Understanding Method

(Abridged)

Best practices based method for creating a process control mechanism that consistently yields high-quality XBRL-based financial reports where the model can be "reshaped" or "altered" by report creators

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> "I skate to where the puck is going to be, not where it has been." *Wayne Gretzky*, legendary Canadian hockey star

Executive summary:

- This document explains, at a high level, a proven, reliable, best practice method for implementing XBRL-based financial reporting following the forthcoming OMG Standard Business Report Model (SBRM).
- This method is specifically designed to address issues which come about when the extensibility features of XBRL are employed which allow report creators to "reshape" or "alter" or other such modifications.
- Report creator alterations must be controlled in order to maintain report quality, avoiding potential contradictions and inconsistencies.
- This method has been rebranded as the ***Seattle Method***[1].

[1] Seattle Method, http://xbrlsite.com/seattlemethod/SeattleMethod.pdf

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This document explains at a high level a proven standard method of implementing a standard digital financial report using the XBRL technical syntax leveraging the extensibility features of XBRL which follow the forthcoming OMG *Standard Business Report Model* (SBRM)[2].

The intent of this document is to summarize know-how. This know-how, when documented in the form of a useful method, eliminates the need for others to re-invent the wheel. Rather than re-inventing the wheel; others can simply leverage a well-thought-through, world-class approach that has been designed, created, rigorously tested, and carefully engineered leveraging approaches that have been proven to work effectively results.

These best practice approaches and techniques that have been generally demonstrated as superior to any known alternatives because the techniques produce results that are superior to those achieved by other means or because it has become a standard way of doing things are documented in this resource. It is anticipated that others will likely improve upon this method over time.

This method provides a process control mechanism that, when followed, will consistently yield high-quality XBRL-based digital financial reports. For full details of this method, please see *Method of Implementing a Standard Digital Financial Report Using the XBRL Syntax*[3].

To understand this method, it is critically important to understand certain specific background information, so that is where this document starts. First, we explain what it takes to achieve effective automation. To get started we will provide important understanding about how computers work and a basic grounding in artificial intelligence.

Control + Rules = Effective Automation (High Quality)

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

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

Who creates these machine-readable rules that are used to control processes that yield effective automation? Accountants must create these rules because the rules tend to be accounting oriented. Technical rules tend to relate to syntax and such technical rules can be

[2] OMG, *Standard Business Report Model* (SBRM), https://omgwiki.org/SBRM/doku.php
[3] *Method of Implementing a Standard Digital Financial Report Using the XBRL Syntax*, http://www.xbrlsite.com/2020/Theory/SBRM-Method.pdf

hidden from business professionals. What is left is the business logic and accounting rules that are used to control information and control process workflow. As such, the creation of machine-readable rules must be "self-service". Business professionals must be empowered to create, adjust, maintain, and otherwise manage the rules that are used to control and therefor effectively automate processes. Once you have the machine-readable rules, you need software that can process the rules; this is sometimes called a rules engine or reasoning engine or a semantic reasoner. We will get to that in a bit, but first let's be sure you have some critically important background understanding.

Computer Empathy and AI in a Nutshell

The following is a brief summary of the document *Computer Empathy*[4] which points out that both computers and specific aspects of accounting work per the rules of mathematics.

If accountants can (1) improve their understanding of how computers work and (2) leverage that understanding and represent some of their accounting knowledge in a more formal machine-readable way, this will lead to accountants and technology providers having much more productive conversations and pave the way to computers being able to do some of the accountant's repetitive, mechanical, monotonous manual work.

To understand how to get a computer to do work, it is important to understand the strengths of computers and the obstacles that get in the way which we will highlight now along with a few other important details.

Strengths of Computers

Computers seem to perform magic. How computers do what they do tends to be a mystery to many people. But computers are simple machines that follow very specific instructions; no magic is involved. The strengths of computers can be summarised as follows. Computers can:

- store information
- retrieve information
- process stored information
- make information accessible to individuals or other machines or software

Obstacles – Communication & Understanding

The accounting profession is yet to fully leverage the strengths of computers mainly due to the following general obstacles that tend to get in the way:

[4] *Computer Empathy*, http://xbrlsite.azurewebsites.net/2018/Library/ComputerEmpathy.pdf

- accountants use different terminologies to refer to exactly the same thing
- accountants differ in their understanding and interpretation of accounting standards
- accountants don't understand technologies' limitations
- IT professionals use different technology stacks and languages to achieve the same result
- IT and business professionals have an oversimplified view of accounting

Complexity and Order

Difference systems have different levels of complexity. Systems can also be ordered or disordered. The *Cynefin Framework*[5] is a conceptual framework that helps you understand the dynamics that are at work within different types of systems.

The following graphic helps one understand the different levels of complexity: simple, complicated, complex, and chaotic. The graphic also helps one understand the difference between disorder and order.

[5] Cynefin Framework, http://xbrl.squarespace.com/journal/2021/3/21/cynefin-framework.html

The video *Using Cynefin to Prioritize and Analyze Features, User Stories, and Functional Requirements*[6] provides an excellent walk through of these ideas. Another video, *Complexity, Cynefin, and Agile*[7]; provides additional useful insights related to understanding how to deal with complexity.

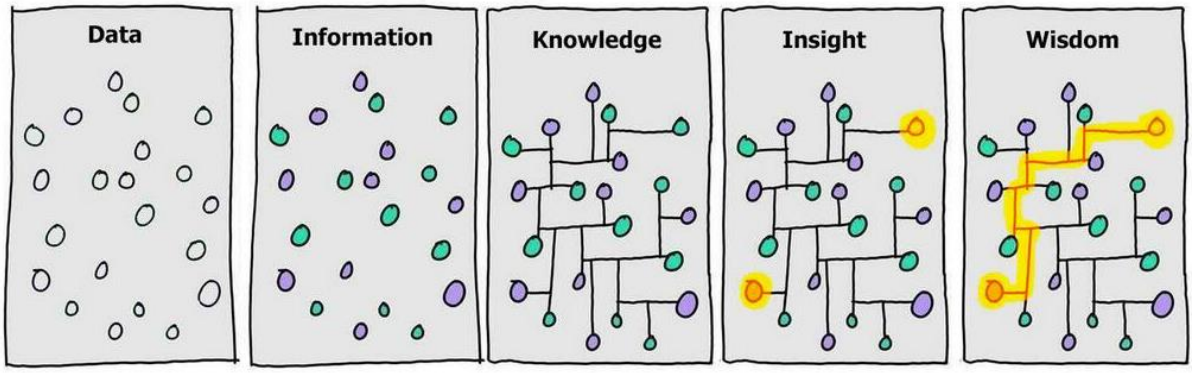
This method leverages "safe to fail" experimentation to understand complexity and to create the necessary control mechanisms necessary to create XBRL-based digital financial reports that are also provably properly functioning logical systems.

Different skill sets are necessary to be able to create simple, complicated, and complex systems that work effectively.

Data vs Information vs Knowledge

We are working with information, not data. The difference between data and information is that data is the raw facts and numbers where information is data in context. This is important to understand as most problems faced by accountants are an information problem, rather than a data problem. Getting data is easy. Knowing what that data represents and how the data fits together is more challenging. Representing information in the form that a machine such as a computer can understand and use that information is difficult and takes a skilled professional.

Knowledge is a set of data and information and a combination of skill, know-how, experience which can be used to improve the capacity to take action or support a decision making process by categorizing, collating, associating the data and information[8].



[6] YouTube.com, *Using Cynefin to Prioritize and Analyze Features, User Stories, and Functional Requirements*, https://www.youtube.com/watch?v=L5fnxahydXM
[7] YouTube.com, *Complexity, Cynefin, and Agile*, https://youtu.be/-F4enP8oBFM
[8] YouTube.com; *Data, Information, Knowledge*; https://youtu.be/3NxN0OgVN2k

Knowing what that data represents and how the data fits together is difficult. Representing information in the form that a machine such as a computer can understand and use that information is difficult.

Standards

Standards can help overcome the obstacles above but won't eliminate them. Good examples of standards that have helped change the world are standard shipping containers, uniform product codes (barcodes), and standard electrical outlets. It is highly unlikely to get everyone to agree so providing options can be a good thing. XBRL is a global standard for business reporting and is an ontology-like thing (explained below) that can represent financial reports digitally. XBRL can be leveraged for automation of accounting, reporting, auditing and analysis processes and tasks. To do that, you use a knowledge based system.

Knowledge Based Systems

The better the capability of a system to represent knowledge, the better the ability for a software application to read and process that knowledge and perform useful work for the user of the system using that machine-readable knowledge.

- A **dictionary** would be a simple flat inventory of terms with no relations.
- A **thesaurus** would document some relations between broader and narrower terms. This is more useful than a simple dictionary.
- A **taxonomy** provides descriptions and a limited amount of structure generally in the form of one information hierarchy. This is more useful than a thesaurus.
- An **ontology** is a model that tends to provide formal descriptions and multiple structures and therefore tends to have more than one hierarchy, e.g. a graph[9].
- A **logical theory** is a set of **models** (ontology like things) that are consistent with the logical theory. A logical theory provides a way of thinking about a domain by means of deductive reasoning to derive logical consequences of the theory.

I have created a logical theory that describes the mechanical aspects and dynamics of a financial report[10]. But to get a knowledge system to work, you have to put knowledge into that system.

[9] Wikipedia, *Graph Theory*, https://en.wikipedia.org/wiki/Graph_theory
[10] *Logical Theory Describing Financial Reports*, http://www.xbrlsite.com/2020/Theory/LogicalTheoryDescribingFinancialReport.pdf

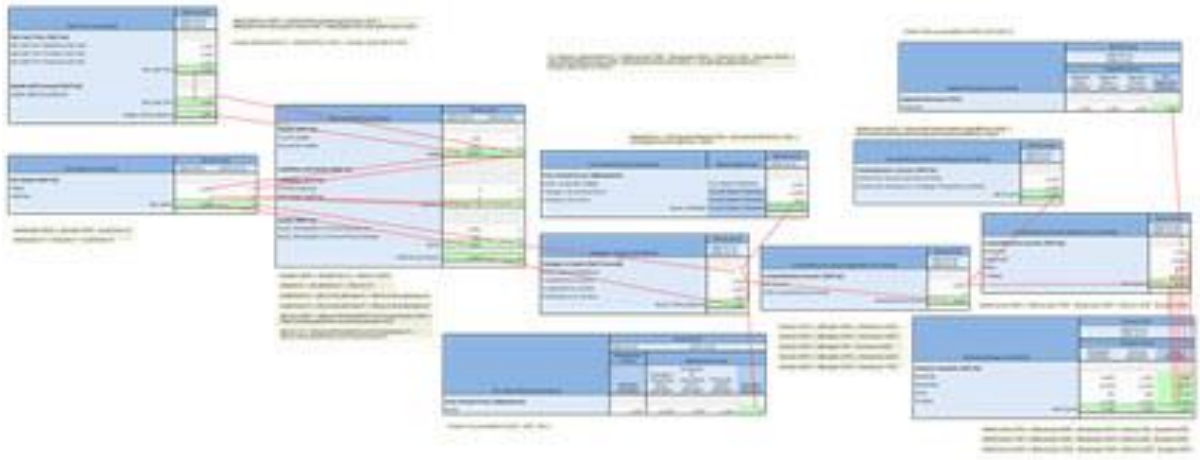
Logical theory

In very simple terms, a logical theory is a set of models that are permissible per that logical theory. Those models are constructed by making logical statements which specify:

- **Terms** (things used by that model)
- **Associations** (relations between things) e.g. "type-subtype" of thing, structure "has-part"
- **Structures** (sets of associations between things)
- **Rules** (assertions that certain things and associations follow specific patterns)
- **Facts** (values that are described by terms, fit into structures, follow specific rules)
- **World view** (e.g. closed world assumption, unique name assumption and negation as failure)

Exchanging Information Effectively

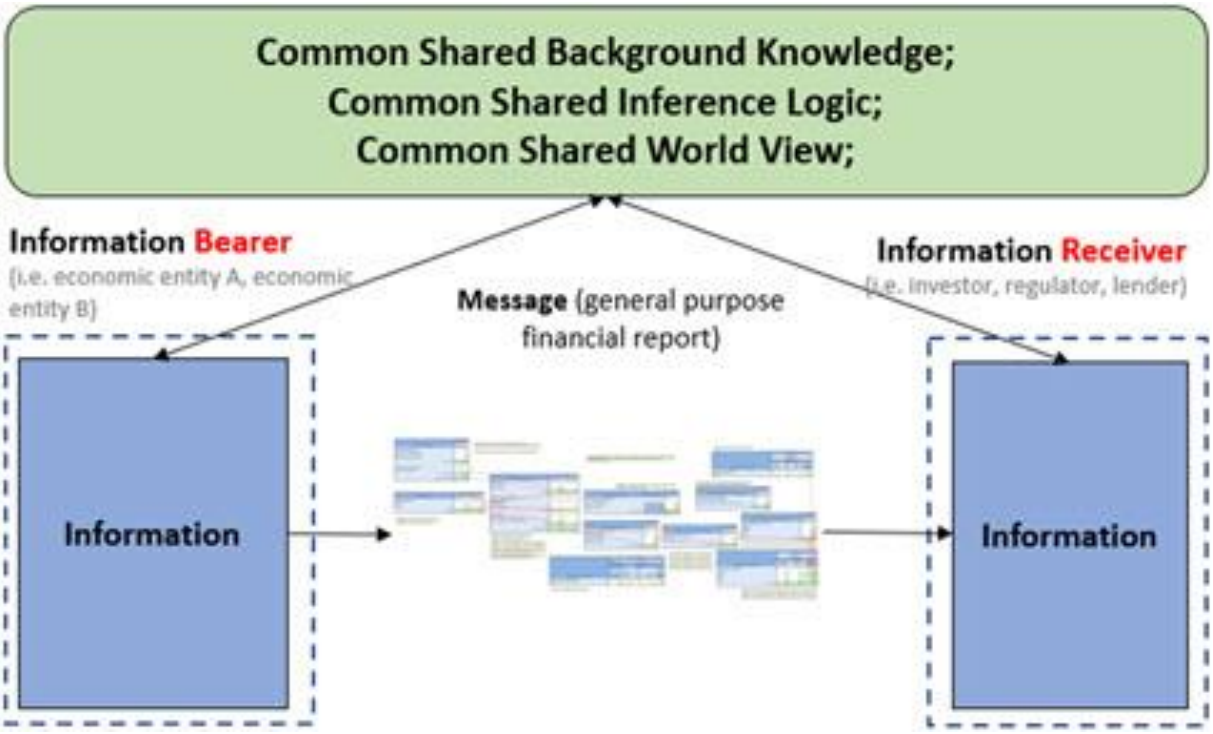
XBRL is a media[11] for exchanging complicated/complex information in either human-readable or machine-readable form. For example, the general purpose financial report is a payload of complex information[12]:



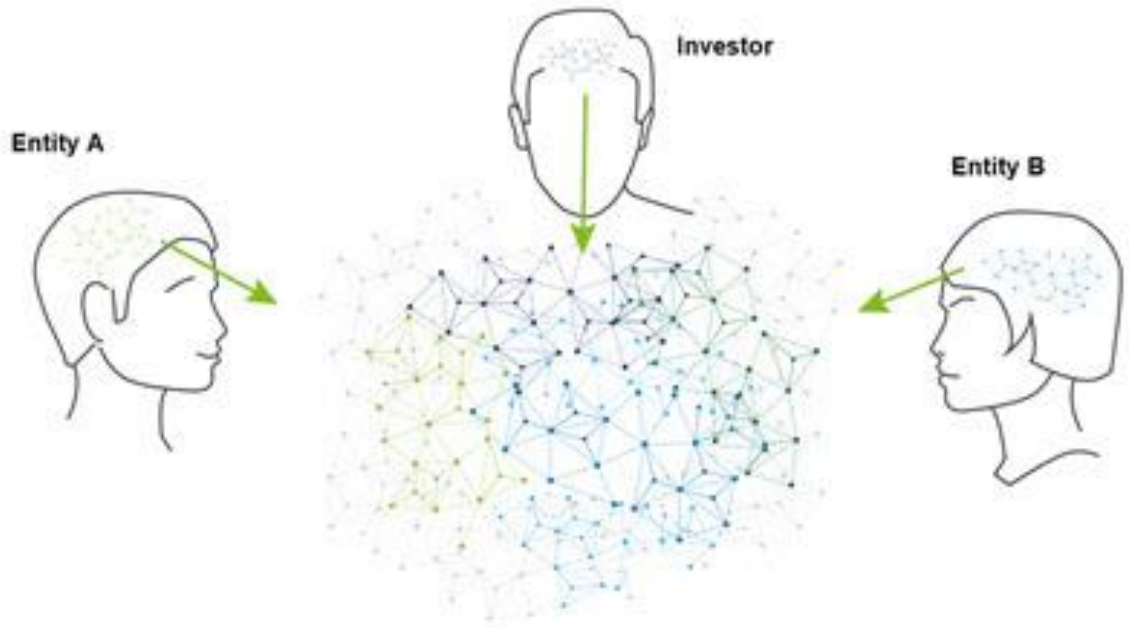
That complex information, such as a general purpose financial report, is the payload in an information exchange:

[11] Understanding the Role of XBRL, http://xbrl.squarespace.com/journal/2021/3/14/understanding-the-role-of-xbrl-brainstorming.html

[12] Financial Report Articulation, http://xbrlsite.azurewebsites.net/2021/reporting-scheme/proof/reference-implementation/PROOF_Articulation.jpg



The diagram above shows a general purpose financial report as a payload that is exchanged between an information bearer and an information receiver. Both the information bearer and receiver share common background knowledge, common inference logic, and a common world view.



This system works because nothing is left to chance. A proven (fail-safe) documented theory, framework, and method document good practices. Clever software

engineers leverage the theory, framework, and method models and metadata to make software easy enough for business professionals to reliably perform the tasks and processes necessary to do their work in new and more efficient ways.

For an information exchange to be useful, the exchange must be reliable. To be reliable, it must be controllable. Rules are used to control the system.

Creating the knowledge to store in the system

There are two general approaches to creating knowledge to store in a knowledge base:

1. **Inductive reasoning**: Let the computer work it out by using AI, machine learning or other approaches. This means, feed the computer a load of data and let it figure out the patterns. (pattern-based, machine learning)
2. **Deductive reasoning**: Tell the computer what the knowledge is. Accountants and auditors are highly trained and have the knowledge in their head. All we need is a way of capturing that knowledge and storing it in an 'ontology' and a knowledge base of rules. (rule-based, expert system)

It is not an either-or question. But option 2 needs to be prioritised because it will provide the foundation for AI and machine learning to build on. Machine learning excels where there is a high tolerance for error. There is an extremely low tolerance for error in financial accounting, reporting, auditing, and analysis.

A knowledge based system draws upon the knowledge of human experts, i.e. accountants and auditors. The more knowledge in the knowledge base, the more the knowledge based system can do. The right information can literally supercharge what can be achieved.

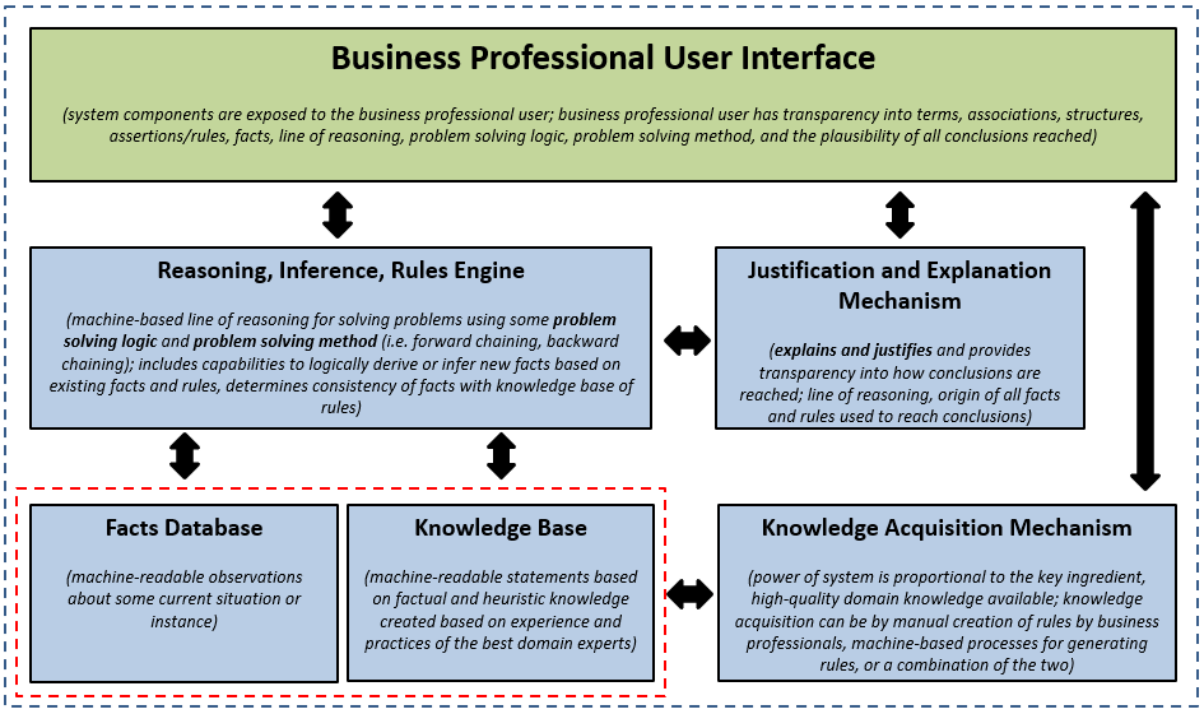
To understand the capabilities of a knowledge based system, it is important to understand the components of such knowledge based systems.

Components of a Knowledge Based System

This information is stored in a fact database and a knowledge base. The system applies problem solving logic using a problem-solving method. The knowledge based system supplies an explanation and justification mechanism to help users understand the line of reasoning used to reach conclusions. The system then presents that information back to the user.

Nothing is a "black box". The origin of information used to reach conclusions is always apparent.

The following is a summary of the components of a knowledge based system. Each of the components shown in the graphic will be described and examples provided in the following sections.

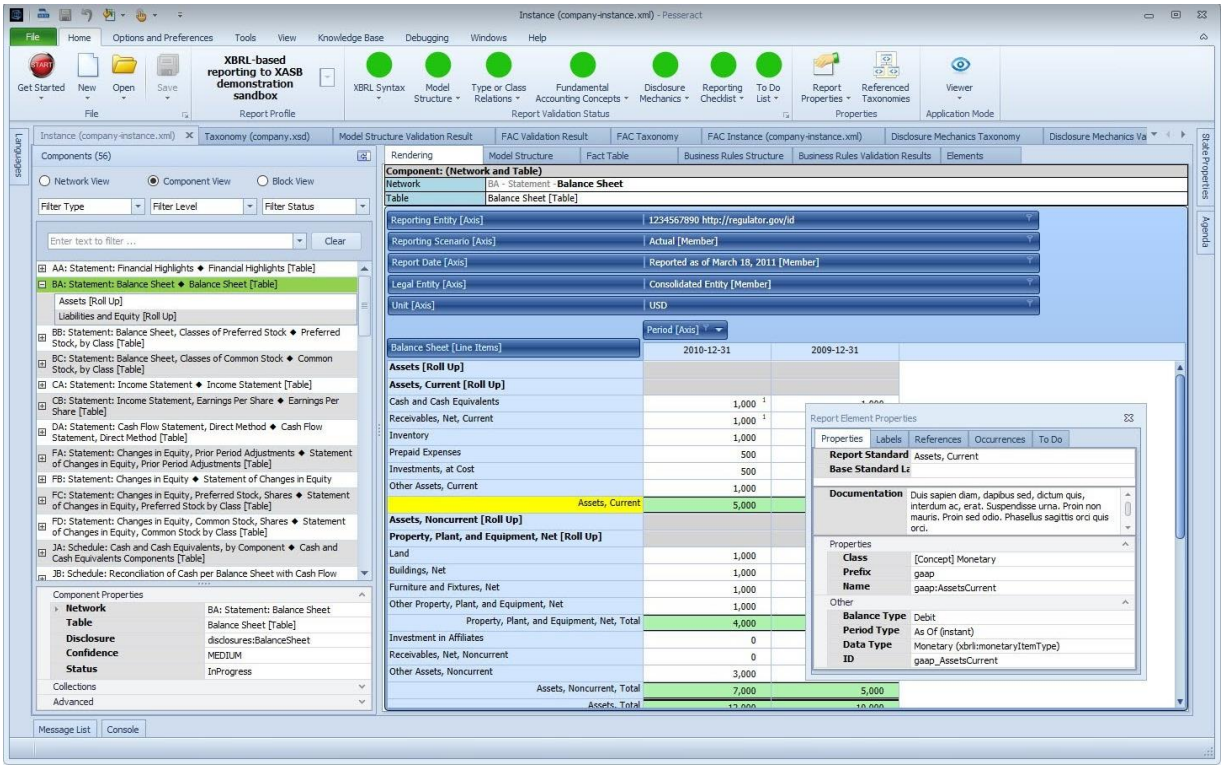


Business Professional User Interface

The business professional user interface are the components that are exposed to the business professional using the system. Business professionals need transparency as to the terms, associations, structures, rules, facts, line of reasoning, problem solving logic, problem solving method, and the plausibility of all conclusions reached by the system.

The following is one of a number of screen shots[13] of the working proof of concept software application Pesseract which provides an example of a user interface with which a business professional could likely interact:

[13] Additional Pesseract User Interface Screenshots, https://photos.app.goo.gl/cWeZYaMBEbmSSm7v8



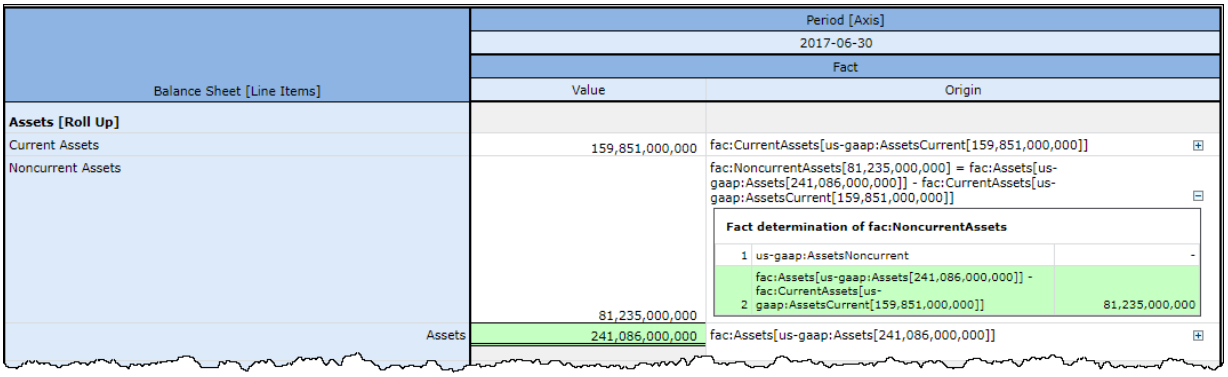
The user interface is non-technical requiring only business and accounting knowledge to effectively understand the software application and how to use it.

Justification and Explanation Mechanism

The justification and explanation mechanisms of the software application explains and justifies and provides transparency into how conclusions are reached by the software application. The rules used, facts used, line of reasoning, and origin of all facts are knowable to the business user of the software. There is transparency into all conclusions that are reached by the software application. Nothing is a black box.

Below you see the fundamental accounting concept relations continuity cross check verification checks provided by XBRL Cloud's Evidence Package[14] which is a review tool that can be used to verify XBRL-based financial reports:

[14] XBRL Cloud Evidence Package, http://xbrlsite.azurewebsites.net/2017/Prototypes/Microsoft2017/evidence-package/USFACRenderingSummary.html



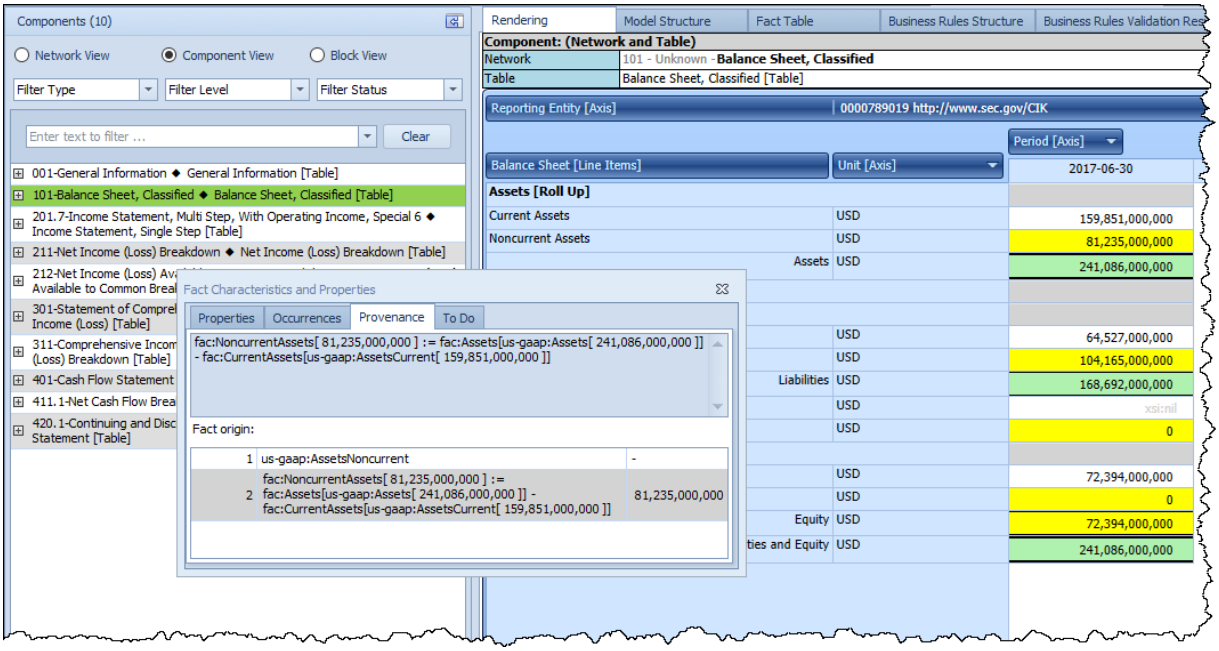
Balance Sheet [Line Items]	Period [Axis] 2017-06-30 Fact Value	Origin
Assets [Roll Up]		
Current Assets	159,851,000,000	fac:CurrentAssets[us-gaap:AssetsCurrent[159,851,000,000]]
Noncurrent Assets	81,235,000,000	fac:NoncurrentAssets[81,235,000,000] = fac:Assets[us-gaap:Assets[241,086,000,000]] - fac:CurrentAssets[us-gaap:AssetsCurrent[159,851,000,000]]
Assets	241,086,000,000	fac:Assets[us-gaap:Assets[241,086,000,000]]

Fact determination of fac:NoncurrentAssets

1	us-gaap:AssetsNoncurrent	-
2	fac:Assets[us-gaap:Assets[241,086,000,000]] - fac:CurrentAssets[us-gaap:AssetsCurrent[159,851,000,000]]	81,235,000,000

If you look at the fundamental accounting concept relations continuity cross check verification results you see that the business user can trace each fact two it's origin, understand all rules used by the software to reach conclusions, etc.

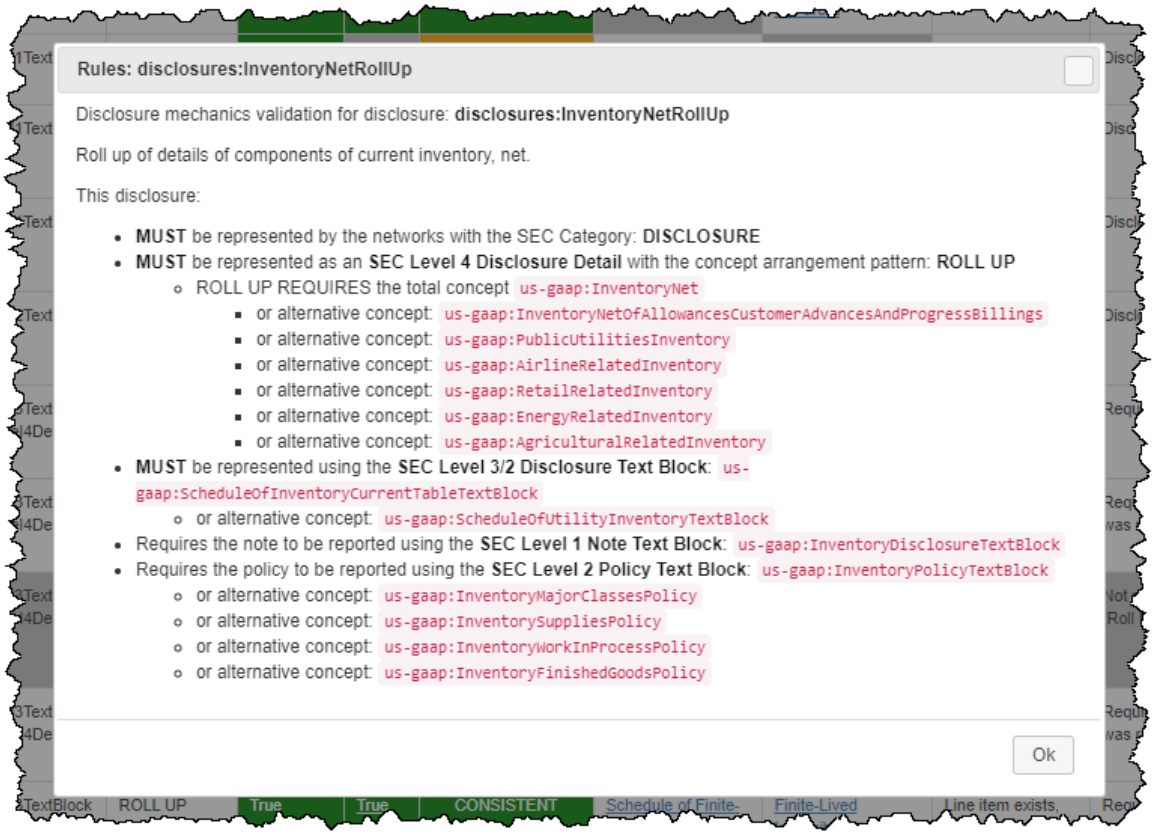
Pesseract provides similar functionality:



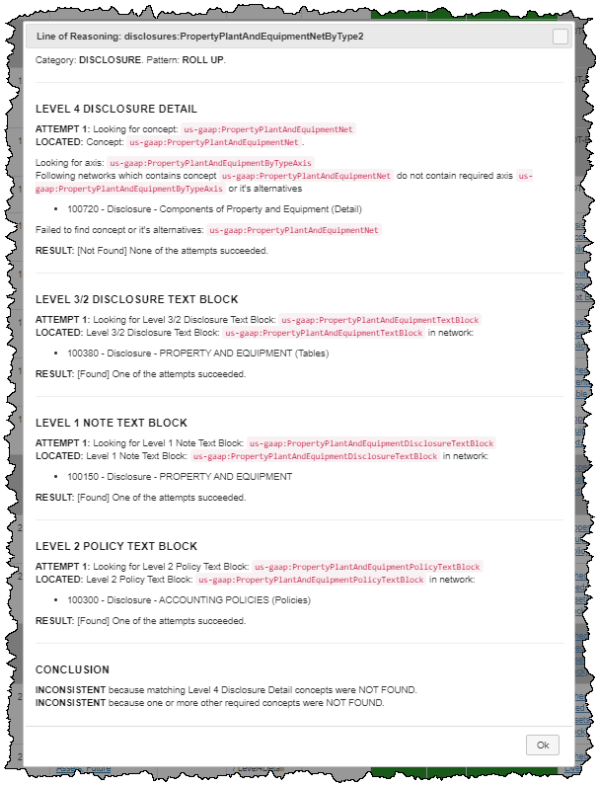
XBRL Cloud's Disclosure Mechanics and Reporting Checklist[15] provides the rules used, line of reasoning used, and conclusions reached for determining if a disclosure is structured consistent with its expected specification:

Disclosure mechanics rules:

[15] XBRL Cloud Disclosure Mechanics and Reporting Checklist, http://xbrlsite.azurewebsites.net/2017/Prototypes/Microsoft2017/Disclosure%20Mechanics%20and%20Reporting%20Checklist.html



Line of reasoning:

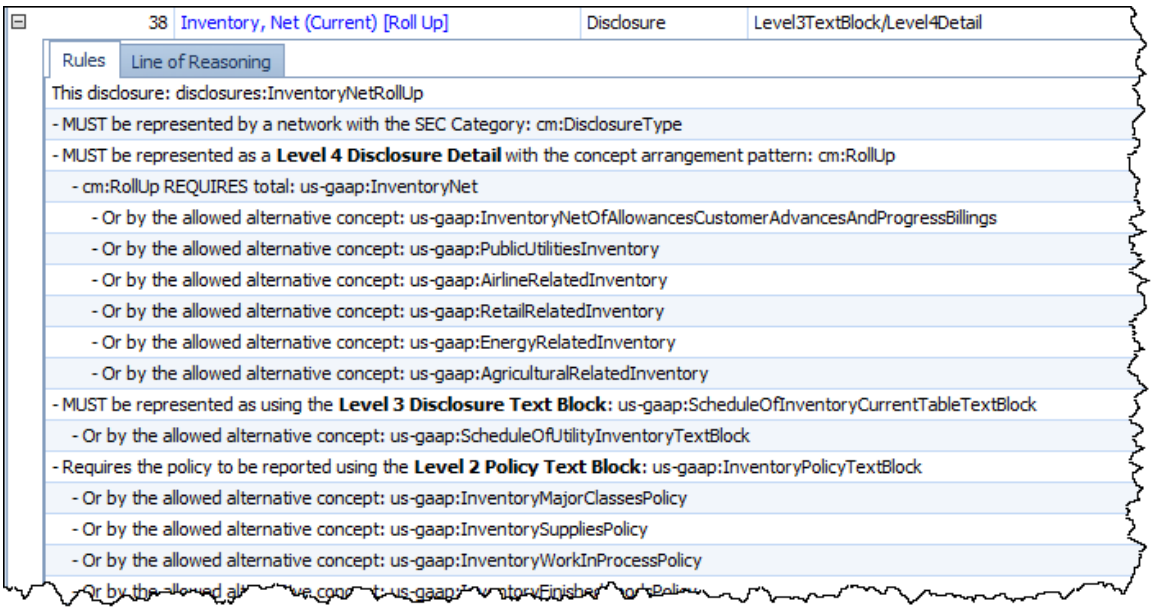


Conclusions reached:

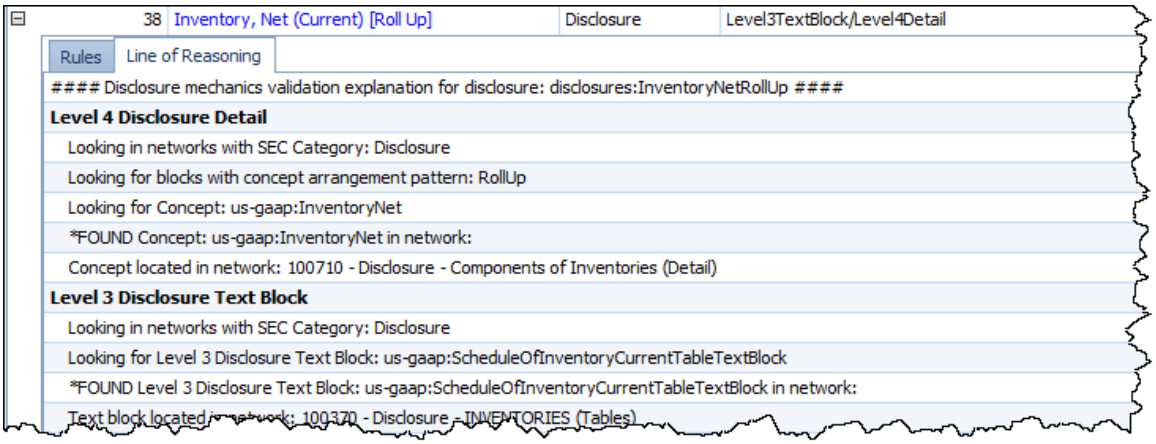
#	Disclosure	Category	Level	Pattern	Applicable	Found	Disclosure Consistent	Representation Concept [TEXT BLOCK]	Representation Concept [DETAIL]	Checklist Category	Reason
1	Document Information [Hierarchy]	DOCUMENT	Level4Detail	HIERARCHY	True	True	CONSISTENT	NOT-EXPECTED	Document Fiscal Period Focus	Required disclosure	Disclosure always required
2	Document and Entity Information [Hierarchy]	DOCUMENT	Level4Detail	HIERARCHY	False	True	CONSISTENT	NOT-EXPECTED	Entity Registrant Name	Alternative representation	Not necessary, satisfied by Document Information [Hierarchy] disclosure
3	Entity Information, by Legal Entity [Hierarchy]	DOCUMENT	Level4Detail	HIERARCHY	True	True	CONSISTENT	NOT-EXPECTED	Entity Registrant Name	Required disclosure	Disclosure always required
4	Document and Entity Information [Hierarchy]	DOCUMENT	Level4Detail	HIERARCHY	False	True	CONSISTENT	NOT-EXPECTED	Entity Registrant Name	Alternative representation	Not necessary, satisfied by Entity Information, by Legal Entity [Hierarchy] disclosure
5	Balance Sheet	STATEMENT	Level4Detail	COMPONENT	True	True	CONSISTENT	NOT-EXPECTED	NOT-EXPECTED	Required disclosure	Disclosure always required, satisfied by Assets [Roll Up] and Liabilities and Equity [Roll Up]
6	Assets [Roll Up]	STATEMENT	Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Assets	Part of disclosure	Disclosure always required
7	Liabilities and Equity [Roll Up]	STATEMENT	Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Liabilities and Equity	Part of disclosure	Disclosure always required
8	Income Statement, by Legal Entity [Roll Up]	STATEMENT	Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Net Income (Loss) Attributable to Parent	Required disclosure	Disclosure always required
9	Statement of Income and Comprehensive Income [Roll Up]	DISCLOSURE	Level4Detail	ROLL UP	False	True	CONSISTENT	NOT-EXPECTED	Net Income (Loss) Attributable to Parent	Alternative representation	Not necessary, satisfied by Income Statement, by Legal Entity [Roll Up] disclosure
10	Statement of Comprehensive Income [Roll Up]	STATEMENT	Level4Detail	ROLL UP	True	True	CONSISTENT	NOT-EXPECTED	Comprehensive Income (Loss), Net of Tax, Attributable to Parent	Required disclosure	Disclosure always required
	[illegible]	DISCLOSURE	Level4Detail	ROLL UP	False	True	CONSISTENT	NOT-EXPECTED	[illegible]	Alternative representation	Not necessary, satisfied by [illegible] [Roll Up] disclosure

Similar functionality is offered by Pesseract:

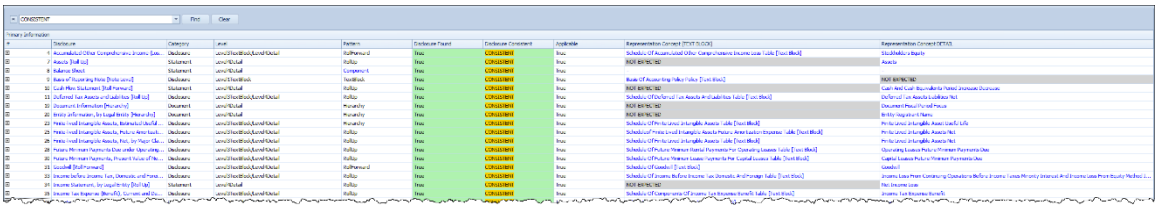
Disclosure mechanics rules:



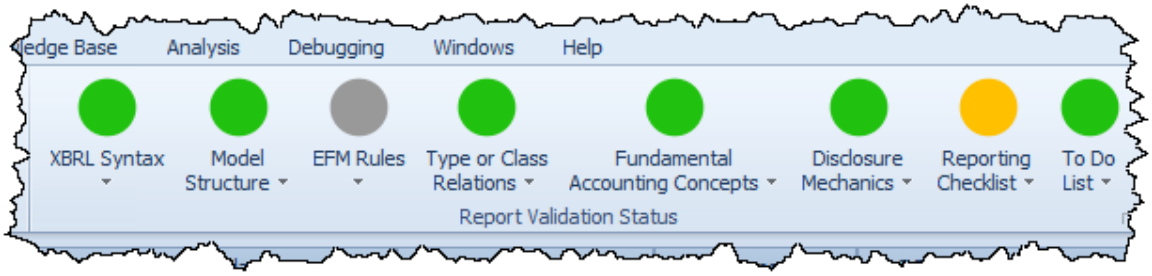
Line of reasoning:



Conclusions reached[16]:



Similar mechanisms exist for all other categories of rules verified using the method that has been created which leverages OMG's Standard Business Report Model (SBRM)[17]:



Reasoning, Inference, Rules Engine

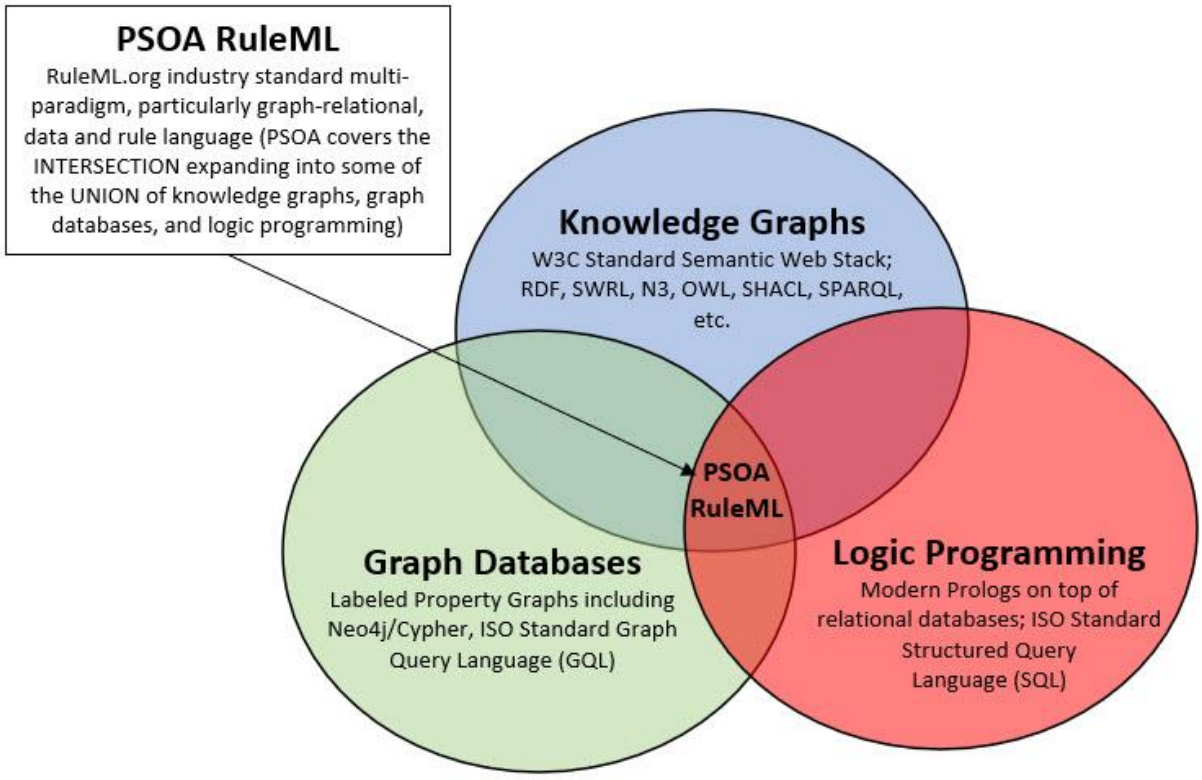
The reasoning, inference, and rules engine use the machine-based rules, a line of reasoning for solving problems using some problem solving logic and problem solving method (i.e. forward chaining, backward chaining) to reach conclusions about facts and all other statements made within the logical system. This includes capabilities to logically derive or infer new facts or other information based on existing facts and rules. It also includes the capability to determine consistency of facts with the systems knowledge base of rules.

[16] Pesseract disclosure mechanics verification of 94.8% of all 124 disclosures verified, http://xbrlsite.azurewebsites.net/2020/Prototype/Microsoft/Microsoft2017_Discovery.jpg
[17] SBRM Progress Report, http://xbrl.squarespace.com/journal/2020/1/30/sbrm-progress-report.html

As described by RuleML.org, there tends to be three primary problem solving paradigms which are used to build a rules engine[18]:

1. **Knowledge Graphs** (i.e. the W3C semantic web stack; RDF, N3, OWL, SHACL, SPARQL, RDF triple stores)
2. **Graph Databases** (i.e. Neo4j and other labeled property graphs, Graph Query Language or GQL, graph databases)
3. **Logic Programming** (i.e. Prolog, SQL, relational databases)

It is unlikely that every enterprise will use the same approach. This graphic shows how these different problem-solving paradigms relate to one another and the intersection or "sweet spot" between these paradigms[19]:

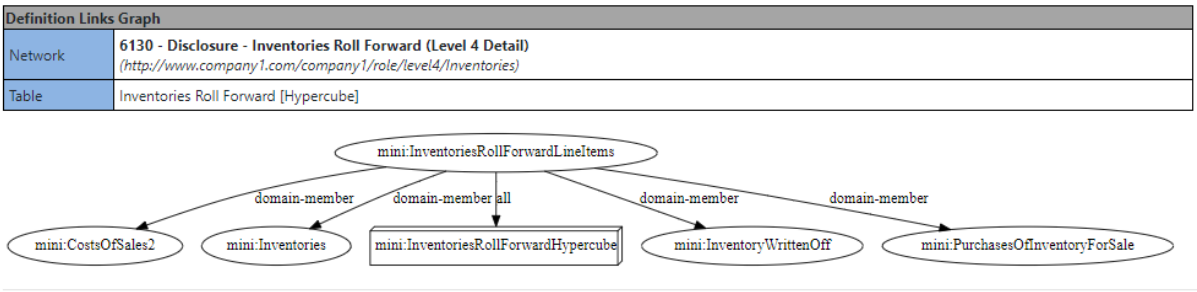


XBRL-based financial reports are consciously architected such that they fit into the PSOA "sweet spot" which means that an XBRL-based financial report can be bidirectionally converted between all three of these primary problem solving paradigms.

[18] Primary Problem Solving Logic Paradigms, http://xbrl.squarespace.com/journal/2020/9/15/primary-problem-solving-logic-paradigms.html

[19] Primary Problem Solving Logic Paradigms, http://xbrl.squarespace.com/journal/2020/9/15/primary-problem-solving-logic-paradigms.html

The following is a graphic which shows the structure of a disclosure within a model of a financial report provided by Pacioli[20]:



Fact Database

The fact database is essentially equivalent to the facts that are reported within an XBRL instance. The separation of the facts reported from the knowledge base of rules that support those reported facts is somewhat arbitrary.

There are many approaches to storing facts within a database[21]. Each approach has a set of PROS and CONS; no approach is 100% the best or 100% the worst. What appear to be the most viable information storage alternatives include:

- **SQL database**: These are the most pervasive and the most popular today.
- **RDF triple store**: These are popular for working with the W3C Semantic Web Stack. These are sometimes implemented within a SQL database.
- **Graph database**: Graph databases such as Neo4j[22] are increasing in popularity, standard query languages are being developed like Cypher[23].
- **NOSQL databases**: NOSQL databases such as MondoDB are increasing in popularity because they require no schema which can be a feature or a bug depending upon whether you desire a database schema.
- **DATOMIC**: Datomic[24] is a fact database or cell store[25] that has a built in DATALOG rules engine.

[20] Mini Financial Reporting Scheme, Report Analysis, Pacioli, http://xbrlsite.azurewebsites.net/2020/master/mini/reference-implementation/ReportAnalysis.html
[21] Understanding Database/Query Options (Part 2), http://xbrl.squarespace.com/journal/2014/4/27/understanding-databasequery-options-part-2.html
[22] Neo4j, http://xbrl.squarespace.com/journal/2020/7/7/neo4j.html
[23] Cypher, https://www.opencypher.org/
[24] Datomic Cloud, https://www.datomic.com/
[25] Ghislain Fourny, PhD, *Cell Stores*, https://arxiv.org/pdf/1410.0600.pdf

- **Cell store**: Reportix[26] is an example of a cell store that is specific to XBRL-based information.

What is the right database alternative to use? That is a decision that should be made by qualified technical professionals.

Knowledge Base

The knowledge base is essentially equivalent to the information that supports reported facts that is represented within XBRL taxonomy schemas, XBRL linkbases, and other information provided in the form of XBRL Formulas. The knowledge base is essentially machine-readable statements based on factual and heuristic knowledge created based on experience and practices of the best domain experts.

The following are example/prototype knowledge bases for several financial reporting schemes:

- US GAAP[27]
- IFRS[28]
- IPSAS[29]
- FRF for SMEs[30]
- US GAAP Not-for-Profit[31]

Other testing, prototype, and other such XBRL-based financial reporting schemes were represented in order to collect information which could yield information useful to create on framework for representing all financial reporting schemes. That information is summarized in *Mastering XBRL-based Digital Financial Reporting*[32].

What I call the PROOF BASELINE[33] representation takes everything that is common between all other prototype financial reporting schemes and distills it down into the simplest yet complete representation possible. This Proof Baseline representation is used to explain and test.

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[26] Reportix, https://www.reportix.com/products_cellstore.php
[27] US GAAP financial reporting scheme, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/us-gaap/documentation/Index.html
[28] IFRS financial reporting scheme, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/ifrs/documentation/Index.html
[29] IPSAS financial reporting scheme (prototype), http://xbrlsite.azurewebsites.net/2020/reporting-scheme/ipsas/documentation/Index.html
[30] FRF for SMEs financial reporting scheme, http://xbrlsite.azurewebsites.net/2016/conceptual-model/reporting-scheme/frf-sme/documentation/Index.html
[31] US GAAP Not-for-Profit financial reporting scheme, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/nfp/documentation/Index.html
[32] *Mastering XBRL-based Digital Financial Reporting*, http://xbrlsite.azurewebsites.net/2020/master/
[33] Proof Baseline, http://xbrlsite.azurewebsites.net/2021/reporting-scheme/proof/documentation/Index.html

In essence, it is possible to represent any financial reporting scheme[34] using the notion of profiles[35] to adjust for any minor differences between how each financial reporting scheme chooses to implement XBRL-based digital financial reporting.

But how do you get the knowledge that ends up in a knowledge base? You need some sort of mechanism for acquiring knowledge.

Knowledge Acquisition Mechanism

The power of any knowledge based system is proportional to the key ingredient of the knowledge based system which is high-quality machine-readable domain knowledge available to that system. Knowledge acquisition is the process of obtaining that domain knowledge.

There are three approaches to acquiring knowledge:

1. A **rules-based approach** which involves humans creating machine-readable knowledge.
2. A **patterns-based approach** which involves machine learning to capture domain knowledge which is useful when there is a high tolerance for error. Further, extensive machine-readable training data is necessary to use this machine-learning based approach.
3. A **combination of approaches** #1 and #2 to create a hybrid approach to acquiring knowledge.

For the domain of financial reporting, there is ZERO probability that approach #2 (i.e. machine learning) can be used to acquire the initial financial reporting domain knowledge.

However, after some unknown period of time when enough machine-readable information has been created by human domain experts; then that human created machine-readable information can be leveraged to create additional new information.

For example, information about disclosures[36] can be used to learn how to create algorithms for identifying other such disclosures simply by probing existing XBRL-based financial reports submitted to financial regulators such as the SEC and ESMA. That machine-readable information along with humans to guide and tweak the process can be used to identify rules for other unknown disclosures by looking for specific known patterns.

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[34] *Comparison of Financial Reporting Schemes High Level Concepts*, http://xbrlsite.azurewebsites.net/2018/Library/ReportingSchemes-2018-12-30.pdf

[35] *XBRL-based Digital Financial Reporting Profiles and General Business Reporting Profile*, http://xbrlsite.azurewebsites.net/2018/Library/Profiles-2018-10-22.pdf

[36] Disclosure Best Practices, http://xbrlsite-app.azurewebsites.net/DisclosureBestPractices/DisclosureBestPractices.aspx?DisclosureName=IncomeStatement

We don't want every enterprise or regulator creating proprietary approaches to creating knowledge based systems for storing and working with financial reports. A better approach for everyone is to have high-quality global standard models which makes creating software more efficient and therefore less costly.

It takes skill and experience of a domain to create knowledge for a domain. Business professionals have that skill and experience and will need software which they can realistically use to put, collate, categorize, associate, and otherwise create useful machine-readable knowledge.

Understanding the SBRM Meta-Meta Model

A meta-model is a model whose purpose is to describe and process models that subscribe to that meta-model. Models and meta-models both prescribe and describe what is permissible and what is not permissible per some model or meta-model.

Utility of Method

One reason for this is to be sure each model is consistent with the specification provided by the meta-model. The following is a summary of the utility of this method:

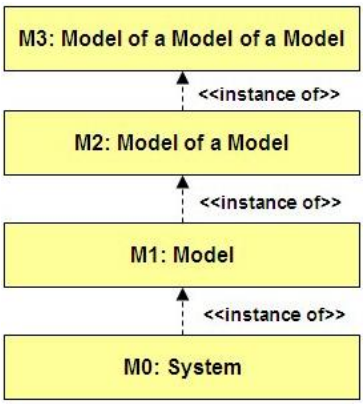
- Clear scope and purpose providing a framework and theory for thinking about financial reports[37].
- Semantic rigor. The model of a business report and financial report is thorough.
- Formally documented and unambiguous specification; XBRL for syntax and SBRM for semantics.
- Open, freely available, global standard XBRL and SBRM.
- Verified and tested leaving no stone unturned, no question unanswered, or argument about how the framework and theory work[38].

No Need to Reinvent the Wheel

Standard meta-models are critically important so individual implementations don't have to reinvent the wheel. Object Management Group (OMG) publishes something called the **Meta Object Facility** (MOF)[39]. Basically, the MOF explains the distinction between an "Object", a "Model", a "Meta Model", and a "Meta-meta Model". These ideas are commonly confused, are not generally understood by business professionals, often not even understood by technical

[37] Charles Hoffman, CPA, *Logical Theory Describing Financial Report*, http://xbrl.squarespace.com/logical-theory-financial-rep/
[38] *Mastering XBRL-based Digital Financial Reporting*, http://xbrlsite.azurewebsites.net/2020/master/
[39] Wikipedia, *Meta Object Facility*, https://en.wikipedia.org/wiki/Meta-Object_Facility

people, but are **CRITICALLY IMPORTANT to getting business professionals what they really want/need**. A model is essentially a pattern in a system.



What we don't need is every individual regulator, standards setter, and/or enterprise creating their own "meta model" when one common meta model will do. What we need is for, say, ESMA and the SEC and other regulators and others to **use the SAME META-META MODEL** where possible. If they could, why would they not?

SBRM

Generally, the answer to that question is ignorance as to the benefits of a common meta-meta model. All this is why OMG is so interested in what I have done with my framework and method and why OMG quickly understood it and created the ***Standard Business Report Model*** (SBRM)[40] which is a syntax independent logical conceptualization of a business report.

OMG calls SBRM a "model" but it is actually a "meta-meta model" in my view. An economic entity defines objects, puts the objects into a model, which needs to conform to some regulator model (meta model) so that the regulator can collect models from many, many economic entities and be able to compare each different economic entity's information. All regulator models could fit into one common meta-meta model, SBRM. Whether a regulator chooses to take this approach is up to the regulator.

XBRL

XBRL provides the technical syntax format which physically transports the information, US GAAP or IFRS or other financial reporting scheme provides the meaning, that meaning is represented using the XBRL syntax, SBRM provides the one common report model that all reporting economic entities use.

The relationships go like this:

[40] OMG, Standard Business Report Model (SBRM), https://www.omg.org/intro/SBRM.pdf

1. An economic entity creates a report, they put their "Objects" into the report which forms the report "Model" for that economic entity.
2. The economic entity can create their own "Objects" (extension Objects) and associate them with some "Model" financial reporting scheme such as the US GAAP or IFRS taxonomies (base Objects).
3. Every economic entity creating their report "Model" must fit into some "Meta model", today ESMA and the SEC have very similar "Meta Models", but they are slightly different (unnecessarily).
4. Rather than each regulator and/or economic entity or others creating their own "Meta model"; I have created a "Meta Model" that anyone can simply pick up and use which (a) is consistent with both ESMA and the SEC (b) adds more information to make sure the reports are properly functioning (consistent, complete, precise), and (c) adds information that is specific to financial reporting.
5. My "Meta-Model" fits into the OMG Standard Business Report Model (SBRM) which is a "Meta-meta Model" for BUSINESS reporting. A financial report is a specialization of the more general business report.

So, XBRL has a "business report meta-meta-model". It is just that XBRL International does not explain that model well enough. The *Open Information Model 1.0*[41] is an attempt to define a business report meta-meta model. Further, I expanded the SBRM adding additional metadata related specifically to financial reporting using the *Logical Theory Describing Financial Report*[42].

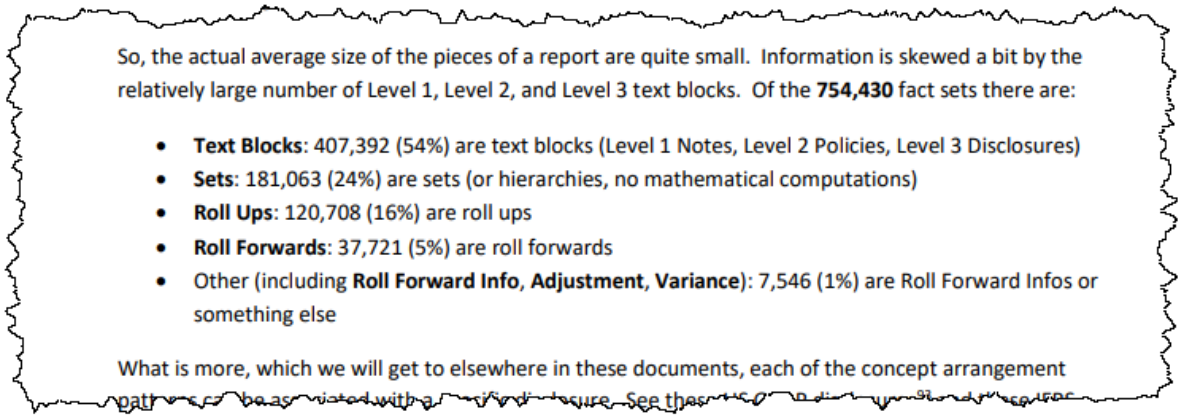
Endeavoring to create this method and model lead to learning much about XBRL-based reports. This information is summarized in *Essentials of XBRL-based Digital Financial Reporting*[43]. This information helps you understand the details of how to use XBRL effectively to create XBRL-based financial reports. If you are not familiar with accounting, *Essence of Accounting*[44] helps you understand this area of knowledge.

Testing

And so, every XBRL-based financial report submitted to the SEC using US GAAP or IFRS, the ESMA field tests[45], and all my prototypes[46] fit into my one common meta-meta-model. How do I know this? Because I loaded 100% of US GAAP and IFRS XBRL-based reports, ESMA field tests,

[41] XBRL International, *Open Information Model 1.0*, https://specifications.xbrl.org/work-product-index-open-information-model-open-information-model.html
[42] *Logical Theory Describing Financial Report*, http://xbrl.squarespace.com/logical-theory-financial-rep/
[43] *Essentials of XBRL-based Digital Financial Reporting*, http://xbrlsite.azurewebsites.net/2021/essentials/EssentialsOfXBRLBasedDigitalFinancialReporting.pdf
[44] *Essence of Accounting*, http://xbrlsite.azurewebsites.net/2020/Library/EssenceOfAccounting.pdf
[45] ESMA Field Tests, http://xbrl.squarespace.com/journal/2018/7/10/esma-field-test-information-great-information-for-testing.html
[46] *Mastering XBRL-based Digital Financial Reporting*, http://xbrlsite.azurewebsites.net/2020/master/

and all my prototypes into my model[47] to be certain that my model was correct. Here are the results from one of those tests:



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 figure. See the

This model was further proven by loading reports into various implementations of the model which includes:

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

Finally, multiple prototypes were created to step someone through very basic and simple examples through increasingly complex examples and ultimately reconciling all information to actual XBRL-based financial reports submitted to the SEC[48].

I then distilled all the important distinct patterns of an XBRL-based financial report into one implementation which I created and call my PROOF representation which includes every aspect of my model (i.e. the SBRM model)[49]. Finally, I took my base proof semantics and represented the proof using both US GAAP and IFRS[50]. This mechanism both tests and explains the proof and also exercises the US GAAP and IFRS XBRL Taxonomies.

And so, you should be able to see the connections between the information from the 754,430 fact sets (a.k.a. Blocks) from above and the "Pattern" column in the PROOF representation

[47] *Understanding Digital*, Page 46, http://xbrlsite.azurewebsites.net/2020/Library/UnderstandingDigital.pdf#page=46
[48] Information and Exercises for Corporate Financial Reporting Class, http://xbrl.squarespace.com/journal/2020/9/30/information-and-exercises-for-corporate-financial-reporting.html
[49] Proof representation, http://xbrlsite.azurewebsites.net/2020/master/proof/index.html
[50] Mechanism for Understanding XBRL-based Financial Report Semantics, http://xbrl.squarespace.com/journal/2020/12/19/mechanism-for-understanding-xbrl-based-financial-report-sema.html

which is used to TEST the meta-model to see if SBRM provides everything that is necessary below. (Note that “Hierarchy” and “Set” are synonyms). Every fragment of the report is represented in the rows. Every ROW is a STRUCTURE of a report that fits into the overall meta-model. Every COLUMN is a common PROPERTY of the STRUCTURE.

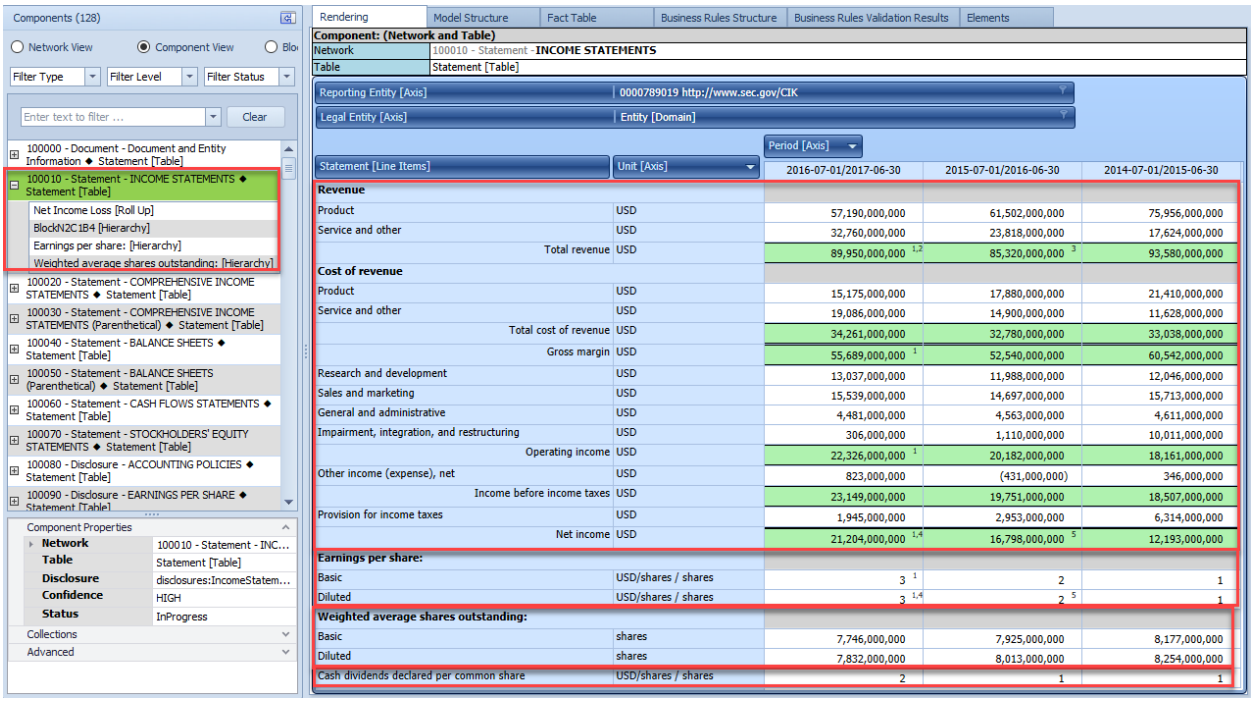
Primary Information

#	Disclosure	Category	Level	Pattern	Disclosure Fo…	Disclosure Co…	Applicable	Representation Concept [TEXT BLOCK]	Representation Concept DETAIL
1	Balance Sheet	Unknown	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Assets
2	Basis of Reporting	Unknown	Level1TextBlock	TextBlock	True	CONSISTENT	True	Basis of Reporting [Text Block]	NOT-EXPECTED
3	Changes in Equity	Unknown	Level4Detail	RollForward	True	CONSISTENT	True	NOT-EXPECTED	Equity
4	Financial Highlights	Unknown	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Revenues
5	Income Statement	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Comprehensive Income
6	Nature of Operations	Unknown	Level1TextBlock	TextBlock	True	CONSISTENT	True	Nature of Operations [Text Block]	NOT-EXPECTED
7	Prior Period Errors	Unknown	Level4Detail	Adjustment	True	CONSISTENT	True	NOT-EXPECTED	Equity
8	Revenue Recognition Policy	Unknown	Level1TextBlock	TextBlock	True	CONSISTENT	True	Revenue Recognition Policy [Text Block]	NOT-EXPECTED
9	Segment Revenues	Unknown	Level4Detail	Hierarchy	True	CONSISTENT	True	NOT-EXPECTED	Revenues
10	Stock Plan Activity	Unknown	Level4Detail	RollForwardInfo	True	CONSISTENT	True	NOT-EXPECTED	Nonvested Fair Value
11	Variance Analysis	Unknown	Level4Detail	RollUp	True	CONSISTENT	True	NOT-EXPECTED	Comprehensive Income

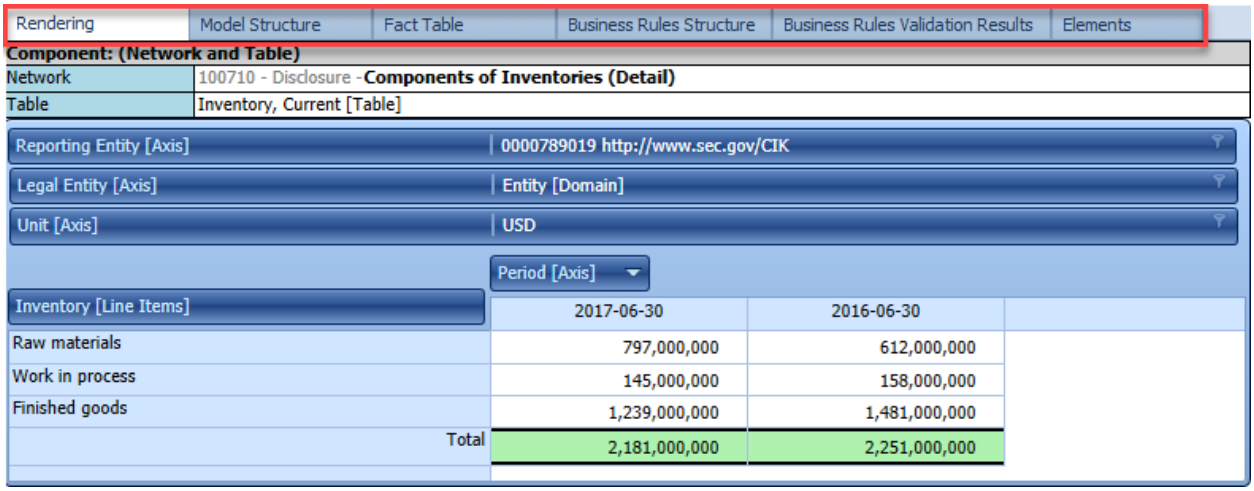
The SET of properties is the META-META MODEL of SBRM which is the SAME for EVERY economic entity that creates a report. This is likewise the SAME for every financial reporting scheme.

ROWs can be combined to create all of the arbitrary fragments of a report that are used to represent the complete report. For example, the Microsoft 10-K contains an income statement fragment[51]. That income statement fragment has FOUR structures: Net income (loss) roll up, earnings per share, weighted average shares outstanding, and cash dividends paid per common share.

[51] Microsoft Income Statement fragment, http://xbrlsite.azurewebsites.net/2017/Prototypes/Microsoft2017/evidence-package/#Rendering-StatementINCOMESTATEMENTS-us_gaap_StatementTable.html



Each **structure** is described in machine-readable terms using XBRL presentation, XBRL calculation, XBRL definition, and XBRL formula relations and resources. Structures can be examined using features implemented in software applications including a "**Rendering**" view which is human readable, a "**Model Structure**" which explains the model, a "**Fact Table**" which is a raw set of the facts included in the structure, "**Business Rules Structure**" which defines the mathematical rules, "**Elements**" which is a list of the elements included in the model structure.



Every structure for every report from any reporting scheme works exactly this same way. The *Logical Theory Describing Financial Report*[52] provides all the details which explains this.

[52] *Logical Theory Describing Financial Report*, http://xbrl.squarespace.com/logical-theory-financial-rep/

Machine readable rules of the meta-meta-model both (a) describe what is permissible, (b) can be used to verify that models created are consistent with the meta-meta-model, and (c) can be used to extract information from created reports with verification that the information is consistent with what is permissible.

Financial Report Levels

To clearly and precisely understand XBRL-based digital financial reporting and the target level of this method, it helps to think of the spectrum of financial reports in terms of levels similar to how levels are helpful in understanding the capabilities of self-driving cars[53]. The term "self-driving" means different things to different people so it makes it difficult to have a precise conversation about that topic. But breaking the description into a spectrum of descriptions is very helpful to the communication process.

This is similarly true for the levels of an XBRL-based digital financial report. Below we will break down a financial report into helpful levels that will enable a precise and clear discussion. We will provide a very brief description, a little bit of information, and a link to specific examples that instantiate a report per each specific level. The marginal difference between each level is very helpful in providing the reader with a solid understanding of the different levels. Here is an overview of the levels related to financial reporting as I see them beginning with the least functional in terms of both human and machine use of the information from with a financial report.

- **Level 0**: Not machine readable. *An example of Level 0 is a clay tablet, papyrus, or paper as the report medium*.
- **Level 1**[54]: Machine readable, nonstandard, structured for presentation. *PDF, HTML, or XHTML are examples of Level 1*.
- **Level 2**[55]: Machine readable, nonstandard, structured for meaning, no taxonomy (a.k.a. dictionary), no rules, no report model. *An XBRL-based report without an XBRL taxonomy schema, without XBRL relations and resources, and without XBRL Formulas is an example of Level 2*.
- **Level 3**[56]: Machine readable, global standard syntax, structured for meaning, with taxonomy (a.k.a. dictionary), incomplete rules, incomplete high-level report model. *An XBRL-based report with a XBRL taxonomy schema, with XBRL relations and resources, but without XBRL Formulas is an example of Level 3.*

[53] Truecar, The 5 Levels of Autonomous Vehicles, https://www.truecar.com/blog/5-levels-autonomous-vehicles/
[54] Level 1 financial report example, http://xbrlsite.azurewebsites.net/2021/reporting-scheme/proof/reference-level1/
[55] Level 2 financial report example, http://xbrlsite.azurewebsites.net/2021/reporting-scheme/proof/reference-level2/
[56] Level 3 financial report example, http://xbrlsite.azurewebsites.net/2021/reporting-scheme/proof/reference-level3/

- **Level 4**[57]: Machine readable, global standard syntax, structured for meaning, with taxonomy (a.k.a. dictionary), complete set of rules provided, incomplete high-level report model. *An XBRL-based report with a XBRL taxonomy schema, with XBRL relations and resources, and with XBRL Formulas that completely describes the report is an example of Level 4*.
- **Level 5**[58]: Machine readable, global standard syntax, structured for meaning, with taxonomy (a.k.a. dictionary), complete set of rules provided, complete global standard high-level report model, yields PROVEN properly functioning system and UNDERSTANDABLE report information. *An XBRL-based report with all the characteristics of Level 4, plus consistency cross checks, type-subtype relations, consistent modeling of XBRL presentation relations, information that describes the correct representation of every disclosure within the report, and a reporting checklist that describes all required disclosures is an example Level 5*.
- **Level 6**: All of Level 5 PLUS blockchain-anchored XBRL to increase trust. *An XBRL-based report with all the characteristics of Level 5, plus information within a digital distributed ledger that assures no one has tampered with the report is an example of Level 6*.
- **Level 7**: All of Level 6 PLUS blockchain-anchored transactions and events. *An XBRL-based report with all the characteristics of Level 6, plus information that indicates that assures no one has tampered with transactions is an example of Level 7*.

The target of this method is Level 5 and above. Below Level 5 the functionality what we generally need from such reports in terms of quality and effective use of reported information in automated machine-based processes is not good enough. It is possible to create a Level 4 XBRL-based report that is properly functioning. Level 5 provides a guarantee that the financial report is properly functioning within a provides specification articulated with a complete set of rules.

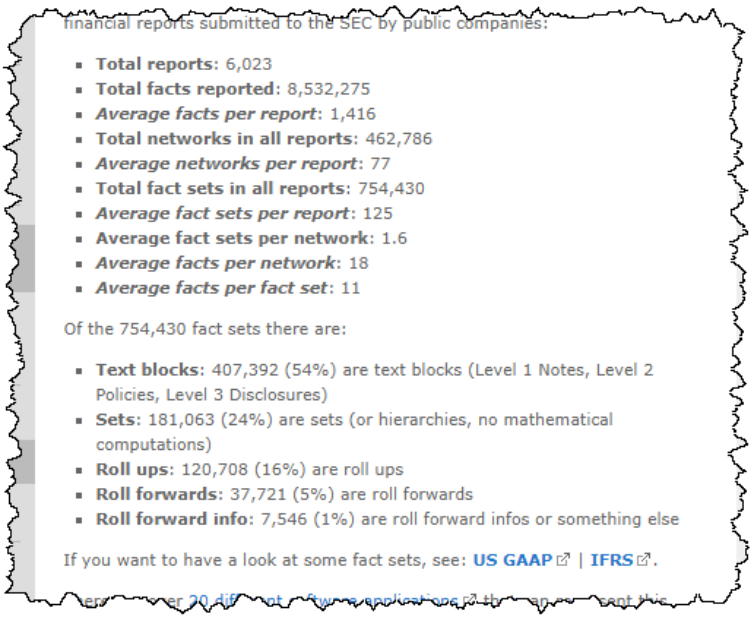
Process Control

This provides a **CONTROL MECHANISM** to keep quality extremely high. Rules provide the control. More rules can be added to the meta-model to expand the control mechanisms; but no set of rules can be removed from the system because if something is removed then the system is "incomplete" and errors can then slip through the system undetected.

The PROOF[59] example model can be expanded to include all the objects of the Microsoft 10-K financial report[60]. Likewise, this model works with Apple, Amazon, Google/Alphabet, Facebook,

[57] Level 4 financial report example, http://xbrlsite.azurewebsites.net/2021/reporting-scheme/proof/reference-level4/
[58] Level 5 financial report example, http://xbrlsite.azurewebsites.net/2021/reporting-scheme/proof/reference-level5/
[59] *Understanding Proof*, http://xbrlsite.azurewebsites.net/2020/Library/UnderstandingProof.pdf
[60] Microsoft Analysis, http://xbrl.squarespace.com/journal/2020/4/13/microsoft-xbrl-based-report-analysis.html

Salesforce per another analysis[61]. Likewise, this model works with every one of the 6,023 10-K financial reports analyzed which submits information using XBRL to the SEC using the US GAAP financial reporting scheme[62].



Similar results were achieved with another earlier analysis of 6,751 US GAAP based 10-K financial reports[63].

Similar results were obtained from an analysis of 406 IFRS based XBRL-based financial reports submitted to the SEC.

This approach that works for US GAAP and IFRS will work for any other financial reporting scheme[64]. A financial reporting scheme by definition (a) follows the rules of the double entry accounting model, (b) follows the rules of the accounting equation in some form, and (c) defines some set of elements of financial statements. And so, this very basic representation of SFAC 6 elements of financial statements[65] can be created for any financial reporting scheme; you simply use the terms and associations defined by that specific financial reporting scheme.

[61] Software Companies Prototype, http://xbrl.squarespace.com/journal/2020/4/2/software-companies-prototype.html
[62] Breaking down the pieces, http://xbrl.squarespace.com/journal/2019/4/9/breaking-down-the-pieces-of-an-xbrl-based-digital-financial.html
[63] Analysis of 6,751 XBRL-based Public Company 10-Ks Submitted to SEC, http://www.xbrlsite.com/mastering/Part05_Chapter08.F_AnalysisOf675110Ks.pdf
[64] Comparison of Financial Reporting Schemes, http://xbrlsite.azurewebsites.net/2020/master/ElementsOfFinancialStatements.pdf
[65] SFAC 6 representation, http://xbrlsite.azurewebsites.net/2020/master/sfac6-basic/

If you strip out the "double entry accounting model" and "accounting equation" from my meta-model you get something that can be used to create high-quality general business reports (a.k.a. semantic workbook, see *Understanding Semantic Spreadsheets*[66]).

When you put all these details together it helps you understand important patterns and a method for leveraging those patterns to control report creation processes. This forms the method for verifying that an XBRL-based financial report is a properly functioning logical system that is complete, consistent, and precise.

If you are new to XBRL-based financial reporting, two tutorials will walk you through the most important details:

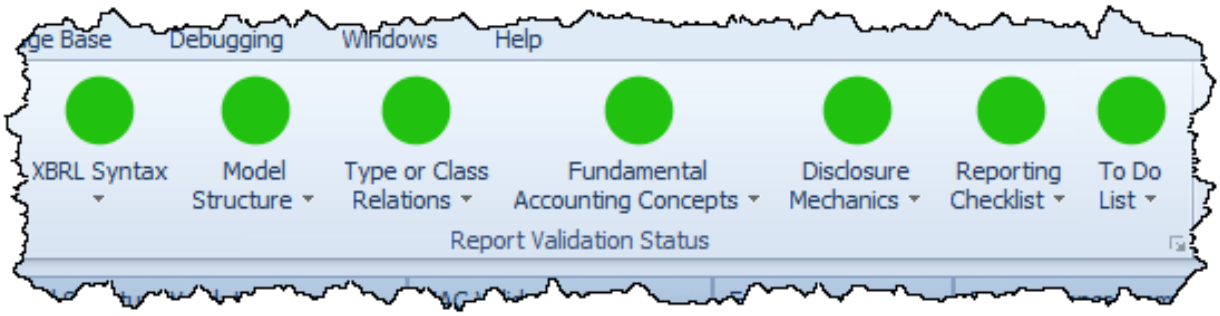
- *Gentle and Cheap Introduction to XBRL-based Digital Financial Reporting*[67]
- *Intermediate XBRL-based Digital Financial Reporting*[68]

Overview of Method Enabled by SBRM

The following is a brief overview of the *Method of Implementing a Standard Financial Report Using the XBRL Syntax*[69].

Thorough

This graphic provides somewhat of a "dashboard" for understanding this method and which shows a thorough and complete summary of the aspects tested using this method (i.e. nothing can be removed or quality issues could creep into the XBRL-based financial report representation):



[66] *Understanding Semantic Spreadsheets*, http://xbrlsite.azurewebsites.net/2020/Library/UnderstandingSemanticSpreadsheets.pdf
[67] Gentle and Cheap Introduction to XBRL-based Digital Financial Reporting, http://xbrlsite.azurewebsites.net/2020/introduction/
[68] Intermediate XBRL-based Digital Financial Reporting, http://xbrl.squarespace.com/journal/2020/12/15/intermediate-xbrl-based-financial-reporting.html
[69] *Method of Implementing a Standard Financial Report Using the XBRL Syntax*, http://www.xbrlsite.com/2020/Theory/SBRM-Method.pdf

The dashboard has seven categories that are explained as follows:

1. **XBRL Syntax**: This category of rules is provided by XBRL International in the form of a machine-readable set of rules referred to as a conformance suite[70]. This conformance suite is 100% automatable via computer-based processes and used to be sure the XBRL technical format is consistent with the expectations of the XBRL Technical specification. The XBRL conformance suite has helped software vendors get their XBRL technical syntax consistent and today about 99.99% of all XBRL-based financial reports are consistent with expectation. But, this checks only the information FORMAT, not the MEANING conveyed by the information expressed using that technical format. (Note that mathematical relations of a specific report are included in this category, represented by either XBRL calculation relations and/or XBRL formula.)
2. **Model Structure**: This category of rules overcomes missing information related to the relationship between the categories of report elements that are used to structure a financial report model. While the permissible sorts of XBRL calculation relations and XBRL definition relations and certain aspects of XBRL presentation relations are specified by the XBRL technical specification; information about the permissible associations between the categories of report elements as shown by the matrix below are not specified by XBRL. The model structure rules simply explicitly specify these rules for expressing XBRL presentation relations:

		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

3. **Type or class relations** (a.k.a. type-subtype relations): This category of rules specifies allowed subtype relations for each type defined in an XBRL taxonomy. Other terms for this are "is-a" relations or "general-special" relations or "wider-narrower" relations. An example would be a type-subtype rule that specifies that "Accounts Payable" is a sub type of the "Current Liabilities" type. This prevents the inadvertent use of "Accounts Payable" as a part of "Noncurrent Liabilities" or "Equity", etc.
4. **Fundamental accounting concepts:** This category of rules specifies information that helps detect common inconsistencies and contradictions within a financial report[71]. Consistency cross checks are created[72] against expectation. There are many examples of the types of errors that

[70] XBRL International, XBRL 2.1, https://specifications.xbrl.org/work-product-index-group-base-spec-base-spec.html
[71] 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
[72] Consistency cross check rules, http://xbrlsite.azurewebsites.net/2019/Library/Signals_2019-03-31.jpg

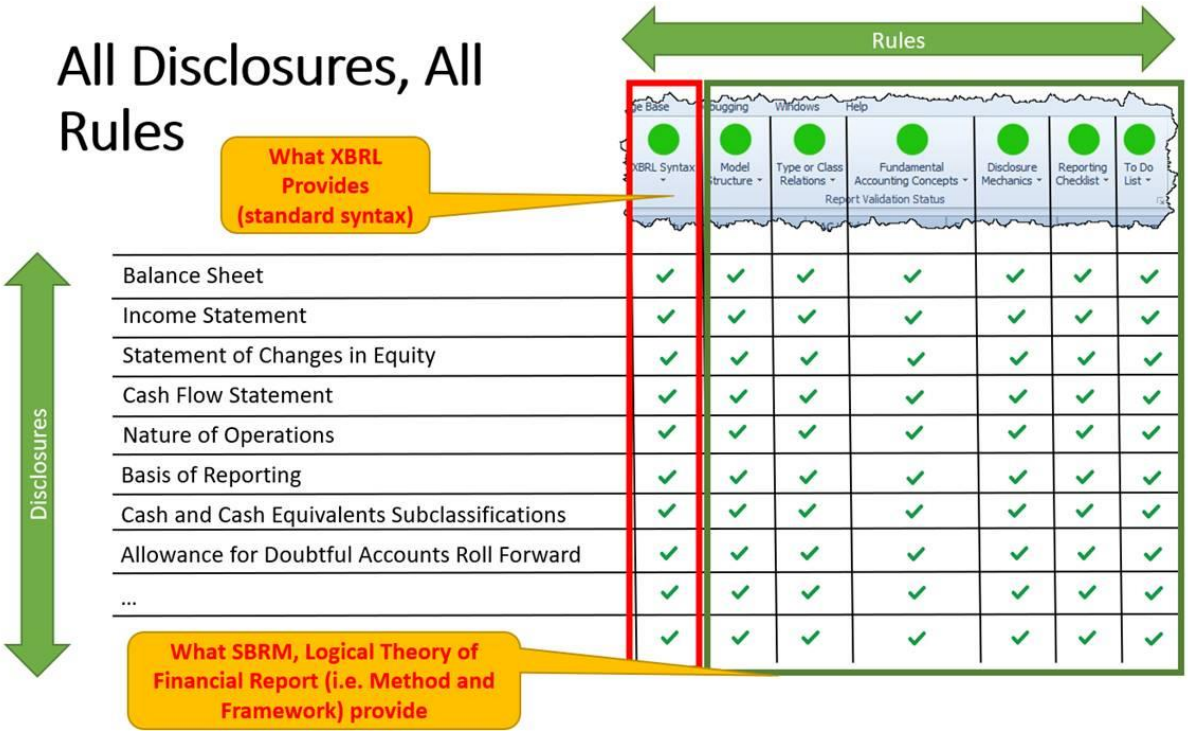
have been known to commonly occur[73]. For example, for US GAAP XBRL-based financial reports submitted to the SEC a common error was to use the concept "us-gaap:NoncurrentAssets" to represent information for which the concept "us-gaap:AssetsNoncurrent" should have been used.

5. **Disclosure mechanics:** This category of rules is used to specify the permissible representations of each specific disclosure. For example, the disclosure "Components of Inventories" would be specified to be a "roll up" mathematical relation which uses the concept "us-gaap:InventoryNet" or a permissible alternative to represent that total. Disclosure mechanics rules likewise specify that the concept "us-gaap:ScheduleOfInventoriesTextBlock" should be used to represent the Level 3 disclosure text block disclosure.
6. **Reporting checklist:** This category of rules is used to specify the permissible sets of disclosures that are required to exist within a financial report. For example, the fact that a balance sheet is always required to be included can be specified, as would be the case for an income statement, statement of cash flow, and statement of changes in equity. The fact that a combined statement of comprehensive income and income could be used as an alternative can be specified. Finally, if a specific line item such as "Inventories" is provided on the balance sheet, the fact that an inventories policy and inventories disclosure must be provided can be specified.
7. **To do list:** This category of rules is for cases where either (a) a rule CANNOT be specified in machine-readable terms because the rules language used is not expressive enough to represent the rule or (b) a rule COULD have been represented but it simply HAS NOT been represented in machine-readable form and therefore manual work is necessary to verify report logic that could have been automated.

Complete

And so, XBRL Syntax validation provides only a small subset of what can be verified to be correctly represented within an XBRL-based financial report. Categories 2 through 6 must either be (a) also represented using machine-readable rules and verified using automated processes or (b) verified using manual processes which are less reliable and therefore more prone to error. Category 7 must always be verified using manual processes. All testing, categories 1 through 7 must be performed for each fragment of an XBRL-based financial report to prove that each individual fragment is consistent, complete, and precise and that any intersection between one report fragment and some other report fragment is consistent (i.e. does not contradict or is not inconsistent with some other report fragment). The graphic below summarizes this visually:

[73] High-quality examples of errors, http://xbrl.squarespace.com/journal/2017/4/29/high-quality-examples-of-errors-in-xbrl-based-financial-repo.html



Further, if 100% of the rule categories are specified for 100% of the disclosures that exist within an XBRL-based report; then a control mechanism is provided to verify that the financial information conveyed within an XBRL-based report is consistent with specified statutory and regulatory rules and other structural, mechanical, mathematical, and logical rules.

System specific rules such as the SEC Edgar Filer Manual rules or the ESMA's European Single Electronic Format (ESEF) are simply further restrictions and therefore additional rules; just another column in the grid above. Additional columns of rules can be added, but no columns can be removed. For example, if one desired to add the XBRL US "Data Quality Checks", then a new column is simply added. Want to add a "spell checker"? That can be added also. But you simply cannot remove an existing column because then errors can slip into the system.

If such a control mechanism is provided; then as shown in *Effective Automation of Record to Report Process*[74] and as explained in *Understanding Digital*[75], accounting, reporting, auditing, and analysis tasks and processes can be automated to the degree that such rules exist to enable such automation. Humans (a) deal with exceptions and (b) manual checks. Further, when such processes leverage Lean Six Sigma philosophies and techniques[76], financial report quality can be controlled (as contrast to making mistakes and then spending hours and hours of human effort to detect and correct errors).

[74] Effective Automation of Record to Report Process, http://xbrl.squarespace.com/journal/2020/11/3/effective-automation-of-record-to-report-process.html
[75] Understanding Digital, http://xbrlsite.azurewebsites.net/2020/Library/UnderstandingDigital.pdf
[76] Lean Six Sigma, http://www.xbrlsite.com/mastering/Part01_Chapter02.K_LeanSixSigma.pdf

The best way to understand the need for this method and the process control mechanisms that it provides is to understand the impediments to creating a properly functioning logical system. We do that in the next section below by looking at the impediments to properly functioning logical systems. But let's wrap up this section first.

Process Automation

Control is achieved by using rules. Rules guarantee high-quality. High quality results in effective automation. Because the method is thorough and complete, processes can be effectively automated. How exactly can you be sure your financial report is a true and fair representation of the financial position and financial performance of your entity without testing it to be sure the report is working effectively? If you cannot measure it, you cannot control it.

Risk Reduction

Process automation and automated verification reduces the risk of noncompliance. Hope and chance are not good strategies for complying with statutory and regulatory reporting rules.

Social Cooperation and Benefit

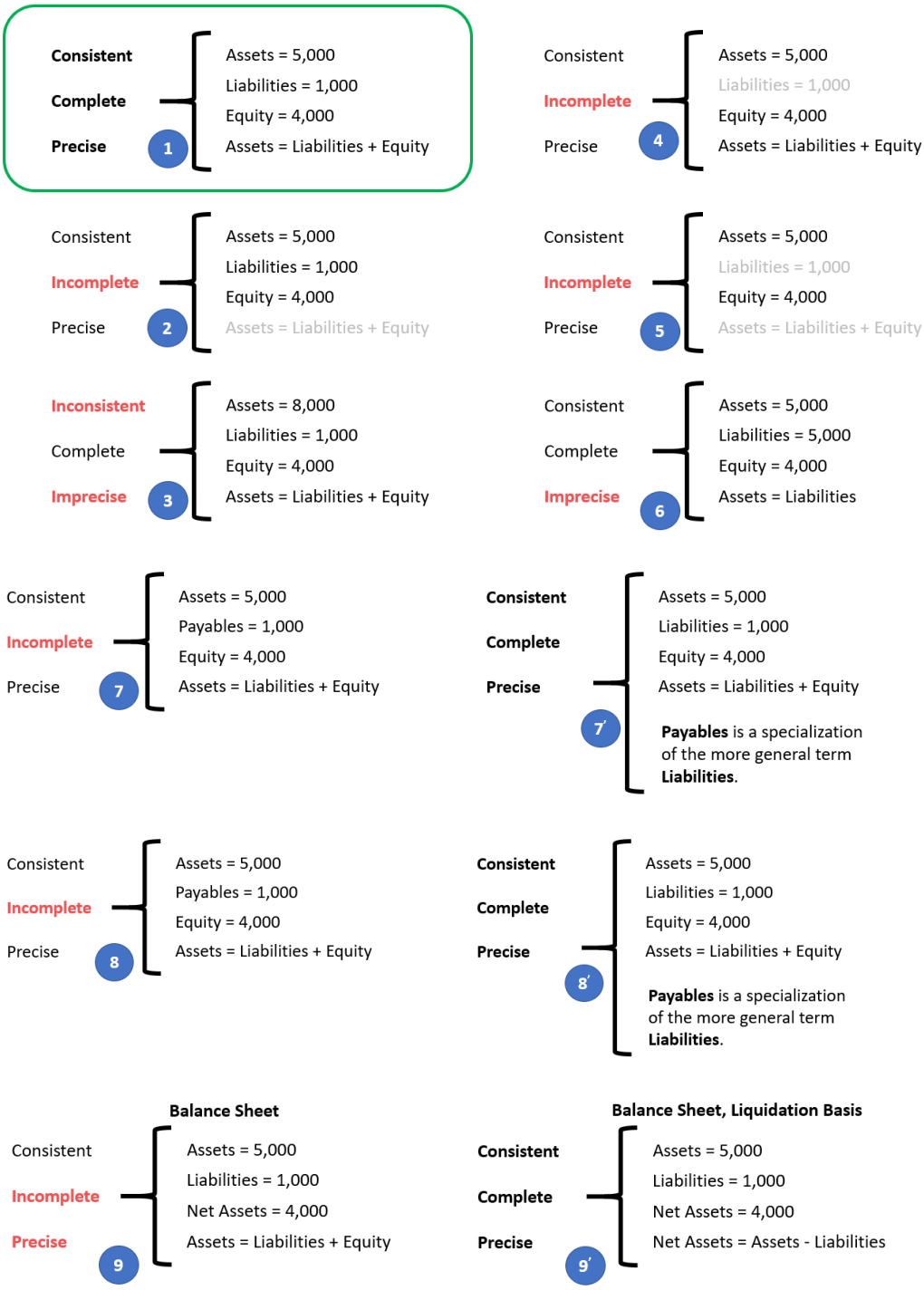
Being able to effectively exchange information between processes which enables the automation of those processes provides social benefit. Among those benefits are cost reduction, process quality improvement, ability to provide new products/services, and improved functioning of capital markets resulting from these process improvements.

Understanding Errors that Can Occur which Method Detects and Prevents (Comparison of States)

The following is a comparison of 9 states of the same simple financial report logical system, the accounting equation[77]. The point of using such a simple financial report logical system is to explain specific things that can go wrong so that a reader can understand why each of the categories of rules are necessary. These 9 states can occur in any financial report with one fragment, two fragments, or 194 fragments like the Microsoft 10 K. Again, Mastering XBRL-based Digital Financial Reports[78] walks you through small and simple to large and complex.

Here is a summary of all nine states with the first state outlined in green being the only properly functioning logical system proven to be complete, consistent, and precise:

[77] Accounting equation, http://xbrlsite.azurewebsites.net/2020/master/ae/index.html
[78] Mastering XBRL-based Digital Financial Reports, http://xbrlsite.azurewebsites.net/2020/master/



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. 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*[79].

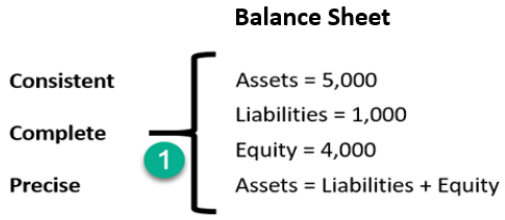
Before we get to the improperly functioning logical systems, let's take one final look at the properly functioning logical system so that you can use that as a baseline for comparing and contrasting the properly functioning and improperly functioning logical systems so that you can understand they sorts of errors that can occur.

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.

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"[80] 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"[81]. You understand your system but you have to map every external system into your system[82]. 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

[79] Understanding the Financial Report Logical System, https://www.youtube.com/playlist?list=PLqMZRUzQ64B7EWamzDP-WaYbS_W0RL9nt
[80] YouTube, *Reality*, https://youtu.be/eq2Jw6waaCI
[81] Fundamental accounting concepts, http://xbrlsite.azurewebsites.net/2020/core/master-ae/fac.xsd
[82] Mapping from accounting equation to fundamental accounting concepts in our system, http://xbrlsite.azurewebsites.net/2020/core/master-ae/fac-mapping-definition.xml

information[83]. 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.

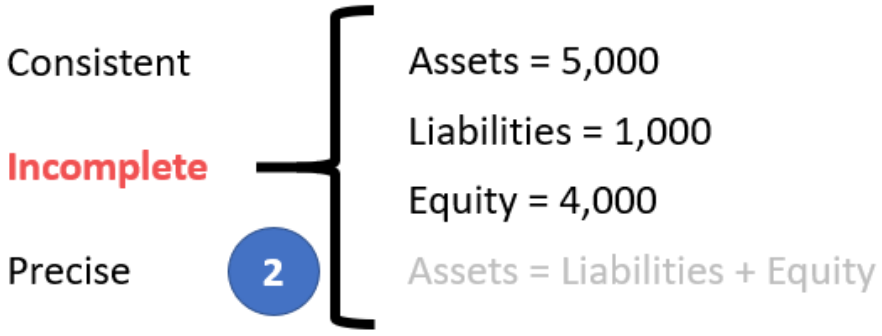
The point is that different economic entities have different models; but all models of a financial reporting scheme are reconcilable from/to one another in some manner[84].

State 2: Incomplete Coverage by Rules

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

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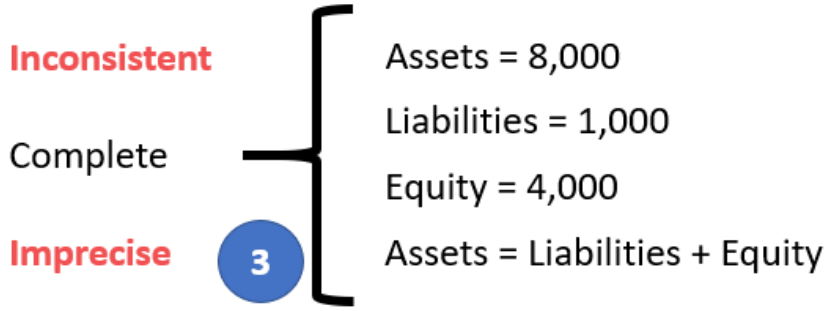
[83] XBRL Formula to derive the value for LiabilitiesAndEquity, http://xbrlsite.azurewebsites.net/2020/core/master-ae/fac-ImputeRule-LiabilitiesAndEquity-formula.xml

[84] 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

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.



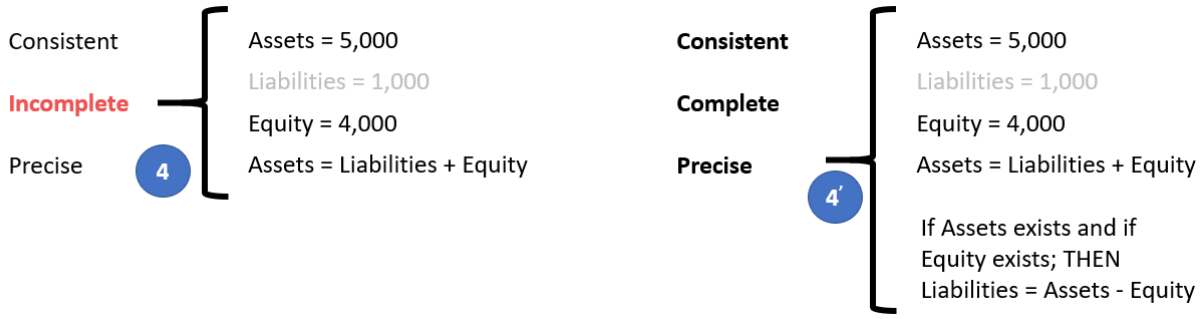
However, given that we know from state #1 that the value for Assets is 5,000 and not 8,000; the facts in this system is imprecise because the fact for Assets does not reflect reality.

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"[85]. *(NOTE that this rule should actually be "IF Assets exists and if Equity exists and if not(exists) Liabilities; THEN Liabilities = Assets – Equity")*

[85] 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[86] or Equity[87] could also be left unreported, similarly derivation rules could be created for each of those facts. Note that XBRL Formula chaining[88] 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[89] plus the derivation rule to impute Liabilities[90] would be necessary.

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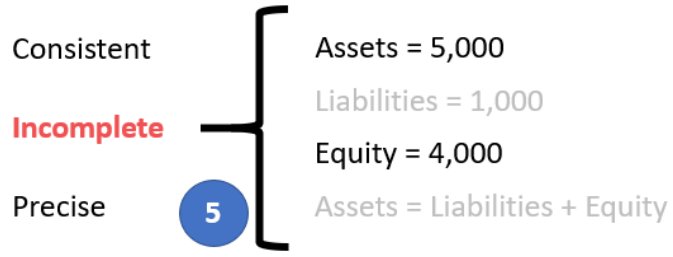
[86] XBRL Formula rule for deriving Assets, http://xbrlsite.azurewebsites.net/2020/core/master-ae/ImputeRule-Key-3-Code-BS-Impute-03-formula.xml
[87] XBRL Formula rule for deriving Equity, http://xbrlsite.azurewebsites.net/2020/core/master-ae/ImputeRule-Key-2-Code-BS-Impute-02-formula.xml
[88] Deriving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

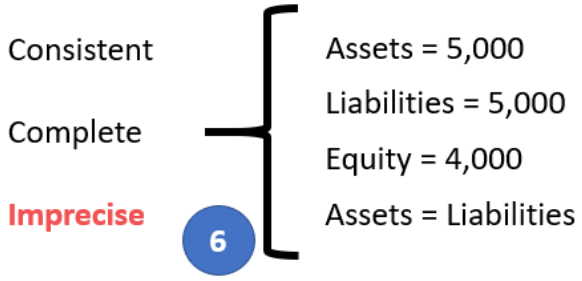


Again, consistent with state #4; Assets and Equity would require similar rules and there is no parity check of reported information.

State 6: Imprecise

A logical system is a true and fair representation of some agreed upon realism. **Precision** is a measure of how precisely you do or can represent the information of a domain within a logical theory. The reality that we formalized in state #1 indicates that "Assets = Liabilities + Equity". Yet, 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.

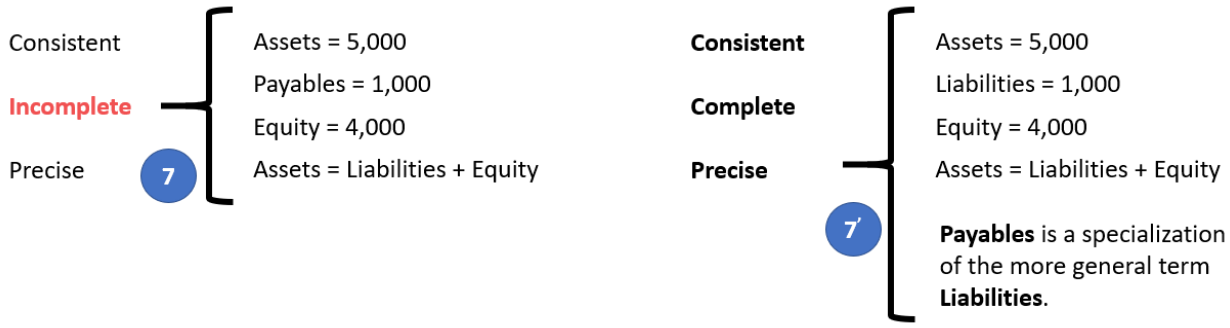
Remember that in state #1 we formalized our truth to be that "Assets = Liabilities + Equity". As such, this logical system can be described as being imprecise. To make this logical system precise, all that needs to be done is to fix the rule.



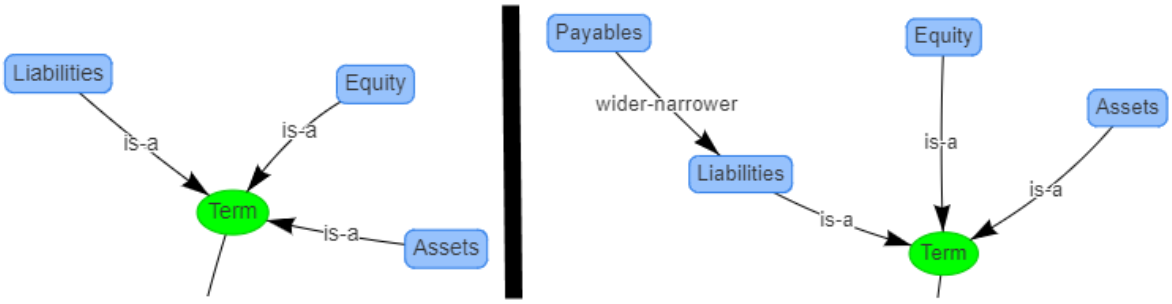
State 7: Extension Concept

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[91].

[91] 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.

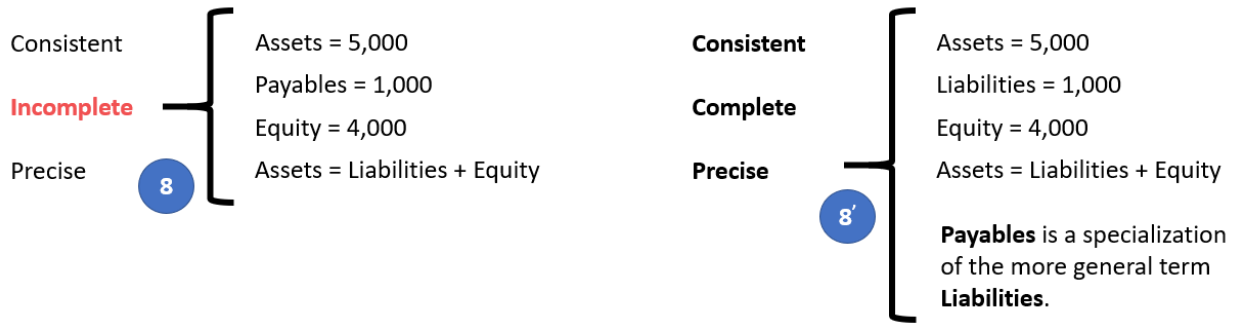


State 8: Base Taxonomy Wider/Narrower Concept Use

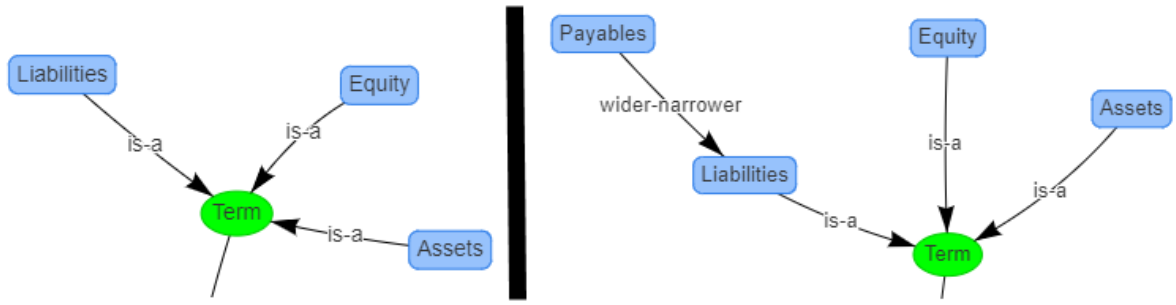
State #8 on the left below is similar to state #7 in that a different concept is used to report a fact; but while state #7 focuses on using an extension concept; state #8 points out that using a wider or narrower base taxonomy concept gives exactly the same result.

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"[92].



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.



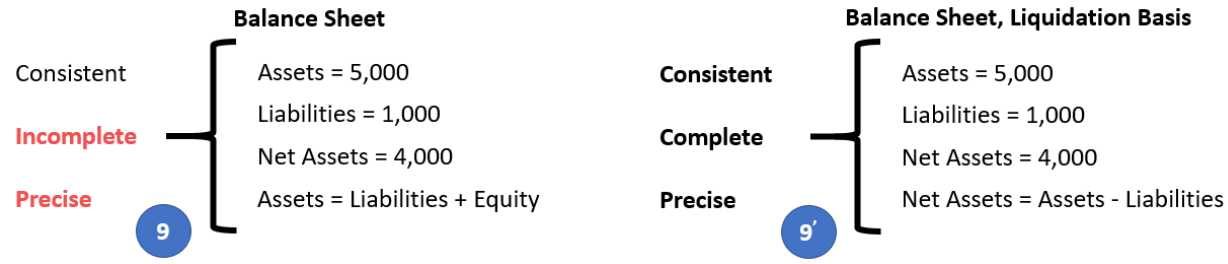
State 9: Defining a Completely New Structure

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[93]. Even base taxonomy structures need to be defined in order to be referred

[92] XBRL Definition relations showing example of a mapping rule, http://xbrlsite.azurewebsites.net/2020/core/master-ae/fac-mapping-definition.xml
[93] XBRL Definition relations used to represent structure rules, http://xbrlsite.azurewebsites.net/2020/core/master-ae/dm-1355-rules-def.xml

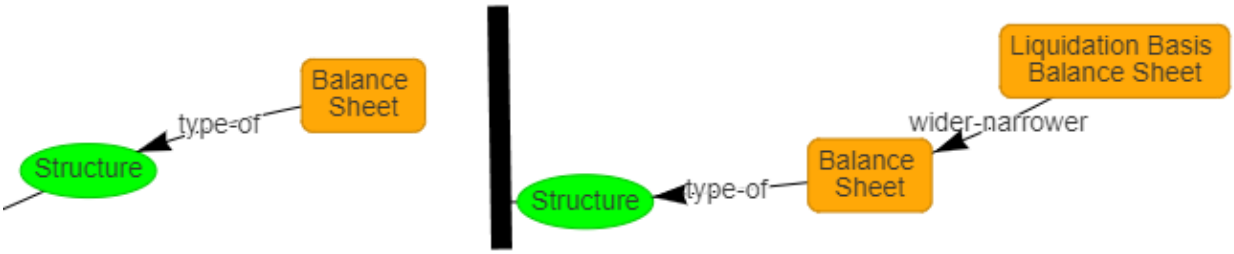
to[94]. When you say "Balance Sheet" you know what that means. But a machine does not know.

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 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[95]. 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.

[94] XBRL taxonomy schema used to define "Balance Sheet", http://xbrlsite.azurewebsites.net/2020/core/master-ae/disclosures.xsd

[95] 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

Examining Errors in Actual Submitted Reports

As explained, a very good way to understand how to create reports correctly is to examine errors in reports that others have created. Here are three documents that provide well documented examples of undisputed errors:

- Issues in XBRL-based Digital Financial Reports[96]
- More Issues in XBRL-based Digital Financial Reports[97]
- Accounting errors[98]

Finally, this blog post[99] (see toward the bottom) provides 24 sets of well documented errors in XBRL-based reports.

Note that all of these errors were discovered using automated processes which leverage this method. If reports were verified using this method prior to submitting the report to a regulator, all such errors could have been detected and corrected. The result would be higher quality XBRL-based reports.

Best Practices

A **best practice** is a method or technique that has been generally accepted as superior to any other known alternatives because it produces results that are superior to those achieved by other means or because it has become a standard way of doing things.

Best practices (or good practices) are techniques that have produced outstanding results in other situations, inside or outside of a particular organization and which can be validated, codified, and shared with others and recommended as models to follow[100].

To understand how to represent XBRL-based financial reports at Level 5 please start with *Essentials of XBRL-based Digital Financial Reporting*[101].

[96] Issues in XBRL-based Digital Financial Reports, http://xbrlsite.azurewebsites.net/2020/master/100IssuesOfPublicCompanyReports.pdf
[97] More issues in XBRL-based Digital Financial Reports, http://xbrlsite.azurewebsites.net/2020/master/About50MoreIssuesOfPublicCompanyReports.pdf
[98] Accounting Errors, http://xbrlsite.azurewebsites.net/2018/Library/AccountingErrorsFoundDuringValidation.pdf
[99] High Quality Examples of Errors in XBRL-based Financial Reports, http://xbrl.squarespace.com/journal/2017/4/29/high-quality-examples-of-errors-in-xbrl-based-financial-repo.html
[100] European Guide to good Practice in Knowledge Management - Part 5: KM Terminology, page 3 (PDF page 9), http://arielsheen.com/wp-content/uploads/2019/10/CEN-CWA14924-05-2004-Mar.pdf#page=9
[101] Charles Hoffman, CPA, *Essentials of XBRL-based Digital Financial Reporting*, http://xbrlsite.azurewebsites.net/2021/essentials/EssentialsOfXBRLBasedDigitalFinancialReporting.pdf

Conclusion

As is said, “If you cannot measure it, you cannot control it.” The method we are providing an overview of in this document provides the measurements necessary to create repeatable, reliable process control mechanism which yields high-quality XBRL-based financial reports.