1. Auditing XBRL-based Digital Financial Reports

The purpose of this section is to discuss issues related to the audit of XBRL-based digital financial reports.

A financial report is a true, faithful, allowed interpretation of an expression of the financial position and financial performance of an economic entity per some set of statutory and regulatory rules. Here-to-for, that expression has been in a form that is only readable by humans. However, XBRL and other machine-readable formats change that, making those expressions readable by both humans and by machine-based processes.

As explained in *Financial Report Knowledge Graphs*[1], an XBRL-based financial report is a knowledge graph that is readable by both human and machine-based processes. Accounting, reporting, auditing, and analysis steps and tasks can be effectively automated.

Using this method, enterprises can reliably and effectively stream a high-quality machine-readable XBRL-based global standard knowledge graph of a complete, consistent, and provably correct general purpose financial statement. Further, an entire record-to-report process can be automated effectively. This method provides both the flexibility and the control necessary to effectively hit this target within an enterprise.

The European Commission has issued a communication relating to the preparation and audit of financial statements created using the ESEF (European Single Electronic Format, which is XBRL). That communication states:

> To ensure the integrity of the internal market and a homogeneous level of protection for all users of financial statements and annual financial reports, users should be granted the same level of protection irrespective of how they access the information contained in the financial statements, be it for instance via scanned-paper documents or via electronically structured documents.

While the U.S. Securities and Exchange Commission and others do not have an audit requirement, that day will eventually come. Also, for enterprises to use significantly more automated processes for generating internal and external financial reports, those automated processes will need to be verified by audit.

An XBRL-based financial report is not only a machine-readable format; it also is a machine-readable logical system and has the potential to be a well-defined and fully expressed logical system. A well-defined and properly functioning logical system, when fully expressed, will be demonstrably consistent, complete, and precise. These properties of a financial report logical system can be leveraged to offer a systematic audit strategy for XBRL-based financial reports.

Essentially, an XBRL-based financial report is a set of declarative logical statements provided in global standard XBRL format that form a knowledge graph of the reported financial information and the report model of that report. Artificial

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[1] *Financial Report Knowledge Graphs*,
http://www.xbrlsite.com/mastering/Part02_Chapter05.AA_FinancialReportKnowledgeGraphs.pdf

intelligence-based software applications can scrutinize those machine readable financial reports.

1.1. Logical Statements

A financial report makes logical statements about the financial position and financial performance of an economic entity. Consider the name, "financial statements". Some of those logical statements might be organized into the form of a table or tabular presentation of information; for example, a balance sheet. But fundamentally, a financial report makes logical statements about the financial position and financial performance of an economic entity. Some logical statements may be quantitative in nature, other statements may be qualitative in nature.

Historically, those logical statements and the meaning they convey have been readable by human-based processes. With the introduction of XBRL this changes. XBRL-based financial reports are readable by both humans and by machine-based processes.

But how do professional accountants creating these reports make sure they convey the information, more make the logical statements, that they desire and intend to make? How does an internal auditor review such reports? How does an independent auditor confirm such reports are conveying meaning appropriately? How do financial analysts extracting and using information do so appropriately?

1.2. Current Audit Guidance

While the AICPA's *Principles and Criteria for XBRL-Formatted Information*[2] lays a good foundation for thinking about how to create XBRL-based financial reports correctly, review a report that another has created, provide attestation services related to such a report, or providing agreed-upon consulting services; the AICPA's guidance state (emphasis added):

> "The quality of XBRL files is an important concern to users of these files. Errors in the XBRL files will have varying consequences. During the development of the XBRL principles and criteria, potential errors that could occur when preparing XBRL files were considered, and **it is believed** that the **criteria addresses many of these errors**. Further, the principles and criteria meet the requirements under AT section 101, as previously discussed in paragraphs .11-.13, and, thus are **considered suitable** for practitioners to perform an attestation engagement."

Hope is not a solid system engineering principle. Clearly, those creating such XBRL-based reports need to **make sure no errors exist**. Accountants and auditors cannot "*believe*" that such a report is correct using a process that "*addresses many of these errors*".

Accountants and auditors need to make sure no errors exist. Two auditors looking at the same XBRL-based report should be able to reach the same conclusion about the subjective mechanical, structural, mathematical, and other logical considerations

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[2] American Institute of Certified Public Accountants, 2017, *Principles and Criteria for XBRL-Formatted Information*,
https://www.aicpa.org/InterestAreas/FRC/AccountingFinancialReporting/XBRL/DownloadableDocuments/aicpa-principles-and-criteria-for-xbrl-formatted-information.pdf

related to such reports. Without this capability, XBRL-based reports really cannot be considered reliable, yet alone auditable.

Many professional accountants and auditors do not understand how to interact with XBRL-based financial reports because they don't have important background necessary to do so[3]. Trying to understand XBRL-based financial reports using old outdated mental maps will be unsatisfying to say the least.

Two academic papers discuss how to audit XBRL-based financial reports: Srivastava, Rajendra Prasad and Kogan, Alex, *Assurance on XBRL Instance Document: A Conceptual Framework of Assertions* (September 9, 2009)[4] and J. Efrim Boritz and Won Gyun No *Computer-Assisted Functions for Auditing XBRL-Related Documents*[5]. Journal of Emerging Technologies in Accounting. Both papers point to the need for a framework and methodology to audit the information contained within an XBRL-based financial report.

1.3. *Myths and Misconceptions Related to the "Audit of XBRL"*

There are many myths and misconceptions professional accountants, professional auditors, and others have about the "audit of XBRL".

The first misconception is that XBRL is audited at all. XBRL is a technical format. XBRL is simply a physical delivery mechanism. The XBRL technical format can be verified 100% by automated software tests. That is the purpose of the XBRL International XBRL conformance suite tests[6]. Those conformance suite tests are used to build automated machine-based processes to be sure the XBRL technical syntax is right in all details.

But XBRL conformance suite tests do not, and cannot, check to see if the meaning conveyed by the XBRL-formatted information is correct.

Second, when one "audits" the financial information represented in the form of paper you are not auditing the paper, you are auditing the information represented on the paper. The meaning conveyed by the XBRL-formatted information and the meaning conveyed by paper-based information including electronic forms of paper or "e-paper" like HTML and PDF should convey the exact same meaning.

Third, the purpose of an audit is to provide an independent third-party opinion as to whether reported information about the financial condition and financial performance of an economic entity is being represented fairly by the information provided in a financial report. The audit is about the *independent third-party opinion* as to the fairness of that information. Financial reporting managers still need to represent information in their XBRL-based reports correctly even if those reports are not audited.

Fourth, external financial reporting managers need to create true and fair representations of their financial information. The team that works with the external

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[3] Charles Hoffman, CPA, *Artificial Intelligence and Knowledge Engineering Basics in a Nutshell*, http://xbrlsite.azurewebsites.net/2019/Library/KnowledgeEngineeringInNutShell.pdf

[4] Srivastava, Rajendra Prasad and Kogan, Alex, *Assurance on XBRL Instance Document: A Conceptual Framework of Assertions* (September 9, 2009). Available at SSRN: https://ssrn.com/abstract=1289467
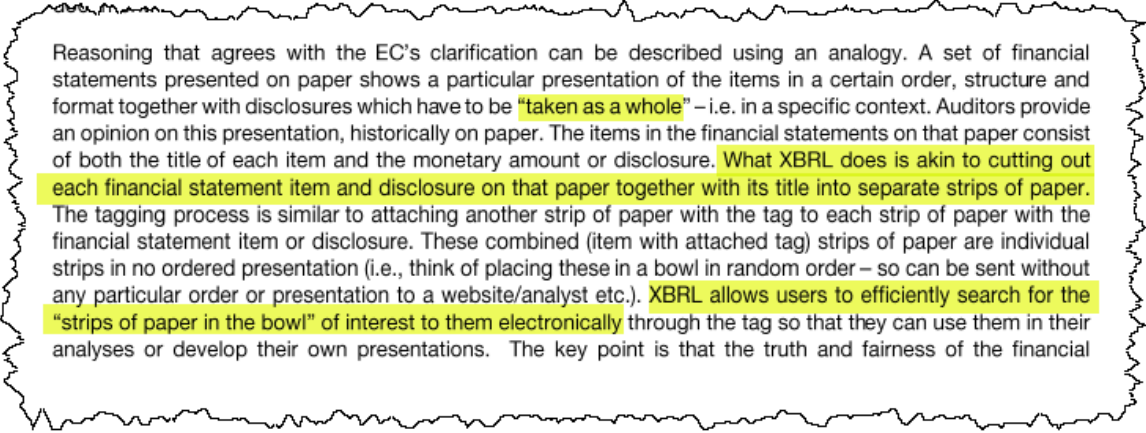
[5] J. Efrim Boritz and Won Gyun No (2016) Computer-Assisted Functions for Auditing XBRL-Related Documents. Journal of Emerging Technologies in Accounting: Spring 2016, Vol. 13, No. 1, pp. 53-83, https://www.aaapubs.org/doi/10.2308/jeta-51436

[6] XBRL International, *XBRL 2.1*, https://specifications.xbrl.org/work-product-index-group-base-spec-base-spec.html

financial reporting manager needs to make sure the financial report is true and fair. Internal auditors that work for a company to make sure the external financial reporting manager is doing their job correctly need to make sure the information is true and fair. Finally, the CFO that signs off on the report needs to make sure the financial report information is true and fair. The point here is that there are lots of people who care that the information contained in a financial report is represented appropriately, not just auditors.

1.4. "Strips of Paper" Analogy

Accountancy Europe issued a briefing paper, *Independent Assurance on European Electronic Format*[7]. In that paper, they make the following statement: (page 8, section 2.A, third paragraph)

Reasoning that agrees with the EC's clarification can be described using an analogy. A set of financial statements presented on paper shows a particular presentation of the items in a certain order, structure and format together with disclosures which have to be "taken as a whole" – i.e. in a specific context. Auditors provide an opinion on this presentation, historically on paper. The items in the financial statements on that paper consist of both the title of each item and the monetary amount or disclosure. What XBRL does is akin to cutting out each financial statement item and disclosure on that paper together with its title into separate strips of paper. The tagging process is similar to attaching another strip of paper with the tag to each strip of paper with the financial statement item or disclosure. These combined (item with attached tag) strips of paper are individual strips in no ordered presentation (i.e., think of placing these in a bowl in random order – so can be sent without any particular order or presentation to a website/analyst etc.). XBRL allows users to efficiently search for the "strips of paper in the bowl" of interest to them electronically through the tag so that they can use them in their analyses or develop their own presentations. The key point is that the truth and fairness of the financial

In essence, what the authors appear to be pointing out is that historically, auditors provide an opinion of the financial statement taken as a whole. But, given that the XBRL technical syntax breaks the here-to-for whole report into individual pieces or as they say "strips of paper" and that XBRL also allows for access to reported information as if each reported fact is a "strip of paper in a bowl" and therefore can be individually accessed (i.e. using pieces of a report as contrast to using the whole financial report).

The paper also makes the statement:

> "The key point is that the truth and fairness of the financial statements was achieved before the scissors were applied to cut the financial statements and also before the application of XBRL tags."

This paper looks at this analogy and that last statement in this briefing paper.

1.4.1. Human Readable Rendering

In this section we cut a financial report into strips. We look at a simple fragment of a simple financial report and literally cut that report into strips.

The report I will use is the report which I created as part of the *Continuous Reporting*[8] example. I will use one fragment of that report, the balance sheet. Here

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[7] Accountancy Europe, *Independent Assurance on European Electronic Format*, https://www.accountancyeurope.eu/wp-content/uploads/191217-ESEF-assurance-paper-FINAL_update_2.pdf

you see a human readable rendering of the ASSETS section of the balance sheet of the *Continuous Reporting* example[9]:

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

I would point out that there are clearly relationships between the reported facts. For example, one can easily understand the subcomponents of the subtotal "Current assets" in the human readable rendering above. When the report model is considered, the XBRL calculations clearly and absolutely show that relations exist between the reported facts.

Note that the human readable rendering above is also machine readable because the document is the Inline XBRL format. Extraction tools, such as an Excel spreadsheet application, can in fact extract individual facts from the document[10].

Notice that there is implied meaning associated with reported facts. For example, the value "$26900" is associated with the line item "Cash and Cash equivalents" because they are on the same line, the balance sheet date "December 31, 2020" because it is in that column, with the currency "US dollars" per the heading "(in US Dollars)", and with the economic entity "ABC Company, Inc" per the title of the balance sheet.

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[8] *Continuous Reporting Example*, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/index.html

[9] *Pixel Perfect Rendering of Continuous Accounting Example*, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/instance-RENDERED.html

[10] Excel-based Information Extraction Tool, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/Extraction-TB-InlineXBRL.zip

1.4.2. Cutting the Human Readable Rendering into Strips

Below, we literally take the above human readable rendering and cut it into strips such:

Each line item is actually three "strips". For example, the line item "Cash and cash equivalents" is reported for the current balance sheet date of December 31, 2020 and the prior balance sheet data of December 31, 2019. And so, there are two strips for each line item description; one for the current balance sheet date and one for the prior balance sheet date.

Notice that there are relationships between the "strips". For example, there is a relationship between "Cash and cash equivalents", "Receivables", "Inventories" and "Current Assets". You can tell there are relationships because of the single underscores and double underscores (bold) in the rendering.

And so, the strips are not arbitrary. The strips need to be pieced together correctly.

1.4.3.Thinking "Cells" rather than "Strips"

Below, you see another version of the report "cut into strips" by automated processes[11]:

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

Using the XBRL Cloud Evidence Package, you can see information about each "strip" or cell. Further, you can click on any sell with a value and get information about that cell. For example, below you see information that describes the cell with the value of "28,900.00", the line item label "Current Assets" for the balance sheet date "2020-12-31":

Fact Characteristics and Properties

Characteristic, trait or fact	Value of characteristic, trait, or fact
Reporting Entity [Axis]	30810137d58f76b84afd (http://standards.iso.org/iso/17442)
Period [Axis]	2020-12-31
Concept	Current Assets
Fact value	28900
Units	USD
Decimals (rounding)	2
Parenthetical explanation (i.e. footnote)	(None)

Similar information exists for each report element that describes each reported number. For example, if you click on the line item "Current Assets" you will see:

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[11] Balance Sheet Generated by XBRL Cloud, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/evidence-package/contents/index.html#Rendering-BalanceSheet-Implied.html

You can see that there is additional explicit information that describes the label "Current Assets"; it is a "DEBIT", it is "Monetary" in nature, and it is associated with the concept "tb:CurrentAssets". We also see that the label "Current Assets" is in English (i.e. "en") and that it is the "Standard label". All of this information is explicitly communicated as contrast to having to be implied by reading the human readable rendering itself.

Further, the associations between reported values are described in the report model and values are verified to be consistent with that machine-readable description[12]:

Label	Rendered	Reported	Calculated	Balance	Decimals	Message
Assets [Roll Up]						
Current Assets [Roll Up]						
Cash and Cash Equivalents	26,900 +	26,900	26,900	DR	2	
Receivables	1,000 +	1,000	1,000	DR	2	
Inventories	1,000 +	1,000	1,000	DR	2	
Current Assets	28,900 +	28,900	28,900	DR	2	OK
Noncurrent Assets [Roll Up]						
Property, Plant and Equipment	13,000 +	13,000	13,000	DR	2	
Noncurrent Assets	13,000 +	13,000	13,000	DR	2	OK
Assets	41,900	41,900	41,900	DR	2	OK

Finally, other rules represent information about mathematical relations between other values. The rules below are for the entire report and give you an idea of the extent of such mathematical relations even in rather small financial reports[13]:

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[12] XBRL Cloud Evidence Package, Balance sheet calculation relations, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/evidence-package/contents/index.html#Rules-BalanceSheet-Implied.html

#	Label	Result	Rule
1	$PropertyPlantAndEquipment_BalanceStart + $CapitalAdditionsPropertyPlantAndEquipment - $DepreciationAndAmortization - $PropertyPlantAndEquipmentWrittenOff = $PropertyPlantAndEquipment_BalanceEnd (RollForward_RF6)	Pass	$PropertyPlantAndEquipment_BalanceStart + $CapitalAdditionsPropertyPlantAndEquipment - $DepreciationAndAmortization - $PropertyPlantAndEquipmentWrittenOff = $PropertyPlantAndEquipment_BalanceEnd
2	$LongtermDebt_BalanceStart + $AdditionalLongtermBorrowings - $RepaymentLongtermBorrowings = $LongtermDebt_BalanceEnd (RollForward_RF8)	Pass	$LongtermDebt_BalanceStart + $AdditionalLongtermBorrowings - $RepaymentLongtermBorrowings = $LongtermDebt_BalanceEnd
3	$NetCashFlow = ($NetCashFlowOperatingActivities + $NetCashFlowFinancingActivities + $NetCashFlowInvestingActivities) (Arithmetic_CF01)	Pass	$NetCashFlow = ($NetCashFlowOperatingActivities + $NetCashFlowFinancingActivities + $NetCashFlowInvestingActivities)
4	$Inventories_BalanceStart + $PurchasesOfInventoryForSale - $CostsOfSales - $InventoryWrittenOff = $Inventories_BalanceEnd (RollForward_RF5)	Pass	$Inventories_BalanceStart + $PurchasesOfInventoryForSale - $CostsOfSales - $InventoryWrittenOff = $Inventories_BalanceEnd
5	$Assets = ($Liabilities + $Equity) (Arithmetic_BS01)	Pass	$Assets = ($Liabilities + $Equity)
6	$Assets = ($Liabilities + $Equity) (Arithmetic_BS01)	Pass	$Assets = ($Liabilities + $Equity)
7	$Receivables_BalanceStart + $Sales - $CollectionReceivables - $AdditionsToAllowanceForBadDebts - $BadDebtsWrittenOff = $Receivables_BalanceEnd (RollForward_RF4)	Pass	$Receivables_BalanceStart + $Sales - $CollectionReceivables - $AdditionsToAllowanceForBadDebts - $BadDebtsWrittenOff = $Receivables_BalanceEnd
8	$AccountsPayable_BalanceStart + $PurchasesOfInventoryForSale - $PaymentOfAccountsPayable = $AccountsPayable_BalanceEnd (RollForward_RF7)	Pass	$AccountsPayable_BalanceStart + $PurchasesOfInventoryForSale - $PaymentOfAccountsPayable = $AccountsPayable_BalanceEnd
9	$RetainedEarnings_BalanceStart + $NetIncomeLoss = $RetainedEarnings_BalanceEnd (RollForward_RF9)	Pass	$RetainedEarnings_BalanceStart + $NetIncomeLoss = $RetainedEarnings_BalanceEnd
10	$CashAndCashEquivalents_BalanceStart + $NetCashFlow = $CashAndCashEquivalents_BalanceEnd (RollForward_RF1)	Pass	$CashAndCashEquivalents_BalanceStart + $NetCashFlow = $CashAndCashEquivalents_BalanceEnd
11	$Equity_BalanceStart + $NetIncomeLoss = $Equity_BalanceEnd (RollForward_RF2)	Pass	$Equity_BalanceStart + $NetIncomeLoss = $Equity_BalanceEnd
12	$CashAndCashEquivalents_BalanceStart + $CollectionReceivables - $PaymentOfAccountsPayable + $AdditionalLongtermBorrowings - $RepaymentLongtermBorrowings - $CapitalAdditionsPropertyPlantAndEquipment = $CashAndCashEquivalents_BalanceEnd (RollForward_RF3)	Pass	$CashAndCashEquivalents_BalanceStart + $CollectionReceivables - $PaymentOfAccountsPayable + $AdditionalLongtermBorrowings - $RepaymentLongtermBorrowings - $CapitalAdditionsPropertyPlantAndEquipment = $CashAndCashEquivalents_BalanceEnd
13	$Assets = ($CurrentAssets + $NoncurrentAssets) (Arithmetic_BS02)	Pass	$Assets = ($CurrentAssets + $NoncurrentAssets)
14	$Assets = ($CurrentAssets + $NoncurrentAssets) (Arithmetic_BS02)	Pass	$Assets = ($CurrentAssets + $NoncurrentAssets)
15	$Liabilities = ($CurrentLiabilities + $NoncurrentLiabilities) (Arithmetic_BS03)	Pass	$Liabilities = ($CurrentLiabilities + $NoncurrentLiabilities)
16	$Liabilities = ($CurrentLiabilities + $NoncurrentLiabilities) (Arithmetic_BS03)	Pass	$Liabilities = ($CurrentLiabilities + $NoncurrentLiabilities)

Notice that rules #5 and #6 specify that the balance sheet needs to balance, "Assets = Liabilities + Equity" and the green cell in the "Result" column which says "Pass" indicates that the values for the current and prior balance sheets are consistent with this rule (although the values for each computation are not shown, this is a flaw in the XBRL Cloud software application).

You see that rules #13, #14, #15, and #16 likewise test balance sheet values.

1.4.4. Unformatted Auto-generated Rendering

Another rendering of the report information shows the "strips of paper" that make up the report with great clarity. The rendering you see below as auto-generated, the representation format is Inline XBRL, but there is no organized presentation of the information, it simply serializes the raw facts that are reported. This screen shot shows a fragment of the report but if you go to the actual report you can see 100% of the reported facts[14]:

tb:DepreciationAndAmortization2	2020-01-01 | 2020-12-31	3,000
tb:Inventories	2020-12-31	1,000
tb:CashAndCashEquivalents	2019-12-31	13,000
tb:Inventories	2019-12-31	1,000
tb:LongtermDebt	2019-12-31	1,000
tb:PropertyPlantAndEquipment	2019-12-31	1,000
tb:Receivables	2019-12-31	1,000
tb:RetainedEarnings	2019-12-31	14,000
tb:BadDebtsWrittenOff	2020-01-01 | 2020-12-31	0

[13] XBRL Cloud Evidence Package, Business Rules Summary, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/evidence-package/contents/index.html#BusinessRulesSummary.html
[14] Auto-generated rendering, http://xbrlsite.azurewebsites.net/2020/master/continuous-accounting/instance-generated.html

Note that this representation also includes facts from other report fragments.

While the facts or values are provided in a flat list with no formatting to speak of; that does not mean that information provided can be inconsistent with or contradict other reported information. The rules from the previous section still apply regardless of how the information is presented.

1.4.5. About Meaning Conveyed, not Medium Used

The Accountancy Europe paper makes the following statement: (pages 8 and 9, section 2.A, third paragraph)

> "The key point is that the truth and fairness of the financial statements was achieved before the scissors were applied to cut the financial statements and also before the application of XBRL tags."

In my view, that statement is not accurate. A financial report represents information about an economic entity. The medium used to convey that meaning, the logical statements made within the report, is different than the actual information conveyed.

Auditors audit information, not the medium. Or, perhaps it is more accurate to say that auditors concern themselves with how information is conveyed using a medium. Auditors are familiar with the medium "paper" but less with the digital medium "XBRL".

Should auditors concern themselves with the proper use of the XBRL technical syntax? Well, sure they should but not how you might think. XBRL International published an XBRL *Conformance Suite*[15]. That Conformance Suite makes sure that software is working with XBRL appropriately. All that an auditor needs to do is run any XBRL-based financial report through software that complies with the XBRL Conformance Suite published by XBRL International and they will know whether the XBRL-based report is properly formatted XBRL technical syntax.

Further, ESMA likewise publishes a conformance suite.[16] Software implements that conformance suite and like the XBRL International Conformance Suite will tell you if the XBRL-based report is consistent with those machine-readable rules.

So, what does the auditor have to do to check the XBRL? Well; nothing but run those conformance suite tests to be sure the technical syntax rules are being adhered to and that ESEF rules are adhered to.

Does that mean the XBRL-based report is correct? No. The auditor does need to check the meaning conveyed by the information represented using the XBRL formatted information to be sure the meaning conveyed is correct.

For example, consider this "strip of paper":

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[15] XBRL International, XBRL 2.1, https://specifications.xbrl.org/work-product-index-group-base-spec-base-spec.html

[16] ESMA PUBLISHES ESEF CONFORMANCE SUITE, https://www.esma.europa.eu/press-news/esma-news/esma-publishes-esef-conformance-suite

The auditor needs to satisfy themselves that the concept used to represent that piece of information is the appropriate concept. The auditor should satisfy themselves that the reported fact is not inconsistent logically from other reported facts or that one fact does not contradict another fact. The auditor should make sure every mathematical relation is consistent with expectation.

The "terms" and "associations" between terms and "structures" used to express associations and "rules" used to specify what is permissible and what is not permissible and "facts" reported by the economic entity and explained by the report model using those logical statements that physically exist within such an XBRL-based report is the meaning conveyed by the report. That meaning should be (a) true and fair and (b) consistent with the logic of accounting as the auditor understands accounting.

A financial report is a logical system[17]. That logical system needs to function properly.

What is particularly interesting is that it is trivial to measure how good the auditors are doing in terms of the logic of the report. It is trivial for software to look at thousands or even tens of thousands of reports and check those reports against the known logic of financial accounting and reporting[18].

This means it is easy for others to scrutinize the work of auditors after that work has been performed.

1.4.6. Automation and Augmented Intelligence

The machine-readable XBRL technical syntax allows certain tasks and processes to be automated. This automation will most certainly make creating such reports cheaper, improve report quality, and make creating such reports take less time. Further, if the proper software is used that understands the structured information and if all the right rules are provided, then auditors can be much "smarter". Every auditor can be as smart as the smartest auditor that helped to create the machine-readable rules.

The Accountancy Europe briefing paper is right to say that the audit is done before "the XBRL tags are applied". Most organizations "bolt on" the process of creating XBRL-based reports to the end of existing financial report creation processes.

But what if that information was added to accounting systems and then flowed through the entire accounting, reporting, auditing, and even analysis processes. The fact is, that is the only way automation can be achieved.

The way I see it is that continuous accounting and continuous auditing are theoretical objectives, goals that people are striving to reach. Can "continuous" really be reached? Time will provide the answer. Focusing on whether everything can or cannot be automated is missing the point. Can certain specific tasks or processes be automated? How smart is it to keep all current processes as they are and then digitize reports at the end of the process? Perhaps it might work to

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

[18] 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

introduce the machine-readable meaning earlier in the process, perhaps even at time of transaction entry.

No one can predict every aspect of the future with 100% clarity. Optimists tend to overestimate capabilities; pessimists tend to underestimate capabilities. The right answer will be somewhere between what the optimists and the pessimists are predicting.

1.5. *Logical Systems and Logical Theory Explained in Simple Terms*

A system can be explained by a logical theory. A logical theory is an abstract conceptualization[19] of specific important details of some area of knowledge. The logical theory provides a way of thinking about an area of knowledge by means of deductive reasoning to derive logical consequences of the logical 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 logical statements used for capturing meaning or representing a shared understanding of and knowledge in some area of knowledge.

A logical theory is made up of a set of logical *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*[20] is a set of structures that are consistent with and permissible interpretations of that model.

- **Structure**: A *structure* is a set of logical statements which describe the structure.

- **Logical statement**: A *logical statement* is a proposition, claim, assertion, belief, idea, or fact about or related to the area of knowledge to which the logical theory relates. There are four broad categories of logical statements:

    - **Terms**: *Terms* are logical statements that define ideas used by the logical theory such as "assets", "liabilities", "equity", and "balance sheet".

    - **Associations**: *Associations* are logical statements that describe permissible interrelationships between the terms such as "assets is part-of the balance sheet" or "operating expenses is a type-of expense" or "assets = liabilities + equity" or "an asset is a 'debit' and is 'as of' a specific point in time and is always a monetary numeric value".

    - **Rules**: *Rules* are logical 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".

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[19] Wikipedia, *Conceptual Model*, https://en.wikipedia.org/wiki/Conceptual_model

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

- ▪ **Facts**: *Facts* are logical 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.
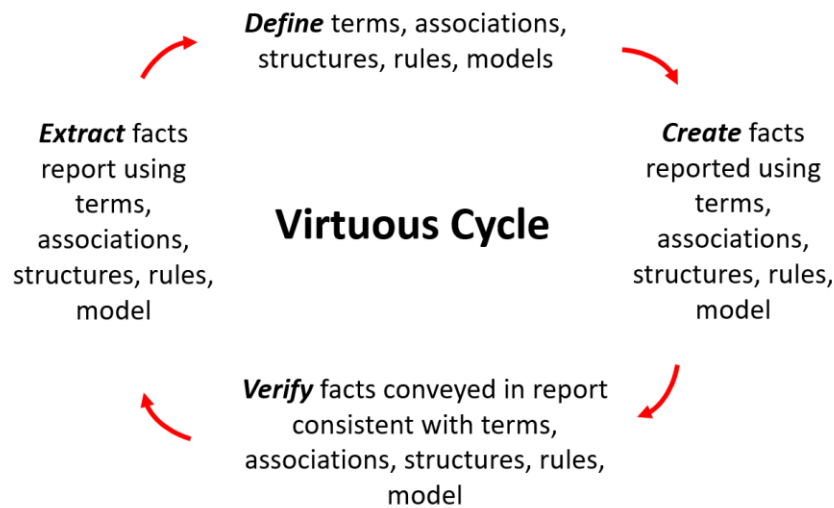
Fundamentally, a logical theory is a set of logical statements. Those logical statements can be represented in human-readable form or they could be expressed in machine-readable form. Once in machine-readable form, those logical statements can be interrogated using software applications. To the extent that this can be performed effectively; software tools can assist professional accountants, financial analysts, and others working with those logical statements.

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

A logical theory can have high to low **precision** and high to low **coverage** with respect to describing a logical system.

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 area of knowledge. *Coverage* is a measure of how completely information in a logical theory has been represented relative to the reality of the logical system for the area of knowledge.

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 logical system is properly functioning, it creates a virtuous cycle[21].

Define terms, associations, structures, rules, models

Create facts reported using terms, associations, structures, rules, model

Virtuous Cycle

Extract facts report using terms, associations, structures, rules, model

Verify facts conveyed in report consistent with terms, associations, structures, rules, model

A logical theory conveys knowledge and that knowledge can be represented within a knowledge graph. For more detailed information related to logical theories and logical systems, please see *Logical Systems*[22].

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

1.6. Logical Statements, Not XBRL Technical Syntax

Within an XBRL-based report, every statement is a logical statement (i.e. nothing is technical); you never interact with the XBRL technical syntax. This is done by using a logical theory that explains how a financial report works[23] and a framework[24] for implementing that logical theory within software applications. When you interact with software created using this framework, XBRL literally disappears into the background and professional accountants interact with the software using terms they innately understand[25]: logic

Further, while some prefer the XBRL technical syntax, others might prefer the Semantic Web Stack[26] of technologies. OMG is even taking steps with their *Standard Business Report Model (SBRM)*[27] to create a logical conceptualization of a business report that is technical syntax agnostic. Another technical syntax alternative is JSON. Fads, trends, and arbitrary personal preferences, point to the need to support multiple technical syntax alternatives. All these alternative technical syntax alternatives have one thing in common: logic.

1.7. Logic of Financial Statements

The basic high-level model of a financial report follows double-entry accounting and is described by the accounting equation which is a logical statement[28]:

$$Assets = Liabilities + Equity$$

Standards setters create financial reporting schemes which provide further details which expand on the accounting equation. By definition a standards setter cannot violate the accounting equation. The financial reporting scheme essentially defines a core set of *classes* of elements[29] used by that financial reporting scheme which reconciles to the accounting equation. The elements of financial statements are the building blocks, or **classes** of defined elements, with which financial statements are constructed by an economic entity reporting per some financial reporting scheme.

The **items** in the financial statements of a specific economic entity represent in words and numbers certain entity resources, claims against those resources, and the effects of transactions and events, circumstances, and other phenomenon that result in changes in those resources and claims. Those words and numbers are logical statements the economic entity makes to describe their financial position and financial performance.

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[22] Charles Hoffman, CPA, *Logical Systems*,
http://www.xbrlsite.com/mastering/Part02_Chapter05.A_LogicalSystems.pdf
[23] Charles Hoffman, CPA and Rene van Egmond, *Financial Report Semantics and Dynamics Theory*,
http://xbrlsite.azurewebsites.net/2016/Library/Theory-2017-06-26.pdf
[24] Charles Hoffman, CPA, *Open Source Framework for Implementing XBRL-based Digital Financial Reporting*, http://xbrlsite.azurewebsites.net/2019/Framework/FrameworkEntitiesSummary.html
[25] Charles Hoffman, CPA, *Narrative Explaining Logical Conceptualization of a Financial Report*,
http://xbrlsite.azurewebsites.net/2019/Framework/NarrativeConceptualization.pdf
[26] Wikipedia, *Semantic Web Stack*, https://en.wikipedia.org/wiki/Semantic_Web_Stack
[27] OMG, *Standard Business Report Model* (SBRM), https://omgwiki.org/SBRM/doku.php
[28] Charles Hoffman, CPA, *Accounting Equation*, http://xbrlsite.azurewebsites.net/2019/core/core-ae/Documentation.pdf
[29] Charles Hoffman, CPA, *Comparison of Elements of Financial Statements*,
http://xbrlsite.azurewebsites.net/2019/Core/ElementsOfFinancialStatements.pdf

These classes of building blocks are **intentionally interrelated mathematically** within the four core statements that make up a financial report; this is called 'articulation'.

Intermediate components, i.e. subtotals, can be used to represent the items of an economic entity within the items that comprise a financial report of the economic entity. However, these intermediate components and the items must fit into the core framework of the classes of elements that are the building blocks of any financial report created using a specific reporting scheme.

The *balance sheet* provides a roll up of assets, a roll up of liabilities and equity, and is bound by the rule "Assets = Liabilities + Equity". The *income statement* is used to compute the roll up total "Net Income" and there are rules for how the intermediate components (i.e. subtotals) of Net Income roll up. Net income then flows to the *statement of changes in equity* which is a roll forward which reconciles beginning and ending equity on the current and prior balance sheets. The *cash flow statement* is a roll up of Net Cash Flow, rules that specify how the intermediate components (i.e. subtotals) of net cash flow roll up, and a roll forward of the asset Cash and Cash Equivalents which reconciles the beginning and ending balance of that asset on the balance sheet[30].

And so, the primary financial statements are explained by:

1. The accounting equation.

2. Some set of elements of the financial statements[31] such as those for IFRS[32]: Assets, Liabilities, Equity, Contributions from Holders of Equity Claims, Distributions to Holders of Equity Claims, Income and Expenses, Income, Expenses.

3. The fundamental relations between the elements where T0 is the beginning balance sheet date, T1 is the ending balance sheet date, and P1 is the current period that reconciles the beginning and ending balance sheet: $0 = \text{Equity}^{T0} + \text{Income}^{P1} - \text{Expenses}^{P1} + \text{ContributionsFromHoldersOfEquityClaims}^{P1} - \text{DistributionsToHoldersOfEquityClaims}^{P1} + \text{Assets}^{T1} - \text{Liabilities}^{T1}$

While the model shown above which is based on "Assets = Liabilities and Equity"; some economic entities use different sorts of models. For example, some economic

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[30] Four statement model, http://xbrlsite.azurewebsites.net/2019/Core/core-ifrs/FourStatements_IFRS.jpg

[31] Charles Hoffman, CPA, *Comparison of Elements of Financial Statements*, http://xbrlsite.azurewebsites.net/2019/Core/ElementsOfFinancialStatements.pdf

[32] Core Elements of Financial Statements (IFRS), http://xbrlsite.azurewebsites.net/2019/Core/core-ifrs/

entities report using a liquidation basis style balance sheet where "Assets - Liabilities = Net Assets". "Net Assets" and "Equity" are two different labels for what is the same financial concept.

Using the rules of mathematics, the equation "Assets = Liabilities + Equity" can be converted to "Assets - Liabilities = Equity".

So, while a financial report is not a static form it is not random either. Financial reports follow patterns and these patterns can be explained using specific logical models to account for and manage the variability inherent in a financial report. Each set of items in the financial report of an economic entity must follow the accounting equation and the elements of a financial statement defined by some financial reporting scheme. All lower-level details then fit into that higher level framework.

1.8. *Similarity to Double-entry Accounting*

I see this as having similarities to the double-entry accounting system. The double-entry accounting approach offers a "parity check" by basically requiring two entries for each transaction. Essentially, double-entry accounting is concurrently using two single-entry ledgers in order to detect errors and tying that ledger with the accounting equation, "Assets = Liabilities and Equity".

This approach is similar in that all of the logical statements describing the financial report and the facts that are provided within that report are tested using automated machine-based processes to be sure the mechanical details are all appropriate.

This is not to say that automated processes can verify that 100% of the report details are appropriate, that is not currently possible and might never be possible. Verifying a report will always be a collaboration between a human and a machine that is providing assistance where it can. The actual third-party verification provided by an auditor still needs to be performed to verify the truth of each statement that exists. The logical system can only tell you if the statements that do exist are consistent with one another and other such details. Basically, once a system is configured that system can be automated effectively. But if a system changes, humans will need to be involved to execute that modification.

An XBRL-based financial report which is comprised of an XBRL taxonomy plus an XBRL instance can borrow this idea from double-entry accounting. While the notion of a "double-entry XBRL taxonomy" is not a perfect one (and might even make knowledge engineers cringe), it does make an important point between allowed variability and the rules necessary to control and manage that variability. When information is added to an XBRL taxonomy, other information must also be added in order to control, manage, and ultimately channel business professionals to success.

And so, if a new term is added; then one or more new associations or assertions will likely also need to be added.

More importantly, if business professionals can reliably create such machine-readable logical systems that will very likely have a very positive and significant impact on the functioning of an enterprise just as double-entry accounting had a significant impact on the enterprise. With the ever-increasing complexity and volume of information, being able to leverage machines effectively to help humans perform work is important.

To make all this work effectively, controlling the process effectively is essential.

1.9. Reconciling Logic Terms to Common Audit Terms

The five terms I used to describe a logical system that is functioning properly are not my terms. These terms are taken from logic and the definition of a logical system[33]: complete, consistent, valid, sound, fully expressed. Further, I have changed the definitions slightly in order to make the definitions consistent with the terms I used to explain the components of logical systems.

Below, I have provided similar terms that are more common to professional accountants and auditors when thinking about financial reports:

- **Completeness**: All relevant logical statements have been included within the financial report representation.

- **Existence**: No logical statement exists which should not be included in the financial report has been included.

- **Accuracy**: The logical statements are included in the financial report are accurate, correct, and precise.

- **Fidelity**: Considered as a whole; the logical statements provided in the financial report are a loyal representation of the actual financial position and financial performance of the reporting economic entity.

- **Integrity**: The logical statements that describe each part of a financial report provide a true and fair representation of such part and no parts are inconsistent with or contradict any other financial report part.

- **Consistency**: The logical statements are consistent with prior periods and with the reporting entity's peers as is deemed appropriate.

- **True and fair representation**: The logical statements of the financial report are a true and fair representation of the information of the reporting economic entity.

Optimally, the terms used to describe logical systems and the terms used by professional accountants and auditors should be reconcilable from one to the other.

1.10. Understanding the Logical Errors that Can Occur

There are common situations of logical errors that can occur in XBRL-based financial reports. The document *Proving Accounting, Structural, Mathematical, and Other Logic of XBRL-based Financial Reports*[34] provides detailed information about nine common errors which are summarized here:

1. Using an existing base taxonomy concept intended to represent one class of concept inadvertently to represent some other class of concept.

2. Lack of clarity as to the meaning of extension concepts.

3. Unreported high-level subtotals.

4. Variability allowed for reporting high-level accounting relationships.

5. High-level financial report line item inconsistencies and contradictions.

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

[34] Charles Hoffman, CPA, *Proving Accounting, Structural, Mathematical, and Other Logic of XBRL-based Financial Reports*, http://xbrlsite.azurewebsites.net/2019/Library/ProvingAccountingStructuralMathematicsLogic.pdf

6. Presentation relations model structure association logic errors.

7. Issues related to the mechanics of each disclosure represented as a logical report fragment.

8. Mathematical relations are not explained using machine-readable rules and then facts verified against that machine-readable explanation.

9. Verification that each report fragment that is required to be disclosure exists within the financial report.

10. Required disclosure is not included within a report.

Additional information is available that helps professional accountants and auditors understand the types of errors that exist in XBRL-based financial reports[35].

1.11. *Variability Caused by Alternative Intermediate Components*

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 is anticipated and allowed by financial reporting schemes such as US GAAP, IFRS, IPSAS, GAS, FAS, etc.[36] By far, the most variability that exists within a set of financial statements exists within the income statement. SFAS 6 discusses the notion of intermediate components[37] 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."

Variability can be caused by choosing to report different common subtotals, by choosing to report specific line items rather than others, by either providing or not providing a subtotal such as "Noncurrent assets", etc. This variability is not random, arbitrary, or illogical; there are common patterns.

Here are common examples of variability using the accounting equation terms, association, and facts:

- **Add new term**: As mentioned, the term "Net Assets" is not provided in this model but is a permissible alternative to the term "Equity" for specific industries with which an economic entity is associated.

- **Add new association**: If a new term such as "Net Assets" is created, then a new association will always be necessary to relate the new term within some a structure to existing terms.

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[35] Charles Hoffman, CPA, *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

[36] Charles Hoffman, CPA, *Comparison of Elements of Financial Statements*, http://xbrlsite.azurewebsites.net/2019/Core/ElementsOfFinancialStatements.pdf

[37] FASB, SFAC 6, page 47, paragraph 77.

- **Change existing association**: If an existing association exists such as the association of "Equity" to "Balance Sheet"; it is possible to change that existing association and replace it with another permissible association.

- **Add new rule**: If a new term is created it is likely that a new rule will also tend to be necessary. For example, if the term "Net Assets" is created, the new rule "Net Assets = Assets + Liabilities" would be created.

- **Change existing rule**: Usually, existing rule would not be changed but rather the existing rule would not be used and would be replace by some other permissible rule.

- **Add new structure**: An economic entity could decide to add an entirely new additional disclosure, creating a new structure that is used to articulate the associations between the terms that make up the new structure.

- **Change existing structure**: An economic entity could choose to modify the associations within an existing structure to provide a different but still permissible alternative disclosure.

- **Unreported fact**: An economic entity could choose to modify an existing structure to remove an association that provided an optional subtotal term and if so then the fact used to report that optional subtotal would not be provided within a report.

Note that "Change existing term" is not included in the list because it is never permissible to change the meaning of an existing term.

And so, the variability caused by these sorts of adjustments to some base model of a financial report must be managed and controlled in order be certain that the adjusted version of the model is still a permissible interpretation of a financial report and that the report is properly functioning.

1.12. Core Purpose of Financial Statement

The core purpose of a financial statement is to transfer information. Consider the following scenario:

> Two economic entities, A and B, each have information about their financial position and financial performance. They must communicate their information to an investor who is making investment decisions which will make use of the combined information so as to draw some conclusions. All three parties (economic entity A, economic entity B, investor) are using a **common set of basic logical principles** (facts, statements, deductive reasoning, inductive reasoning, etc.), **common financial reporting standard concepts and relations** (terms, relations, assertions for US GAAP, IFRS, IPSAS, etc.), and a **common world view** so they should be able to communicate this information fully, so that any inferences which, say, the investor draws from economic entity A's information should also be derivable by economic entity A itself using common basic logical principles, common financial reporting standards (terms, relations, assertions), and common world view; and vice versa; and similarly for the investor and economic entity B.