "general-special" relations or the "wider-narrower" association.

For example, if the line item "Property, Plant and Equipment" (a noncurrent asset) is reported as a part of Current Assets (instead of the proper total Noncurrent Assets); that is a logical error and then a report is created incorrectly.

For more information please see Associations[138].

Model Structure Associations

As described in the section which explained terms; terms can be grouped into categories. Those categories are: Network, Hypercube, Dimension, Member, Line Items, Abstract, and Concept.

The following table shows the permissible and disallowed associations between a parent term category and a child term category:

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

For more information please see Associations[139].

For example, if a report element that is of the category Member is used within a report element Line Items" to represent a structure, that would be a logical error.

[135] XBRL Formula, Derivation rule, Assets = Liabilities + Equity, http://xbrlsite.azurewebsites.net/2020/master/workflow/Rule-Derivation-Code-BS-Impute-03-formula.xml

[136] Mastering XBRL-based Digital Financial Reporting, *Fundamental Accounting Concept Relations and Reporting Styles*, http://www.xbrlsite.com/mastering/Part02_Chapter05.L_FundamentalAccountingConceptAndReportingStyles.pdf

[137] Quarterly XBRL-based Public Company Financial Report Quality (March 2019), http://xbrl.squarespace.com/journal/2019/3/29/quarterly-xbrl-based-public-company-financial-report-quality.html

[138] Mastering XBRL-based Digital Financial Reporting, *Associations*, http://www.xbrlsite.com/mastering/Part02_Chapter05.D_Associations.pdf

[139] Mastering XBRL-based Digital Financial Reporting, *Associations*, http://www.xbrlsite.com/mastering/Part02_Chapter05.D_Associations.pdf

Auditing

In order to include the audit process, a simple audit step was included in this working proof of concept. That step included the simple test of making sure that all the journal entries in the general journal followed the expectations specified in the CodeMatrix. This test checks to see that the GeneralLedgerAccountCode and the TransactionDescriptionCode matched the expected values from the table below:

Key	GeneralLedgerAccountCode	SortOrder	TransactionDescriptionCode	AuditRisk	Comment
1	tb:CashAndCashEquivalents	1	tb:CollectionReceivables	Medium	Ties to cash receipts journal.
10	tb:CashAndCashEquivalents	2	tb:PaymentOfAccountsPayable	Medium	Ties to check registrer.
11	tb:CashAndCashEquivalents	3	tb:AdditionalLongtermBorrowings2	Medium	Ties to bank statement.
12	tb:CashAndCashEquivalents	4	tb:RepaymentLongtermBorrowings2	Medium	Ties to bank statement.
13	tb:CashAndCashEquivalents	5	tb:CapitalAdditionsPropertyPlantAndEquipment2	Medium	Ties to fixed assets ledger.
32	tb:Receivables	11	tb:Sales2	Medium	Ties to sales journal.
15	tb:Receivables	12	tb:CollectionReceivables2	Medium	Ties to cash receipts journal.
16	tb:Receivables	13	tb:AdditionsToAllowanceForBadDebts	High	Ties to supporting spreadsheet.
17	tb:Receivables	14	tb:BadDebtsWrittenOff	High	Ties to supporting spreadsheet.
18	tb:Inventories	21	tb:PurchasesOfInventoryForSale	Medium	Ties to inventory ledger.
19	tb:Inventories	22	tb:CostsOfSales2	Medium	Ties to sales ledger.
20	tb:Inventories	23	tb:InventoryWrittenOff	High	Ties to supporting spreadsheet.
21	tb:PropertyPlantAndEquipment	31	tb:CapitalAdditionsPropertyPlantAndEquipment	Medium	Ties to fixed assets ledger.
22	tb:PropertyPlantAndEquipment	32	tb:DepreciationAndAmortization2	Medium	Ties to fixed assets ledger.
23	tb:PropertyPlantAndEquipment	33	tb:PropertyPlantAndEquipmentWrittenOff	High	Ties to supporting spreadsheet.
24	tb:AccountsPayable	41	tb:PurchasesOfInventoryForSale2	Low	Ties to purchase order system.
25	tb:AccountsPayable	42	tb:PaymentOfAccountsPayable2	Low	Ties to check register.
26	tb:LongtermDebt	51	tb:AdditionalLongtermBorrowings	Medium	Ties to bank statement.
27	tb:LongtermDebt	52	tb:RepaymentLongtermBorrowings	Medium	Ties to bank statement.
28	tb:RetainedEarnings	61	tb:NetIncomeLoss	Medium	Ties to income statement
35	tb:Sales	91	tb:NetIncomeLoss	Medium	Ties to sales journal.
36	tb:CostsOfSales	92	tb:NetIncomeLoss	Medium	Tiles to sales journal.
37	tb:IncomeTaxExpenseBenefit	93	tb:NetIncomeLoss	Medium	Ties to tax provision.
38	tb:NonoperatingIncomeExpenses	94	tb:NetIncomeLoss	Medium	Ties to check register.
39	tb:DepreciationAndAmortization	95	tb:NetIncomeLoss	Medium	Ties to fixed assets ledger

In addition, this table is used within the accounting system application prototype to provide a dynamic list of TransactionDescriptionCode values for a selected GeneralLedgerAccountCode.

Lead schedules:

A lead schedule is an audit working paper that provides a detailed list of general ledger accounts from the chart of accounts comprising a line item in the financial statements. The total amount on the audit lead schedule should always match the corresponding line item in a financial statement. Here is an example audit lead schedule:

https://auditnz.parliament.nz/good-practice/csf/lead-schedules

Ref.	Item	Item balance		Reclassification and adjustments		Final balance		Original Budget	Prior period balance	Variance Actual - Budget			Variance Actual - Prior Year		
		Ref.	$000	Ref.	$000	$000	Ref.	$000	$000	$000	%	Expl.	$000	%	Expl.
			0			0		0	0	0			0		
Total per Financial Statements			0		0	0		0	0	0	0%		0	0%	

Acct #	Account Title	Audited Balance 12/31/2016 $		Unaudited Balance 12/31/2017 $		Adjustments Debit $	Adjustments Credit $	AJE#	Audited Balance 12/31/2017 $	WP Ref #
10100	Cash on Hand	A1.1		A1.2					0.00	
10200	Regular Checking Account	A1.1		A1.2	B2				0.00	
10300	Payroll Checking Account	A1.1		A1.2					0.00	
10400	Savings Account	A1.1		A1.2					0.00	
			0.00		0.00	$ -	$ -		0.00	

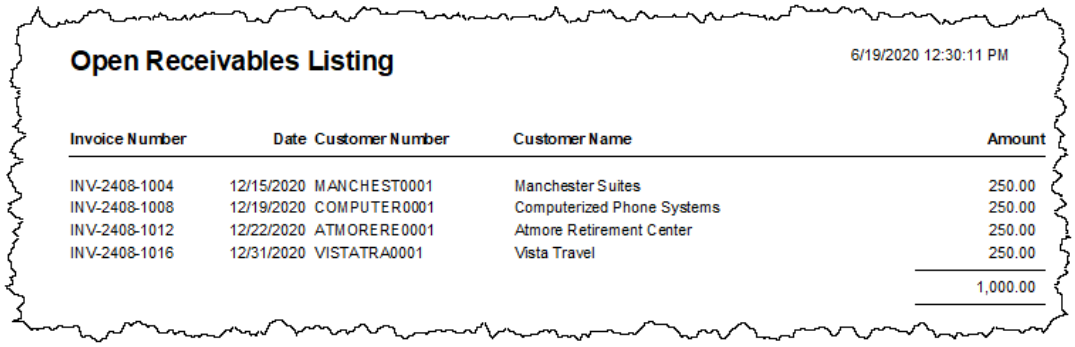
Many audit working papers are connected mathematically to the audit lead schedule.

Cash and cash equivalents workpapers:

Ref		
	Bank Reconciliation Summary	
Ref		12/31/2020
	Regular Checking Account (XXXXXX)	
	Unadjusted book balance	26,900.00
	Bank Adjustments	-
	Amount to balance	-
	Adjusted book balance	26,900.00
	Balance per Bank Confirmation	24,000.00
	Add Deposits in Transit	3,900.00
	Deduct Outstanding Checks	(1,000.00)
	Adjusted bank balance	26,900.00
	Check (Should be Zero)	-

Accounts receivable workpapers:

Detailed trial balance of accounts receivable:



Open Receivables Listing 6/19/2020 12:30:11 PM

Invoice Number	Date	Customer Number	Customer Name	Amount
INV-2408-1004	12/15/2020	MANCHEST0001	Manchester Suites	250.00
INV-2408-1008	12/19/2020	COMPUTER0001	Computerized Phone Systems	250.00
INV-2408-1012	12/22/2020	ATMORERE0001	Atmore Retirement Center	250.00
INV-2408-1016	12/31/2020	VISTATRA0001	Vista Travel	250.00
				1,000.00

Accounts receivable roll forward:

Receivables [Roll Forward]	Period [Axis] 2020-01-01 - 2020-12-31
Receivables [Roll Forward]	
Receivables, Beginning Balance	1,000.00
Sales 2	48,000.00
Collection of Receivables 2	(48,000.00)
Additions to Allowance for Bad Debts	.00
Bad Debts Written Off	.00
Receivables, Ending Balance	1,000.00

Accounts receivable aging:

CustomerNumber	CustomerName	TotalOfInvoiceAmount	2020-12-31	2020-12-22	2020-12-19	2020-12-15
ATMORERE0001	Atmore Retirement Center	250.00		250.00		
COMPUTER0001	Computerized Phone Systems	250.00			250.00	
MANCHEST0001	Manchester Suites	250.00				250.00
VISTATRA0001	Vista Travel	250.00	250.00			

Accounts receivable confirmations:

Jun 19, 2020

ATMORE RE 0001

61701-9392
Atmore Retirement Center
735 W 7th St.
Bloominoton. IL 61701-9392

Dear Sir:

We are conducting an audit of ABC Company, Inc. and would like to verify the following information.

Could you please verify the following information as of December 31, 2020, and let us know if it does not agree with the information you have in your records:

Current AR Balance:	$250.00
Approxomate Total Annual Purchases:	$6,000.00
Date of Last Payment:	1/5/2021
Other:	
Other:	

Thank you for your assistance with respect to this matter.

If you have any questions regarding this letter, please contact our auditors, Jones Associates, CPA's directly.

Sincerely,

ABC Company, Inc.
Treasurer

Inventories workpapers:

Physical inventory:

Physical Inventory Listing

Inventory ID	Item Name	Descrpition	Unit Price	Quantity in Stock	Inventory Value
INV1	Item 1	Description 1	$ 1.00	500	500.00
INV2	Item 2	Description 2	$ 1.00	500	500.00
					1,000.00

Inventory roll forward:

Inventories [Roll Forward]	Period [Axis] 2020-01-01 - 2020-12-31
Inventories [Roll Forward]	
Inventories, Beginning Balance	1,000.00
Purchases of Inventory for Sale	24,000.00
Costs of Sales 2	(24,000.00)
Inventory Written Off	.00
Inventories, Ending Balance	1,000.00

Property, plant and equipment workpapers:

PPE Listing:

Property, Plant and Equipment

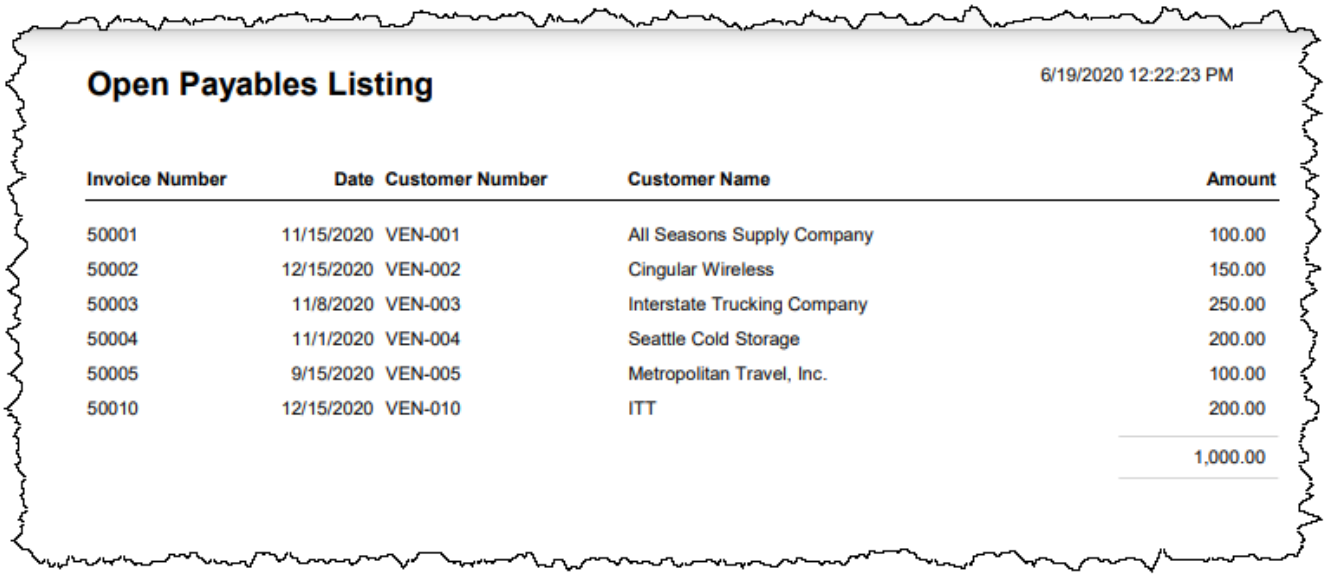
							Depreciation Expense for Year						
Asset ID	Name	Descrpition	Cost	Year	Life	Method	2020	2021	2022	2023	2024	2025	Check
ASSET1	Asset 1	Description 1	$ 1,000.00	2019	5	SL	200.00	200.00	200.00	200.00	200.00	-	-
ASSET2	Asset 2	Description 2	$ 15,000.00	2020	5	SL	2,800.00	3,000.00	3,000.00	3,000.00	3,000.00	200.00	-
							3,000.00	3,200.00	3,200.00	3,200.00	3,200.00	200.00	

Property, plant, and equipment roll forward:

Property, Plant and Equipment [Roll Forward]	Period [Axis] 2020-01-01 - 2020-12-31
Property, Plant and Equipment [Roll Forward]	
Property, Plant and Equipment, Beginning Balance	1,000.00
Capital Additions of Property, Plant and Equipment	15,000.00
Depreciation and Amortization 2	(3,000.00)
Property, Plant and Equipment Written Off	.00
Property, Plant and Equipment, Ending Balance	13,000.00

Accounts payable workpapers:

Detailed trial balance of accounts payable:



Open Payables Listing

6/19/2020 12:22:23 PM

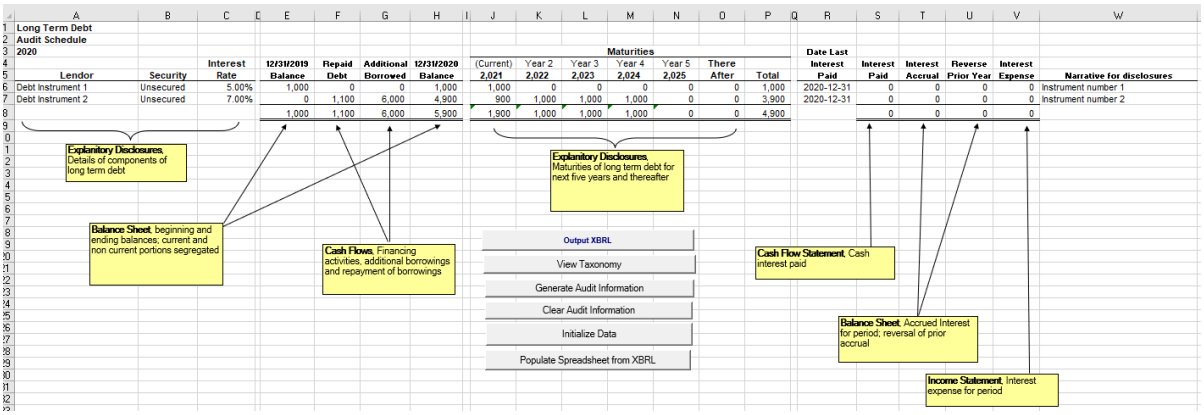
Invoice Number	Date	Customer Number	Customer Name	Amount
50001	11/15/2020	VEN-001	All Seasons Supply Company	100.00
50002	12/15/2020	VEN-002	Cingular Wireless	150.00
50003	11/8/2020	VEN-003	Interstate Trucking Company	250.00
50004	11/1/2020	VEN-004	Seattle Cold Storage	200.00
50005	9/15/2020	VEN-005	Metropolitan Travel, Inc.	100.00
50010	12/15/2020	VEN-010	ITT	200.00
				1,000.00

Accounts payable roll forward:

Accounts Payable [Roll Forward]	Period [Axis] 2020-01-01 - 2020-12-31
Accounts Payable [Roll Forward]	
Accounts Payable, Beginning Balance	1,000.00
Purchases of Inventory for Sale 2	24,000.00
Payment of Accounts Payable 2	(24,000.00)
Accounts Payable, Ending Balance	1,000.00

Long term debt workpapers:

Debt instruments; maturities of long-term debt; accrued interest:



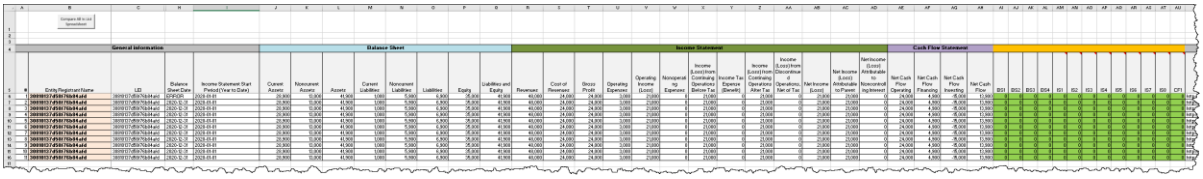
Long-term debt roll forward:

Long-term Debt [Roll Forward]	Period [Axis] 2020-01-01 - 2020-12-31
Long-term Debt [Roll Forward]	
Long-term Debt, Beginning Balance	1,000.00
Additional Long-term Borrowings	6,000.00
Repayment of Long-term Borrowings	(1,100.00)
Long-term Debt, Ending Balance	5,900.00

Analysis

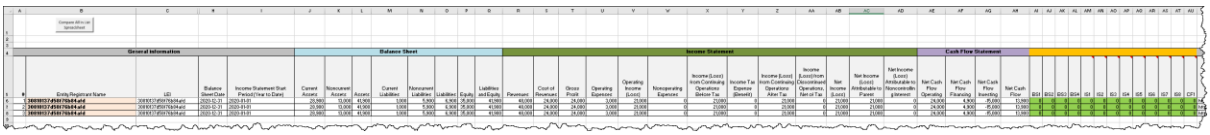
One of the ultimate objectives of providing financial information in machine-readable form is to be able to analyze the information. The following two Excel spreadsheet applications extract information from raw XBRL instances and Inline XBRL instances for analysis, in this case a simple comparison:

Period and entity comparison using Raw XBRL[140]:



[140] Raw XBRL extraction tool, http://xbrlsite.azurewebsites.net/2020/master/workflow/Extraction-TB.zip

Period and entity comparison using Inline XBRL[141]:



Again, don't be distracted by what appears to be a simplistic example. The example is simple rather than simplistic to help focus on a small, easy to understand example. If you want to try a more real extraction, please see this tool that extracts information from 10 years of XBRL-based financial reports from Microsoft, Apple, and Saleforce submitted to the SEC:

http://xbrlsite.azurewebsites.net/2020/Prototype/SoftwareCompanies/COMID-BSC-CF1-ISM-IEMIB-OILY-SPEC6.zip

Note that Microsoft, Apple, and Salesforce all use the same reporting style. This blog post[142] has 13 Excel-based extraction tools that extract information from the XBRL-based reports of 4,060 public companies (68% of all public companies). Each spreadsheet is for a different reporting style.

Adding facts to report

Facts were dynamically added to the XBRL instance that was being analyzing by deriving values from other facts that did exist and rules that were used to derive information. XBRL Formula chaining was used to add the additional facts:

- Working capital[143]
- Return on Assets[144]
- Return on Equity[145]
- Return on Sales[146]

Off-the-shelf XBRL Formula Processor (UBmatrix XPE 4.0) was used to dynamically derive the additional facts using a process called formula chaining. "Chaining" or explicitly defined sequence of processing is necessary when an XBRL Formula processor is used because such processors do not provide functionality for automated forward or backward chaining. The following facts were appended to the XBRL instance using a series of steps:

---

[141] Inline XBRL extraction tool, http://xbrlsite.azurewebsites.net/2020/master/workflow/Extraction-TB-InlineXBRL.zip

[142] Additional Excel-based extraction tools, http://xbrl.squarespace.com/journal/2018/1/11/further-updated-and-expanded-xbrl-based-financial-report-ext.html

[143] Working capital, http://xbrlsite.azurewebsites.net/2020/master/automation/analysis-formula-Impute-WorkingCapital.xml

[144] Return on Assets, http://xbrlsite.azurewebsites.net/2020/master/automation/analysis-formula-Impute-ReturnOnAssets.xml

[145] Return on Equity, http://xbrlsite.azurewebsites.net/2020/master/automation/analysis-formula-Impute-ReturnOnEquity.xml

[146] Return on Sales, http://xbrlsite.azurewebsites.net/2020/master/automation/analysis-formula-Impute-ReturnOnSales.xml

element	value	unit	effectiveValue	isNil	context
analysis:WorkingCapital	4000	U-USD	4000	false	I-2019
analysis:WorkingCapital	6000	U-USD	6000	false	I-2020
analysis:ReturnOnAssets	0.153846153846153846	U-USD	0.15	false	D-2020
analysis:ReturnOnEquity	0.333333333333333333	U-USD	0.33	false	D-2020
analysis:ReturnOnSales	0.5	U-USD	0.5	false	D-2020

Further discussion of XBRL Formula chaining is beyond the scope of this document but more information can be found in the blog post Deriving Information Using XBRL Formula Chaining (Example)[147].

More Complex Financial Models

Various models exist for analysis of financial information. For example, Finbox.com[148] provides financial analysis templates that can be used to perform different types of analysis driven by templates.

Templates could be created using global standard XBRL and exchanged. Proprietary software is not necessary, off-the-shelf software that supports XBRL can be utilized. Here are several analysis examples

Unlevered discounted cash flow model[149]:

WALL STREET PREP - FINANCIAL MODELING QUICK LESSON - BUILDING A SIMPLE DISCOUNTED CASH FLOW MODEL

Valuation Date:	1/1/2013
Share Price on Valuation Date:	$25.00
Diluted Shares Outstanding	500.0

Select Operating Data

				Projected Annual Forecast				
	2010A	2011A	2012A	2013P	2014P	2015P	2016P	2017P
Revenue	$5,300.0	$5,700.0	$6,000.0	$6,600.0	$7,326.0	$8,205.1	$9,271.8	$10,477.1
Revenue Growth Rate (%)				*10.0%*	*11.0%*	*12.0%*	*13.0%*	*13.0%*
EBITDA	$2,000.0	$2,080.0	$2,150.0	$2,310.0	$2,564.1	$2,871.8	$3,245.1	$3,667.0
EBITDA Margin (%)				*35.0%*	*35.0%*	*35.0%*	*35.0%*	*35.0%*
EBIT	1,700.0	1,750.0	1,800.0	$1,980.0	$2,197.8	$2,461.5	$2,781.5	$3,143.1
EBIT Margin (%)				*30.0%*	*30.0%*	*30.0%*	*30.0%*	*30.0%*
Depreciation & Amortization	$300.0	$330.0	$350.0	$369.6	$388.3	$336.4	$435.8	$461.0
D&A as a % of revenue				*5.6%*	*5.3%*	*4.1%*	*4.7%*	*4.4%*

Select Balance Sheet And Other Data

				Projected Annual Forecast				
	2010A	2011A	2012A	2013P	2014P	2015P	2016P	2017P
Cash	$700.0	$1,000.0	$1,500.0	1,500.0	1,500.0	1,500.0	1,500.0	1,500.0
Accounts Receivable	1,100.0	1,250.0	1,350.0	1,485.0	1,648.4	1,846.2	2,086.2	2,357.4

Inline XBRL information for unlevered discounted cash flow model[150]:

[147] *Deriving Information Using XBRL Formula Chaining (Example),* http://xbrl.squarespace.com/journal/2019/4/24/deriving-information-using-xbrl-formula-chaining-example.html

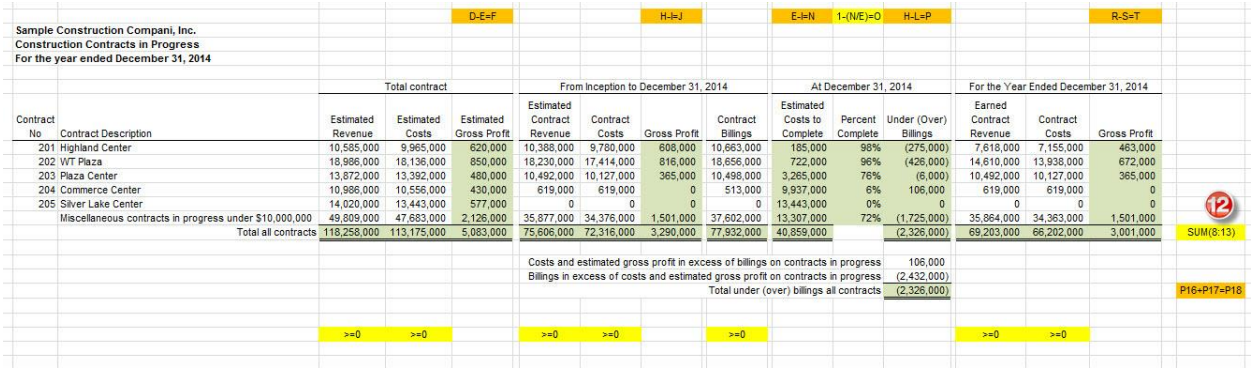
[148] Finbox.com, https://finbox.com/

[149] Unlevered discounted cash flow model, http://xbrl.squarespace.com/journal/2018/9/4/representing-unlevered-discounted-cash-flow-model-using-xbrl.html

[150] Inline XBRL model for discounted cash flow model, Microsoft, http://www.xbrlsite.com/2018/Prototype/DCFM/DCFM-Instance-Microsoft-InlineXBRL.html

Weighted Average Cost of Capital [Hypercube]	Period [Axis]							
	2023-01-01 - 2023-12-31	2022-01-01 - 2022-12-31	2021-01-01 - 2021-12-31	2020-01-01 - 2020-12-31	2019-01-01 - 2019-12-31	2018-01-01 - 2018-12-31	2017-12-31	2016-12-31
Weighted Average Cost of Capital [Hypercube]								
Weighted Average Cost of Capital Components [Hierarchy]								
Share Price						112.33		
Diluted Shares Outstanding						7,794,000,000		
Cost of Debt						5.20%		
Tax Rate	22.00%	22.00%	22.00%	22.00%	22.00%	22.00%		
After-tax Cost of Debt						4.10%		
Cost of Equity						13.00%		
Total Capital [Roll Up]								
Total Debt	76,898,000,000	76,898,000,000	76,898,000,000	76,898,000,000	76,898,000,000	76,898,000,000	77,837,000,000	40,949,000,000
Total Equity						875,500,020,000		
Total Capital						952,398,020,000		
Weightings [Hierarchy]								
Debt Weighting						8.10%		
Equity Weighting						91.90%		
Resulting WACC [Hierarchy]								
WACC	12.30%	12.30%	12.30%	12.30%	12.30%	12.30%		

Work in Progress Taxonomy example (Construction in progress)[151]:



Sample Construction Compani, Inc.
Construction Contracts in Progress
For the year ended December 31, 2014

		Total contract		D-E=F	From Inception to December 31, 2014		H-I=J		At December 31, 2014			For the Year Ended December 31, 2014		R-S=T	
Contract No	Contract Description	Estimated Revenue	Estimated Costs	Estimated Gross Profit	Estimated Contract Revenue	Contract Costs	Gross Profit	Contract Billings	Estimated Costs to Complete	Percent Complete	Under (Over) Billings	Earned Contract Revenue	Contract Costs	Gross Profit	
201	Highland Center	10,585,000	9,965,000	620,000	10,388,000	9,780,000	608,000	10,663,000	185,000	98%	(275,000)	7,618,000	7,155,000	463,000	
202	WT Plaza	18,986,000	18,136,000	850,000	18,230,000	17,414,000	816,000	18,656,000	722,000	96%	(426,000)	14,610,000	13,938,000	672,000	
203	Plaza Center	13,872,000	13,392,000	480,000	10,492,000	10,127,000	365,000	10,498,000	3,265,000	76%	(6,000)	10,492,000	10,127,000	365,000	
204	Commerce Center	10,986,000	10,556,000	430,000	619,000	619,000	0	513,000	9,937,000	6%	106,000	619,000	619,000	0	
205	Silver Lake Center	14,020,000	13,443,000	577,000	0	0	0	0	13,443,000	0%	0	0	0	0	
	Miscellaneous contracts in progress under $10,000,000	49,809,000	47,683,000	2,126,000	35,877,000	34,376,000	1,501,000	37,602,000	13,307,000	72%	(1,725,000)	35,864,000	34,363,000	1,501,000	
	Total all contracts	118,258,000	113,175,000	5,083,000	75,606,000	72,316,000	3,290,000	77,932,000	40,859,000		(2,326,000)	69,203,000	66,202,000	3,001,000	SUM(8:13)
					Costs and estimated gross profit in excess of billings on contracts in progress						106,000				
					Billings in excess of costs and estimated gross profit on contracts in progress						(2,432,000)				
					Total under (over) billings all contracts						(2,326,000)				P16+P17=P18
		>=0	>=0		>=0	>=0		>=0				>=0	>=0		

[151] Gaining an Appreciation of XBRL's Power to Express Business Rules, http://xbrl.squarespace.com/journal/2016/1/17/gaining-an-appreciation-of-xbrls-power-to-express-business-r.html

XBRL Details for Prototypes

All machine-based and human-readable representations of information can be found on the *Continuous Accounting* example[152] that was created to show the connections between accounting, reporting, auditing, and analysis. The *Mastering XBRL-based Digital Financial Reporting*[153] page has additional examples that are helpful. For further details, please see *Mastering XBRL-based Digital Financial Reporting* (book)[154]. Every example provides 100% of the machine readable information necessary to repeat the results which I have obtained. However, those undertaking to repeat these examples need proper software to control the process effectively.

Process Control

In order to be sure a financial report created, or any part of this process really, business professionals need to be able to control this process. The XBRL technical format is controlled 100% by XBRL processors and XBRL formula processors that pass the *XBRL Conformance Suite* published by XBRL International[155]. The business report logic is similarly controlled using the forthcoming OMG *Standard Business Report Model* (SBRM)[156]. The financial report logic is similarly controlled using the *Logical Theory Describing Financial Report*[157]. All of this is combined together into a best practice based, tested, and proven method[158] for implementing an XBRL-based digital financial report.

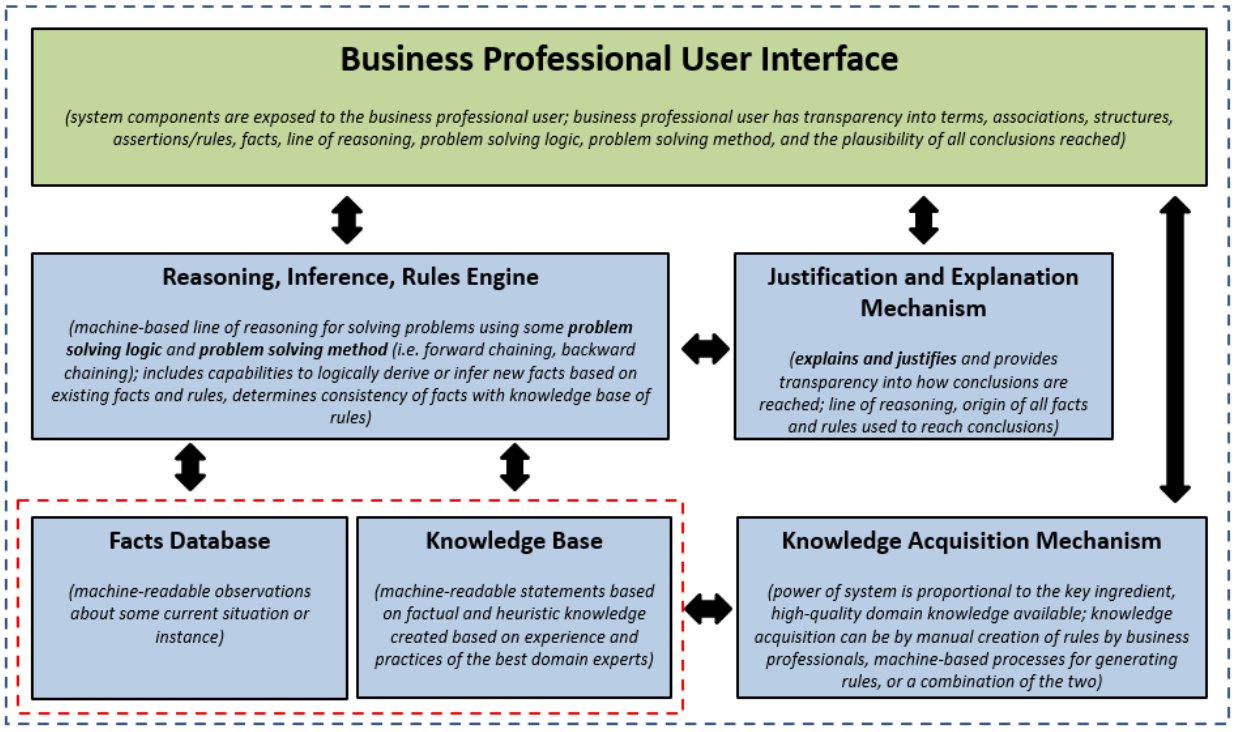
To process an XBRL-based financial report, or any other technical format for that matter, you need a rules engine. The following is a comparison of rules engines[159]:

[152] Continuous Accounting example, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/index.html
[153] Mastering XBRL-based Digital Financial Reporting, http://xbrlsite.azurewebsites.net/2020/master/
[154] Mastering XBRL-based Digital Financial Reporting (book), http://xbrl.squarespace.com/mastering-xbrl/
[155] XBRL International, *XBRL 2.1*, https://specifications.xbrl.org/work-product-index-group-base-spec-base-spec.html
[156] SBRM Progress Report, http://xbrl.squarespace.com/journal/2020/1/30/sbrm-progress-report.html
[157] Charles Hoffman, CPA, *Logical Theory Describing Financial Report*, http://xbrl.squarespace.com/logical-theory-financial-rep/
[158] Charles Hoffman, CPA, Method of Implementing XBRL-based Digital Financial Report Explained in Simple Terms, http://xbrlsite.azurewebsites.net/2020/master/MethodForImplementingXBRLBasedFinancialReportingInSimpleTerms.pdf
[159] Rules Engine Comparison, http://xbrlsite.azurewebsites.net/2020/Library/RulesEngineComparison.jpg

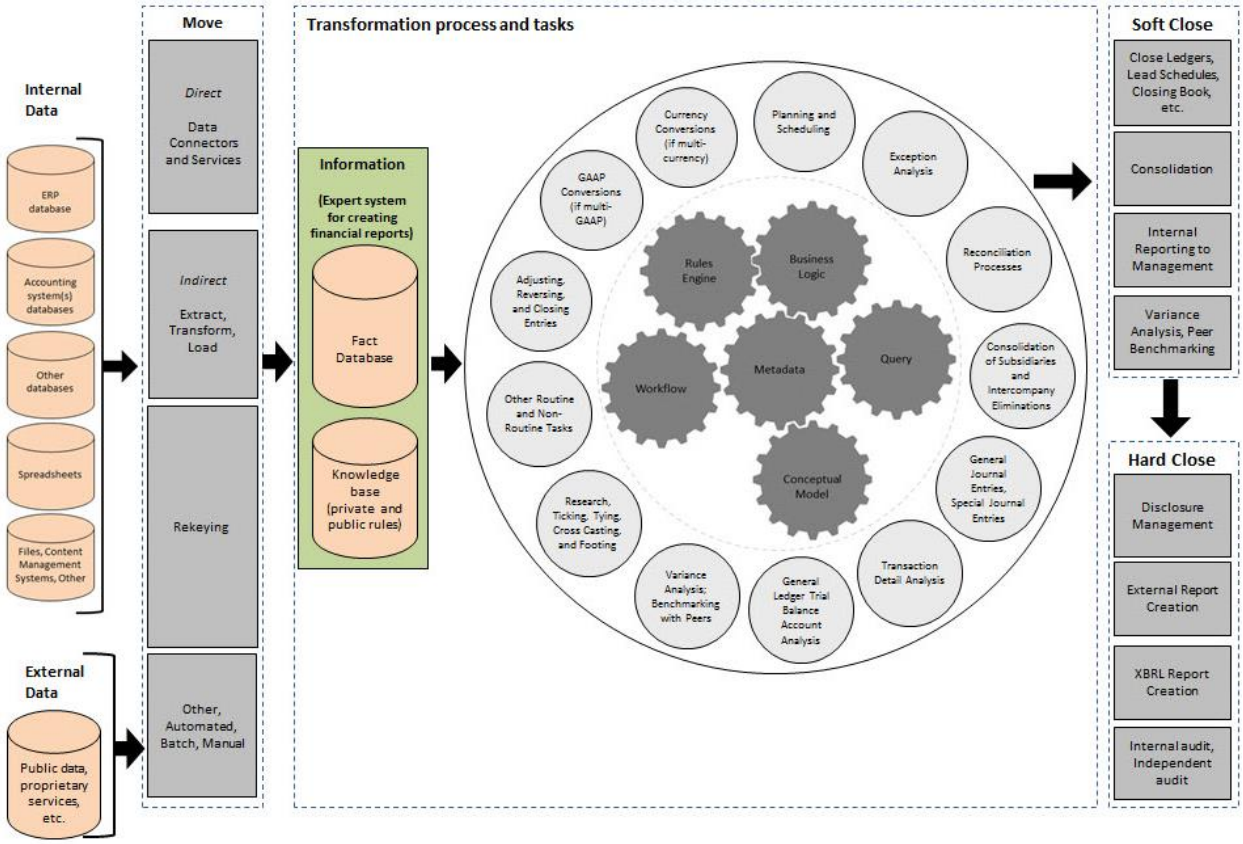
Business Rules Processor	For more information	Approach	Information Syntax/Format	XBRL Processor	XBRL Formula Processor	Supports Inference	Problem Solving Method	Supports Probabilistic Reasoning (Model logic)	State Machine	General Problem Solving Logic Capabilities	Fact Database	Knowledge Base	Rule Creation Interface (XBRL Taxonomy, XBRL Formula, Other)	Understanding of Business Report Conceptual Model	Understanding of Financial Report Conceptual Model	Justification and Explanation Mechanism (Transparency into Line of Reasoning and Information Provenance)	Knowledge Acquisition Mechanisms
Arelle (Open source API level interface)	http://arelle.org/	XBRL	Standard XBRL	Yes	Yes	No	Sequential	No	No	INCOMPLETE, Limited to XBRL Formula	XBRL Instance	XBRL Taxonomy	None provided	No	No	Not provided, can be created	Manual
XBRL Development Tools (Altova)	https://www.altova.com/xbrl-tools	XBRL	Standard XBRL	Yes	Yes	No	Sequential	No	No	INCOMPLETE, Limited to XBRL Formula	RaptorXML+XBRL Server	RaptorXML+XBRL Server	XBRL Specific but oriented to technical users	No	No	Not provided, can be created	Manual
Interstage Xwand (Fujitsu)	http://www.fujitsu.com/global/products/software/middleware/application-	XBRL	Standard XBRL	Yes	Yes	No	Unknown	No	No	INCOMPLETE, Limited to XBRL Formula	XBRL Instance	XBRL Taxonomy	XBRL Specific but oriented to technical users	No	No	Not provided, can be created	Manual
Sphinx (CoreFiling)	https://www.corefiling.com/products/sphinx/	XBRL	Standard XBRL	Yes	Yes	No	Sequential	No	No	INCOMPLETE, Limited to XBRL Formula	XBRL Instance	XBRL Taxonomy	XBRL Specific but oriented to technical users	No	No	Unknown	Manual
Clean Score (XBRL Cloud)	https://www.xbrlcloud.com/cleanscore.html	XBRL-based Business Reporting	Profile based Standard XBRL	Yes	Yes	Yes	Sequential	No	No	GOOD (Subset of RuleLog)	XML Infoset stored in file system	XML Infoset stored in file system	None provided	Yes	Yes	Good, usable by business professionals	Manual
Pesseract Knowledge Based Financial Report Creation System	http://pesseract.azurewebsites.net/	XBRL-based Business Reporting	Profile based Standard XBRL	Yes	No	Yes	Forward chaining	No	Yes	GOOD (Subset of RuleLog)	XML Infoset stored in file system	XML Infoset stored in file system	None provided at present time, will be business user oriented	Yes	Yes	Good, usable by business professionals	Manual
SWI PROLOG	https://www.swi-prolog.org/	Logic Programming	Open source defacto standard	No	No	Yes	Backward chaining (can do forward)	No	No	VERY GOOD (Turing machine; can be limited to DATALOG)	Proprietary or general format	Defacto standard PROLOG format	None provided	No	No	Unknown	Manual
FlexRule Business Logic Platform	http://www.flexrule.com/solution/	Business Rules	Proprietary or general format	No	No	Yes	Forward chaining	No	No	BETTER (Larger subset of RuleLog)	Proprietary or general format	Proprietary or general format	Comprehensive but oriented to technical users	No	No	Unknown	Manual
InRule (InRule Technologies)	http://www.inrule.com/products/inrule/	Business Rules	Proprietary or general format	No	No	Yes	Forward chaining	No	No	BETTER (Larger subset of RuleLog)	Proprietary format	Proprietary format	Oriented toward non-technical users and business professionals	No	No	Unknown	Manual
Smarts (Sparkling Logic)	https://www.sparklinglogic.com/smarts-decision-manager/	Business Rules	Proprietary or general format	No	No	Yes	Forward chaining	No	No	BETTER (Larger subset of RuleLog)	Proprietary or general format	Proprietary or general format	Comprehensive but oriented to technical users	No	No	Unknown	Manual
Fluent Editor (Cognitum)	http://www.cognitum.eu/semantics/FluentEditor/	Semantic Web Stack	Standard RDF, OWL SWRL	No	No	Yes	Forward chaining	No	No	BETTER (Larger subset of RuleLog)	RDF stored in file system	RDF, OWL SWRL stored in file system (Semantic Web	Comprehensive but oriented to technical users	No	No	Unknown	Manual
TopBraid Platform (TopQuadrant)	https://www.topquadrant.com/technology/topbraid-platform-overview/	Semantic Web Stack	Standard RDF, SHACL, RDFS, OWL, SPIN	No	No	Yes	Forward and Backward chaining	Yes	No	BEST (RuleLog plus)	RDF triple store repository	SHACL, RDFS, OWL, SPIN stored in file system (Semantic	Comprehensive but oriented to technical users; rule creation templates usable by business	No	No	Good, usable by business professionals	Manual or Automated
Ergo Logic System (Coherent Knowledge)	http://coherentknowledge.com/financial-domain-application/	Semantic Web Stack	Standard RDF, RIF	No	No	Yes	Forward and Backward chaining	Yes	No	BEST (RuleLog plus)	RDF stored in file system	RDF, OWL, RIF stored in file system (Semantic Web	Comprehensive but oriented to technical users	No	No	Good, electronic audit trail with provenance usable by business	Manual or Automated

Currently, while no one commercial product or working proof of concept can be used to control the entire process of creating a machine-readable financial report; a combination of rule engines could be used effectively.

Ultimately, software applications including the rules engine needs to be wrapped within an easy to use user interface what will enable business professionals such as accountants to effectively and efficiently complete the tasks and processes required to successful achieve their goals. The following graphic summarizes the general functionality necessary:



The following is a high level overview of the general processes and tasks that are involved in the creation of a financial report. Some of these tasks and processes are performed manually, other tasks and processes will be automated, and other tasks will be completed by humans but augmented by machines similar to how a calculator assists humans in their processes and tasks.



These sorts of processes and tasks (workflows) can be documented in machine-readable form[160].

Conclusion

While not all information found in a financial report flows through a double entry accounting system and therefore subject to the mathematical rules; much is.

Distilling Problem Down to Logic and Math

Rather than look at all the different moving pieces of this puzzle as being from different silos; I choose to leverage the best practices, safest practices, and create a solid, powerful, practical, and reliable method[161] that business professionals can effectively understand and leverage by using other proven systems. Business professionals need not understand each individual theory,

[160] Workflow: BPMN, BPM, XPDL, and BPEL, http://xbrl.squarespace.com/journal/2020/1/5/workflow-bpmn-bpm-xpdl-and-bpel.html

[161] Charles Hoffman, CPA, *Method of Implementing XBRL-based Digital Financial Report Explained in Simple Terms*, http://xbrlsite.azurewebsites.net/2020/master/MethodForImplementingXBRLBasedFinancialReportingInSimpleTerms.pdf

only that the theory has been proven. Equilibrium is achieved by weaving the appropriately selected other systems based on the goals and objectives agreed to by the stakeholders of the information exchange mechanism.

A logical system[162] is a type of formal system[163]. To be crystal clear what I am trying to create is a **finite model-based deductive first-order logic system**[164]. "Finite" as opposed to "infinite" because finite systems can be explained by math and logic, infinite systems cannot. "Model-based" is the means to address the necessary variability inherent in the required system. "Deductive", or rule-based, as contrast to inductive which is probability based which is not appropriate for this task. "First-order logic" because first-order logic can be safely implemented within software applications and higher order logics are unsafe. "System" because this is a system.

The point is to create a logical system that has high expressive capabilities but is also a provably safe and reliable system that is free from catastrophic failures and logical paradoxes which cause the system to completely fail to function. To avoid failure, computer science and knowledge engineering best practices seems to have concluded that the following alternatives are preferable:

- **Systems theory**: A system[165] is a cohesive conglomeration of interrelated and interdependent parts that is either natural or man-made. Systems theory explains logical systems.
- **Set theory**: Set theory is foundational to logic and mathematics. Axiomatic (Zermelo–Fraenkel) set theory[166] is preferred to naïve set theory.
- **Graph theory**: Directed acyclic graphs[167] are preferred to less powerful "trees" and graphs which contain cycles that can lead to catastrophic problems caused by those cycles.
- **Logic**: Logic is a formal communications tool. Horn logic[168] is a subset of first-order logic which is immune from logical paradoxes should be used as contrast to more powerful but also more problematic first order logic features. Note that deductive reasoning is leveraged for the process of creating a financial report and not inductive reasoning (i.e. machine learning)
- **Logical theory**: (a.k.a. logical system) There are many approaches to representing "ontology-like things" in machine-readable form, a logical theory being the most powerful. (see the ontology spectrum[169])
- **Model theory**: Model theory is a way to think about flexibility. Safer finite model theory[170] is preferable to general model theory.

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[162] Wikipedia, *Logical Systems*, https://en.wikipedia.org/wiki/Logic#Logical_systems

[163] Wikipedia, *Formal System*, https://en.wikipedia.org/wiki/Formal_system

[164] Wikipedia, *First-order Logic, Deductive System*, https://en.wikipedia.org/wiki/First-order_logic#Deductive_systems

[165] Wikipedia, *Systems Theory*, https://en.wikipedia.org/wiki/Systems_theory

[166] Wikipedia, *Set Theory, Axiomatic Set Theory*, https://en.wikipedia.org/wiki/Set_theory#Axiomatic_set_theory

[167] Wikipedia, *Directed Acyclic Graph*, https://en.wikipedia.org/wiki/Directed_acyclic_graph

[168] Wikipedia, *Horn Logic*, https://en.wikipedia.org/wiki/Horn_clause

[169] *Difference between Taxonomy, Conceptual Model, Logical Theory*, http://xbrl.squarespace.com/journal/2018/12/11/difference-between-taxonomy-conceptual-model-logical-theory.html

[170] Wikipedia, *Finite Model Theory*, https://en.wikipedia.org/wiki/Finite_model_theory

- **World view**: The following are common issues which appear when implementing logical systems in machine-readable form, the safest and most reliable alternatives are:
    - **closed world assumption**[171] which is used by relational databases is preferred to the open world assumption which can have decidability issues;
    - **negation as failure**[172] should be explicitly stated;
    - **unique name assumption**[173] should be explicitly stated;

Business professionals are (a) not capable of having precise discussions of these sorts of issues with software engineers, (b) don't care to have such technical discussions about these sorts of issues with software engineers, (c) are not interested in the theoretical or philosophical or religious debates that commonly exist related to these alternatives, (d) if the alternatives were ***appropriately articulated to a business professional***, who tend to be very practical, they would most often error on the side of safety and reliability. As such, we have made all of the above decisions which are consistent with modern logic programming paradigms such as Prolog, DataLog, and Answer Set Programming[174]. Business professionals can simply use this system if they desire to do so, they don't need to reinvent the wheel.

A logical system or logical theory can be made flexible precisely where they need to be flexible using model theory[175]. Model theory essentially allows for any number of permissible interpretations of the logical theory, referred to as models. There are various forms of model theory including first order model theory[176], finite model theory[177], and the consciously and intentionally very safe finite first order model theory.

It is not important to understand the specific details of model theory, although it is very helpful to have a basic understanding[178]. I am not trying to prove the mathematics or logic of model theory; as I understand it that has already been proven.

What I am trying to do is apply the most powerful but also the safest, most reliable version of system theory, graph theory, model theory, set theory, logic, etc. in order to have the most expressive system possible that is also very safe and well behaved.

I can provide empirical evidence in the form of working representations of what I would call a finite model-based deductive first-order logic system using the global standard XBRL technical syntax language. Several of these examples have also been represented using Prolog; the XBRL and Prolog language representations yielding the same result. Any "knowledge graph" can work.

All the characteristics of the logical system that I point out are "necessary" meaning that they *must exist* within the logical system. What I cannot prove is that the characteristics are

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[171] Wikipedia, *Closed World Assumption*, https://en.wikipedia.org/wiki/Closed-world_assumption

[172] Wikipedia, *Negation as Failure*, https://en.wikipedia.org/wiki/Negation_as_failure

[173] Wikipedia, *Unique Name Assumption*, https://en.wikipedia.org/wiki/Unique_name_assumption

[174] Charles Hoffman, CPA, *Understanding Answer Set Programming*, http://xbrl.squarespace.com/journal/2019/5/10/understanding-answer-set-programming.html

[175] Wikipedia, *Model Theory*, https://en.wikipedia.org/wiki/Model_theory

[176] Stanford University, *First Order Model Theory*, https://plato.stanford.edu/entries/modeltheory-fo/

[177] Wikipedia, Finite Model Theory, https://en.wikipedia.org/wiki/Finite_model_theory

[178] LessWrong, *Very Basic Model Theory*, https://www.lesswrong.com/posts/F6BrJFkqEhh22rFsZ/very-basic-model-theory

"sufficient" to prove that the logical system is provably consistent, precise, and complete. Perhaps a mathematician can provide this proof. But, in my view, the empirical evidence goes a long way towards proving this logical theory. Whether it goes far enough is up to others to determine.

Think Knowledge Graph

A **knowledge graph** is one approach to storing information within a knowledge base. Knowledge graph is more or less an analogy or buzz word dreamed up in 2012 to describe the functionality you get when you use a set of web standards. A knowledge graph has four core building blocks:

- **Resolvable Identity**: a unique web address is assigned to each term in the form of an individual resource identifier (IRI). The IRI becomes the Rosetta stone for identity resolution allowing anyone to link data wherever it resides to one master identifier, eliminating the need to continually map information.
- **Ontologies**: (ontology-like things[179]) data modeling is a communications process to ensure a shared understanding of requirements between business stakeholders and applications developers. The Web standard uses conceptual data models (ontologies) to describe what the information means as well as how terms are connected (associations). These ontologies link the meaning of information to business glossaries that can be directly translated into physical information structures.
- **Triple Expression**: the triple expression method (subject-predicate-object) is similar to classical conceptual modeling approaches. The subject denotes a resource, the predicate denotes traits or aspects of the resource, and expresses a relationship between the subject and the object. As such, information is defined at its most granular level.
- **Business Rules**: Data quality and structural business rules are linked to the ontologies to ensure that meaning is shared. The logic of these rules is captured and expressed as executable models and consistently enforced across all systems and processes.

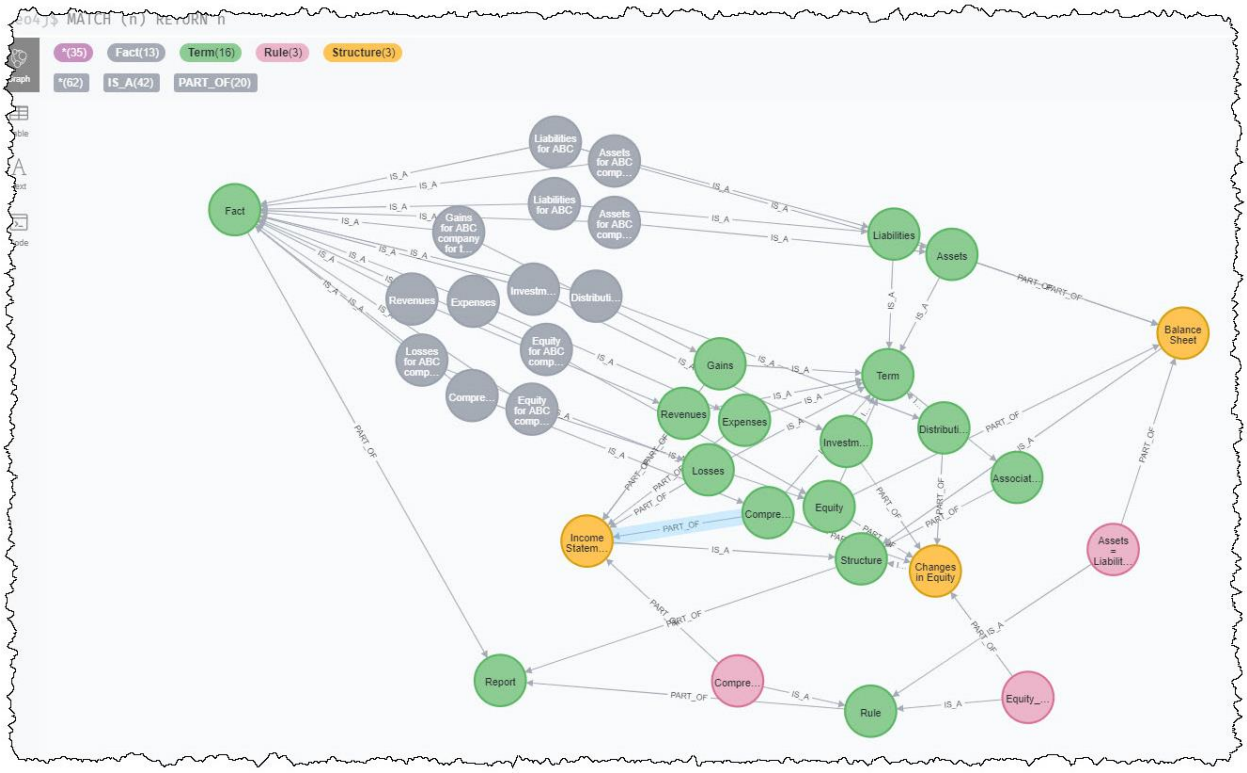
Knowledge graphs is one of many different possible implementation approaches. Imagine a knowledge graph that exists within a digital distributed ledger and can be edited somewhat like a wiki. When creating knowledge graphs, consider best practices[180]!

We showed an example knowledge graph on page 9 which is a simplified example of a simple logical system, the accounting equation. That knowledge graph is fairly easy to read. As the amount of information in the logical system grows, the knowledge graph becomes increasingly challenging for humans to read. For example, below you see a knowledge graph for FASB's SFAC 6, Elements of Financial Statements[181]:

[179] Ontology-like Things for Industry, http://xbrl.squarespace.com/journal/2019/7/13/ontology-like-things-for-industry.html

[180] EKGF.org, *Enterprise Knowledge Graph Foundation Principles*, https://www.ekgf.org/principles

[181] FASB's SFAC 6 Elements of Financial Statements representation, http://xbrlsite.azurewebsites.net/2020/master/sfac6/index.html



The knowledge graph is represented using the Cypher syntax[182]. While humans might find the above representation hard to understand and read, this is exactly the sort of representation computers need. That same knowledge graph could be represented in the following more human readable format[183]:

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

The XBRL Cloud Evidence Package is simply a knowledge graph of information represented in a different form which is a set of human readable HTML pages. But the information in XBRL, in Cypher, in PROLOG, and the HTML version are all the same information.

[182] SFAC 6 Knowledge Graph represented using Cypher syntax, http://xbrlsite.azurewebsites.net/2020/master/sfac6/sfac6_Cypher.txt

[183] XBRL Cloud Evidence Package is a knowledge graph represented in human readable form, http://xbrlsite.azurewebsites.net/2020/master/sfac6/evidence-package/contents/index.html#Rendering-ComprehensiveIncome-sfac6_ComprehensiveIncomeStatementHypercube.html