Conceptual Overview of an XBRL-based, Structured, Digital Financial Report

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December 31, 2016 (DRAFT)

The general purpose financial statement (or financial report) has existed for over two millennium. Formats for general purpose financial statements have included clay, papyrus, paper, word processor documents such as Microsoft Word, PDF, and HTML. The common thread that all these reports have is that a machine cannot read and understand these reports.

The global standard XBRL is showing promise as a structured, machine-readable information format that is also human-readable. Five years of XBRL-based financial reports submitted to the SEC by public companies is revealing how to employ this technology and enable machines to be employed to not only use such structured information for more effective and efficient analysis of reported financial information, but also enable the use of artificial intelligence, intelligent software agents, and exert systems to make the process of creating financial reports more efficient and effective.

Think of how the digital blueprint changed not only the utility of blue prints but rather the entire design, engineering, and construction of almost everything; literally that entire supply chain.

The institution of accountancy needs to create a digital, or structured, version of the general purpose financial statement which is machine-readable.

The digital general purpose financial report is an improvement that helps move the institution of accountancy forward, providing an improvement to that institution. Given today's increasing volume of financial information, complexity of financial information, and importance of financial information; it makes perfect sense to provide such a digital alternative or option.

Financial analysis has been digital for many years; first via the electronic spreadsheet and now with a multitude of options.

With digital books, maps, photos, films, music, blueprints, etc.; what about the digital financial statement does not make sense? Perhaps I am stating the obvious.

This document provides a conceptual overview of an XBRL-based, structured, digital financial report.

1. Conceptual Overview of an XBRL-based, Structured, Digital Financial Report

We live in the digital age, the information age. The paper-based financial report is an obsolete relic of the past. Unstructured[1] electronic financial reports formatted and distributed as HTML, PDF, or word processing documents are likewise obsolete. A financial report that is not only readable by humans, but also machine-readable is superior.

There is a need for a digital alternative for the general purpose financial report[2]. This section provides you with a conceptual overview of an XBRL-based, structured, digital financial report. It helps you obtain the appropriate perspective for thinking about such reports, how they work, what benefits they offer, and other characteristics of such a tool.

1.1. Conceptual overview of a structured XBRL-based digital financial report

To begin, keep in mind that the terms "digital financial report" and "structured data" mean the same thing. The CFA Institute wrote an insightful paper, *Data and Technology: Transforming the Financial Information Landscape*[3], which communicates their vision of financial reports which have been created as structured data.

"Begin with the end in mind," is habit 2 of Stephen R. Covey's, *The Seven Habits of Highly Effective People*. To explain what a digital financial report is we will start at the end. We will explain what a general purpose financial report is and how a digital financial report can also help us achieve that objective, sometime in more effective and efficient ways than traditional general purpose financial reports.

At a very high level the goal of a general purpose financial report is this: communicate information about the financial condition and financial position of an economic entity.

Generalizing this even more, the goal can be stated as: means of conveying meaningful information. To do so, that process must be reliable, repeatable, predictable, safe, cost effective, easy to use, robust, scalable, secure when necessary, auditable (track provenance) when necessary.

1.2. Historical financial reporting

General purpose financial reporting has existed for thousands of years in different forms. Below is an annual balance sheet of a State-owned farm which was drawn up by a scribe which details the account of materials and workdays for a basketry shop in 2040 BC[4]:

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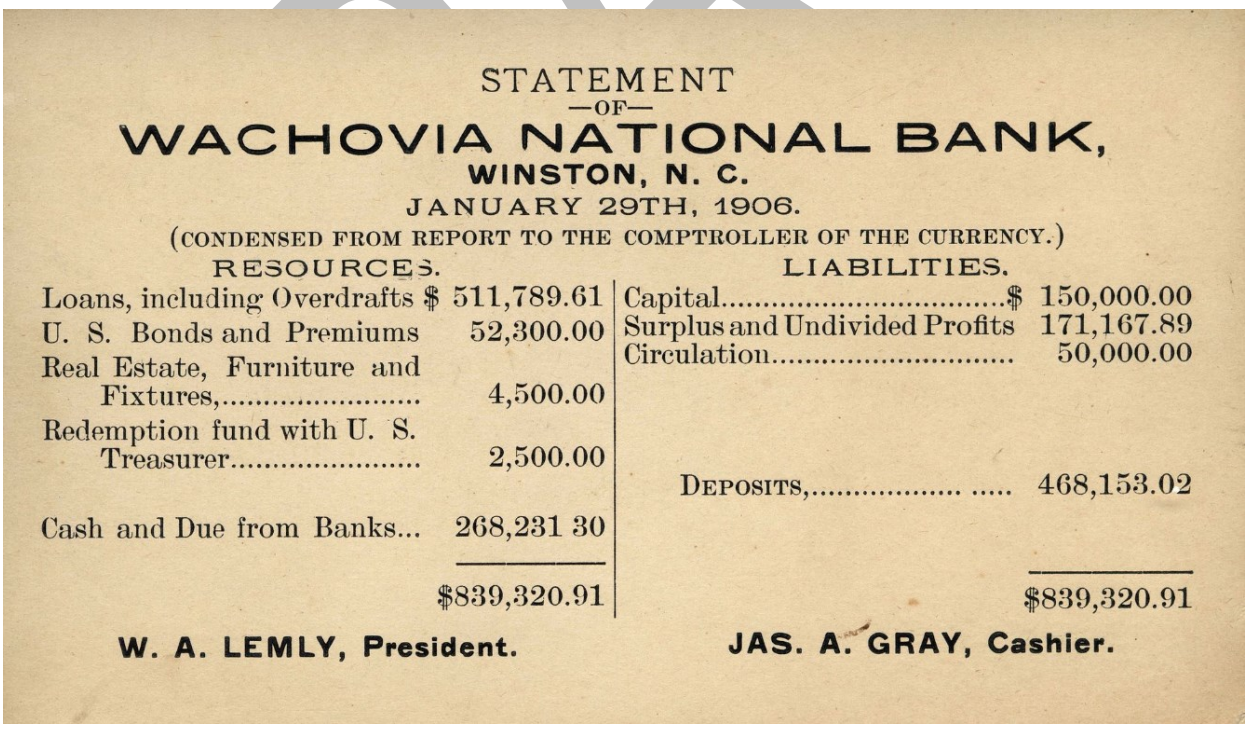
[1] YouTube, *How XBRL Works*, https://www.youtube.com/watch?v=nATJBPOiTxM

[2] *Need for digital alternative to general purpose financial report*, http://xbrl.squarespace.com/journal/2015/10/28/need-for-digital-alternative-to-general-purpose-financial-st.html

[3] CFA Institute, *Data and Technology: Transforming the Financial Information Landscape*, http://www.cfapubs.org/doi/pdf/10.2469/ccb.v2016.n7.1

[4] Annual balance sheet of a State-owned farm, drawn up by the scribe responsible for artisans: detailed account of materials and workdays for a basketry workshop. Clay, ca. 2040 BC.; Wikipedia, Retrieved October 28, 2015.

A significant advancement the general purpose financial statement[5] was the move from clay tablets to paper. Another significant advancement in financial reporting included the invention of the printing press, the copy machine, and word processing which made distributing information easier. Yet another advancement was the internet which enabled the broad distribution of financial information for literally pennies.



STATEMENT
—OF—
WACHOVIA NATIONAL BANK,
WINSTON, N. C.
JANUARY 29TH, 1906.
(CONDENSED FROM REPORT TO THE COMPTROLLER OF THE CURRENCY.)

RESOURCES.		LIABILITIES.	
Loans, including Overdrafts	$ 511,789.61	Capital	$ 150,000.00
U. S. Bonds and Premiums	52,300.00	Surplus and Undivided Profits	171,167.89
Real Estate, Furniture and Fixtures,	4,500.00	Circulation	50,000.00
Redemption fund with U. S. Treasurer	2,500.00		
		DEPOSITS,	468,153.02
Cash and Due from Banks	268,231 30		
	$839,320.91		$839,320.91

W. A. LEMLY, President. JAS. A. GRAY, Cashier.

[5] Wikipedia, *Financial Statement*, retrieved October 28, 2015, https://en.wikipedia.org/wiki/Financial_statement

For the past 100 years or so financial reporting has been mainly paper based. Only in the last 25-30 years have reports been created electronically in a word processor and then printed or saved to an electronic format such as PDF or HTML and broadly distributed simultaneously anywhere on the planet.

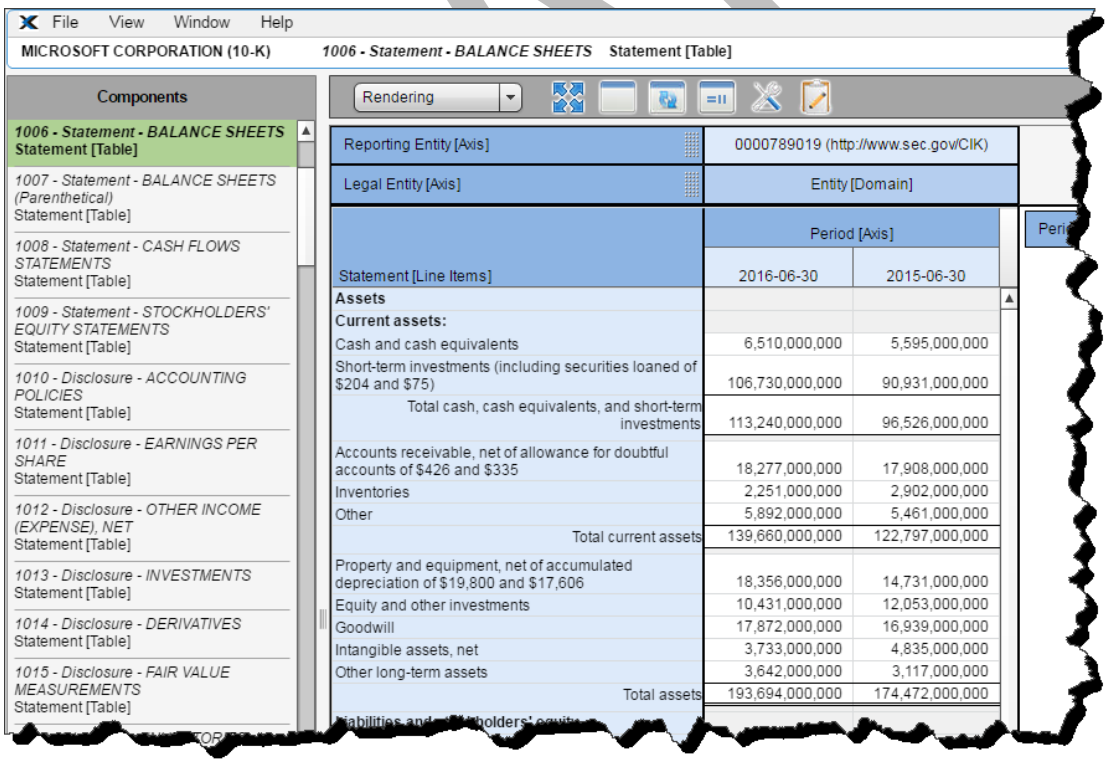
But the information contained in PDF and HTML reports can still only be read by humans. Digital financial reporting, in contrast, makes much of this information readable by computers, vastly expanding the potential for automating processes for creating financial reports and analyzing information communicated by those financial reports.

Help from machines can reduce many mechanical tasks and therefore the time and also the costs of creating and consuming financial report information and improve information quality at the same time. Automation results in increased productivity.

1.3. Benefits of digital financial reporting

With machine readability of financial reports computers can read the reported financial information, truly *understand* that information, and help users of the report make use of the reported information. But not only users of reported financial information will benefit. Creators of reports will also benefit. Computers can also help during the report creation process. For example, computers can compare reported information to mandated disclosure rules and make sure the report's creator complied with those rules.

Below is a rendering of the balance sheet of Microsoft Corporation viewable in a free publically available XBRL-based digital financial report viewer application[6]:



[6] You can try out an XBRL-based digital financial report here: https://edgardashboard.xbrlcloud.com/flex/viewer/XBRLViewer.html#instance=http://www.sec.gov/Archives/edgar/data/789019/000119312516662209/msft-20160630.xml

Here is a summary of some of the general benefits of structured digital financial reporting and machine readability of that information:

- **Increased report flexibility** - reported information can be easily and reliably reconfigured, reformatted and otherwise repurposed without rekeying to suit the specific needs of an analyst or regulator.
- **Reliable repurposing of information and improved communication** - ambiguity is reduced because for a computer to make use of the information, that information cannot be ambiguous. Going through the process of making the information easy for a computer to understand also makes it easier for humans to communicate more effectively and helps them bring into consciousness ambiguities that exist in the current process but are unconscious of[7].
- **Reliable process automation** - processes can be reliably automated because computers can reliably move information through the workflow. Linking digital financial information together based on the meaning of the information can be much more reliable than trying to link physical locations within spreadsheets, which commonly change.
- **Increased software adaptability** - software can easily adapt itself to specific reporting scenarios and user preferences because it understands the information it is working with; rather than having to get software developers involved and program to make changes, accounting professionals adjust metadata themselves to make adjustments they require.

This is not to say that humans will no longer be involved in creating or consuming financial reports. Clearly, machines will never be able to exercise judgment, which will remain something only humans can do. But to understand exactly what computers will be able to do, will never be able to do and how exactly to successfully get a computer to perform work; you need to understand a little bit about how to harness the power of a computer.

No magic is involved here. Rather, digital financial reporting relies on well-understood information technology practices, agreement on standard technical syntaxes, and carefully and clear articulation of already agreed-upon financial reporting rules articulated in a manner that computers can effectively make use of.

1.4. Essentials of a machine-readable financial report

Fundamentally, three things are needed to make financial information, or any information for that matter, understandable by computers.

First you need a *technical syntax* format that will physically carry the information between computer systems. In our case we are interested in the global standard XBRL, or the *Extensible Business Reporting Language*[8], format for expressing business information digitally. Second, you need to express the *semantics of the domain* you want the computer to understand. Semantics has to do with meaning: what are the important things in a business domain, such as financial reporting, and what are the important relations between the things that a computer must understand. If the sending computer and receiving computer do not have the same understanding of the meaning of the information, an automated information exchange can never take place as humans would always need to get involved to manually translate information from one computer to something understandable

[7] *Differentiating Alternatives from Ambiguity in US GAAP,* http://xbrl.squarespace.com/journal/2015/4/22/differentiating-alternatives-from-ambiguity-in-us-gaap.html
[8] *Introduction to XBRL*, XBRL International, https://www.xbrl.org/the-standard/what/an-introduction-to-xbrl/

by the other computer. Third, you need to express *workflow or process rules* so that the machines understand the correct protocol for exchanging and otherwise working with the information. For example, what is the protocol for correcting an error that has been detected?

1.5. Digital financial reporting alternative/option

> *"The difficulty lies not so much in developing new ideas as in escaping from old ones." (John Maynard Keynes)*

As we have said, the general purpose financial statement (or financial report) has existed for over two millennium. Formats for general purpose financial statements have included clay, paper, word processor documents such as Microsoft Word, PDF, and HTML. The common thread that all these reports have is that a machine cannot read these reports because the reports are unstructured.

The institution of accountancy needs to create a digital, or structured, version of the general purpose financial statement which is machine-readable.

With digital books, maps, photos, films, music, blueprints, etc.; what about the digital financial statement does not make sense? Perhaps this is stating the obvious.

The digital general purpose financial report is an improvement that helps move the institution of accountancy forward, providing an improvement to that institution. Given today's increasing volume of financial information, complexity of financial information, and importance of financial information; it makes perfect sense to provide such a digital alternative or option.

Financial analysis has been digital for many years; first via the electronic spreadsheet and now with a multitude of options including business intelligence (BI) or other sorts of analysis software. Until only recently, these electronic spreadsheets and other tools have all used proprietary technical syntax alternatives and the business semantics and workflows where non-standard.

Structured financial reporting that is both human-readable and machine-readable and based on the global standard XBRL completely changes the paradigm of financial reporting.

In later sections we will show you in detail how a digital financial report works, a few new skills professional accountants must acquire to work within this new digital financial report paradigm, and understand new tasks that machine-based processes can perform for professional accountants.

The next section provides a brief description of what might be possible by looking at another document that has already made this transition to digital: the blueprint.

1.6. Learning about digital financial reporting from CAD/CAM

Contrasting something new that does not yet exist to something similar that does exist is one way of understanding something[9]. Digital financial reporting has the opportunity to do for the financial report and the financial reporting supply chain what CAD/CAM did for not only the blueprint, but for the entire product design and manufacturing life cycle.

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[9] This blog post provides three videos which show how CAD works, helps you to imagine how digital financial reporting will work; *Intelligent XBRL-based Digital Financial Reports*, http://xbrl.squarespace.com/journal/2017/1/1/intelligent-xbrl-based-digital-financial-reports.html

1.7. Digital blueprint

Computer-aided design[10] (CAD) is the use of computer systems to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. Computer-aided manufacturing[11] (CAM) is the use of software to control machine tools such as numerically controlled machines (NC).

In CAD/CAM software architectural objects have relationships to one another and interact with each other intelligently. For example, a window has a relationship to the wall that contains it. If you move or delete the wall, the window reacts accordingly.

In addition, in CAD/CAM software machine-readable architectural objects maintain dynamic links with construction documents and specifications, resulting in more accurate project deliverables. When someone deletes or modifies a door, the door schedule is automatically updated in your local application's database and perhaps even in the database of the door supplier. Spaces and areas are update automatically when the size of a room is changed and calculations such as total square footage are always up to date. That means, say, that the amount of paint necessary to cover a room or an entire building is always updated. Blueprints can be sent directly to numerically controlled[12] (NC) machines.

Imagine what it would be like to construct a 100 story sky scraper, an iPhone, or a Boeing 777 if all the blueprints were paper-based. Turning this around, digital blueprints enable process and other improvements which allow more sophisticated products to be created effectively and efficiently.

1.8. Expert systems for creating financial reports

Expert systems are computer programs that are built to mimic human behavior and knowledge. Expert systems are computer applications that perform a task that would otherwise be performed by a human expert. A model of the expertise of a domain of knowledge of the best practitioners or experts is put into machine-readable form and the expert system reaches conclusions or takes actions based on that information.

CAD/CAM software is an expert system that understands architectural design and engineering objects. CAD/CAM systems understand what thing like buildings, walls, doors are and the relations between those things.

Digital financial report creation and analysis software will be an expert system that understands things like economic entities, reported facts such as "Assets", parts of a financial report such as a "balance sheet" and an "income statement"; characteristics of financial reports such as the difference between a "business segment" and a "geographic area"; and other such information about a financial report.

In his book, *Systematic Introduction to Expert Systems*, Frank Puppe describes what an expert system is, how they work, and what they can achieve. Frank Puppe explains in his book that there are three general categories of expert systems:

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[10] *Computer-aided Design*, https://en.wikipedia.org/wiki/Computer-aided_design

[11] *Computer-aided Manufacturing*, https://en.wikipedia.org/wiki/Computer-aided_manufacturing

[12] *Numerical control*, https://en.wikipedia.org/wiki/Numerical_control

- **Classification or diagnosis type**: helps users of the system select from a set of given alternatives.
- **Construction type**: helps users of the system assemble something from given primitive components.
- **Simulation type**: helps users of the system understand how some model reacts to certain inputs.

A digital financial report creation tool is basically an expert system that helps its user, a professional accountant, assemble and generate an external financial report. The final product, the financial report, could be generated in human-readable form like the HTML, PDF, or word processing document-type outputs; and/or in machine-readable form such as XBRL or other machine-readable formats.

A software based expert system has four primary components:

- **Database of facts**: A database of facts is a set of observations about some current situation or instance. The database of facts is "flexible" in that they apply to the current situation. The database of facts is machine-readable. An XBRL instance is a database of facts.
- **Knowledge base**: A knowledge base is a set of universally applicable rules created based on experience and knowledge of the practices of the best domain experts generally articulated in the form of IF…THEN statements or a form that can be converted to IF...THEN form. A knowledge base is "fixed" in that its rules are universally relevant to all situations covered by the knowledge base. Not all rules are relevant to every situation. But where a rule is applicable it is universally applicable. All knowledge base information is machine-readable. An XBRL taxonomy is a knowledge base.
- **Rules processor/inference engine**: A rules processor/inference engine takes existing information in the knowledge base and the database of facts and uses that information to reach conclusions or take actions. The rules processor/inference engine is the machine that processes the information. Some problem solving logic[13] is used by the business rules processor. An XBRL Formula processor is a rules processor and inference engine.
- **Explanation mechanism**: The explanation mechanism explains and justifies how a conclusion or conclusions are reached by the problem solving logic of the expert system. It walks you through which facts and which rules were used to reach a conclusion. The explanation mechanism is the results of processing the information using the rules processor/inference engine and justifies why the conclusion was reached. The output of an XBRL Formula processor is an explanation mechanism.

The four primary components of an expert system are generally wrapped within some graphical user interface that presents the expert system to the user of the software based system.

Rather than each software application producing a new theory expressed in its own unique language; a digital financial report is based on global standard syntax, global standard semantics, and global standard workflow. And so, engines or machines can be used to effectively and efficiently process digital financial reports and information can be exchanged

[13] *Comprehensive Introduction to the Notion of Problem Solving Logic for Professional Accountants*, http://xbrlsite.azurewebsites.net/2016/Library/ComprehensiveIntroductionToNotionOfProblemSolvingLogicForProfessionalAccountants.pdf

between machines using the global standard technical syntax which has global standard meaning. Other machines can be used in this process.

- A **finite-state machine**[14] is a computing model used or paradigm to represent and control execution flow within a software application. Finite-state machines are very useful for implementing expert systems because they reduce software creation complexity. One benefit is that there is an audit trail that shows what happens as different pieces of information are input.
- A **workflow engine**[15] is a software application/system that defines, manages, and monitors business processes, activities, and tasks used in the process of creating a financial report.
- A **business rules engine**[16] is a software application/system that executes one or more business rules in a runtime production environment.
- An **inference engine or reasoner**[17] is a piece of software able to infer logical consequences from a set of asserted facts or axioms.

The structured global standard syntax, the software machines/engines and their problem solving logic, and the agreed upon reporting standards of reporting schemes such as US GAAP, IFRS, and others work together to make the creation of such expert systems cost effective, make the software systems easy to use by the average professional accountant, and therefore enable work to be automated using computer processes which could here-to-for only be performed using manual processes.

1.9. Intelligent software agents assisting humans

Artificial intelligence is the automation of activities that we associate with human thinking and activities such as decision making, problem solving, learning and so on[18].

Expert systems is a branch of artificial intelligence. An intelligent agent is software that assists people and acts on their behalf. Intelligent agents work by allowing people to:

- delegate work that they could have done to the agent software,
- perform repetitive tasks,
- remember things you forgot,
- intelligently find, filter and summarize complex information,
- customize information to your preferences,
- learn from you and even make recommendations to you.

An agent is an entity capable of **sensing** the **state** of its **environment** and **acting** upon it based on a set of specified **rules** using some problem solving logic. An agent performs specific tasks on behalf of another. In the case of software, an agent is a software program.

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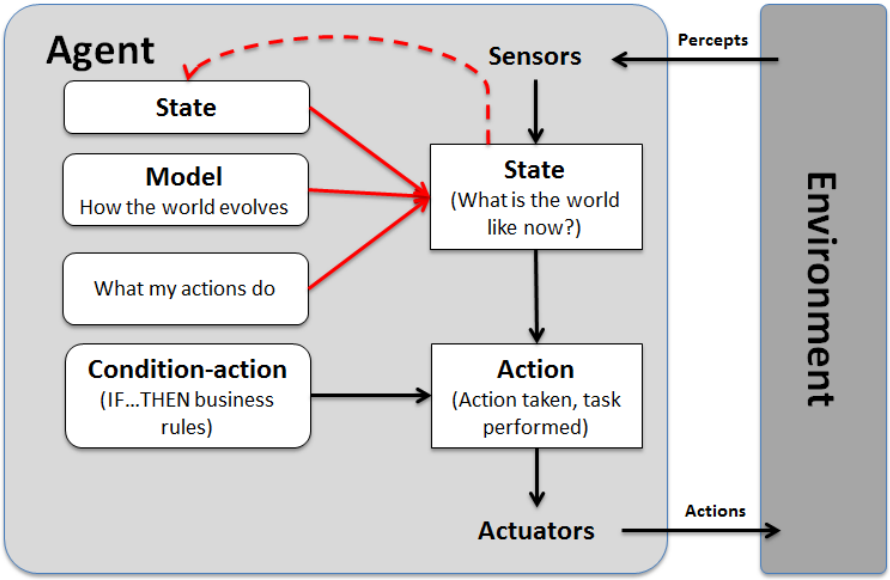
[14] *Finite-state machine*, https://en.wikipedia.org/wiki/Finite-state_machine
[15] *Workflow engine*, https://en.wikipedia.org/wiki/Workflow_engine
[16] *Business rules engine*, https://en.wikipedia.org/wiki/Business_rules_engine
[17] *Semantic reasoner*, https://en.wikipedia.org/wiki/Semantic_reasoner
[18] *Introduction to Artificial Intelligence Terminology*, http://xbrl.squarespace.com/journal/2016/7/21/introduction-to-artificial-intelligence-terminology.html

The main difference between a software agent and an ordinary program is that a software agent is autonomous; that is, it must operate without direct intervention of humans or others. There are many different types of intelligent software agents[19].



Intelligent agents can perform sophisticated work. A rational agent is one that acts so as to achieve the best outcome or, when there's uncertainty, the best expected outcome. Rationality as used here refers to following the rules of logical reasoning (problem solving logic), making correct inferences, and selecting the appropriate action that will lead to achieving the desired goal.

Machine-readable business rules are key to creating intelligent software agents that provide the functionality within an expert system.

1.10. Important role of machine-readable business rules

The Merriam-Webster dictionary defines anarchy[20] as "a situation of confusion and wild behavior in which the people in a country, group, organization, etc., are not controlled by rules or laws." Business rules prevent information anarchy[21].

Business rules guide, control, or influence behavior[22]. Business rules cause things to happen, prevent things from happening, or suggest that it might be a good idea if something did or did not happen. Business rules help shape judgment, help make decisions, help evaluate, and help reach conclusions.

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[19] *Comprehensive Introduction to Intelligent Software Agents for Professional Accountants (DRAFT)*, http://xbrlsite.azurewebsites.net/2016/Library/ComprehensiveIntroductionToIntelligentSoftwareAgentsForProfessionalAccountants.pdf

[20] Anarchy definition, Merriam-Webster, http://www.merriam-webster.com/dictionary/anarchy

[21] *Understanding that Business Rules Prevent Anarchy*, http://xbrl.squarespace.com/journal/2016/7/15/understanding-that-business-rules-prevent-anarchy.html

[22] *Comprehensive Introduction to Business Rules for Professional Accountants*, http://xbrlsite.azurewebsites.net/2016/Library/ComprehensiveIntroductionToBusinessRulesForProfessionalAccountants.pdf

Business rules arise from the best practices of knowledgeable business professionals. A business rule is a rule that describes, defines, guides, controls, influences or otherwise constrains some aspect of knowledge or structure within some problem domain.

Don't make the mistake of thinking that business rules are completely inflexible and that you cannot break rules. Sure, maybe there are some rules that can never be broken. Maybe there are some rules that you can break. It helps to think of breaking rules as penalties in a football game. The point is that the guidance, control, and influence offered by business rules is a choice of business professionals.

Business professionals interact with business rules every day by may not even realize it. Most business rules are in human readable form. But business rules can be represented in both human-readable form and machine-readable form. With the move to digital, more and more business rules are being represented in both human readable form and more importantly machine-readable form. Machine-readable business rules help automate processes which have been manual in the past.

Key to making an expert system or intelligent software agent work is business rules[23] of the domain being put into machine-readable form.

Business rules provide a thick metadata layer that enables computer systems to perform useful work. The more business rules that exist, the more work a computer system can perform.

A simple example of a business rule is "Assets = Liabilities and Equity", the accounting equation. An example of a more comprehensive set of business rules is accounting and reporting checklists[24] that are used by professional accountants to create external financial reports. Today, these business rules are organized in the form of a human-readable accounting and disclosure checklist which are used as a memory jogger by professional accountants creating a financial report. In the future this information will be organized as machine-readable business rules that guide expert systems software[25].

1.11. Zero defect XBRL-based digital financial report

The notion of a *Zero Defect XBRL-based digital financial report* creation is a collection of values, principles, techniques, and practices. It is a philosophy. The objective is to create an XBRL-based digital financial report which is free from objective mistakes such as logical, mechanical, and mathematical defects. The philosophy is a means to achieving the objective.

Having financial reports free from such easy to agree with objective mistakes lets professional accountants and analysts that interact with such reports be confident in the meaning of the underlying facts being conveyed by the report so that they can focus on the subjective aspects where they add the most value, areas where computer assisted verification of financial reports is impossible because of the limitations of computer capabilities in processing information[26].

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[23] *Business Rules Manifesto*, http://www.businessrulesgroup.org/brmanifesto.htm

[24] *Automating Accounting and Reporting Checklists*, http://xbrl.squarespace.com/journal/2016/5/5/automating-accounting-and-reporting-checklists.html

[25] *World's First XBRL-based Digital Financial Reporting Checklist*, http://xbrl.squarespace.com/journal/2016/11/4/worlds-first-xbrl-based-digital-financial-reporting-checklis.html

[26] To understand that a computer's ability to process information is not infinite, please read *Comprehensive Introduction to the Notion of Problem Solving Logic*,

Machine-readable business rules provide a safety net of direct evidence to support report quality and compliance with reporting standards and regulatory rules. With this approach, near zero defects (Sigma level 6[27], 99.99966% correct) is achievable at a lower cost and higher quality than current manually oriented approaches. Further, quality is verifiable whereas under current approaches since measurements cannot really be taken true quality levels are unknown.

And so, the financial report is verified with the assistance of automated business rules and all such business rules must pass. Business rules are suggestive evidence that a financial report has no logical, mechanical, or mathematical defects. Passing all business rules is not definitive proof that a report is 100% correct in all regards (because business rules could be missing), but the business rules are certainly an excellent first line of defense and if the appropriate business rules are created a very high comfort level is achievable.

This leaves professional accountants to focus on the subjective areas which are beyond the capabilities of machine-based processes to verify.

1.12. Example of business rules guiding report creation

A simple example helps you understand how business rules provide leverage. This simple example highlights the difference between the current approach used to create financial reports in unstructured form or even a structured form and a process where business rules drive the report creation process fewer defects at a lower overall cost.

Current approach:

- Step 1: Provide fact "Assets".
- Step 2: Provide fact "Liabilities and equity"
- Report complete.

Give the steps above, what prevents the creator of a financial report from creating the fact "Assets" with a value of say 1,000; creating the fact "Liabilities and equity" with a value of "1,500"; and then submitting that report to the SEC or other regulator? Nothing prevents the report error above from being submitted to a regulator, even though the report violates the accounting equation. And that is exactly the sort of thing that is going on with XBRL-based public company financial filings to the SEC.

Business rules driven approach:

- Step 1: Create business rule: "Assets = Liabilities and equity"
- Step 2: Create fact "Assets"
- Step 3: Create fact "Liabilities and equity"
- Report complete.

The business rule prevents facts that would violate the accounting equation from inadvertently being created. Software uses the business rule created in Step 1 to monitor the report creation process. Given these steps above, it is impossible to create a financial report that violates the logical relationship specified by the accounting equation, a

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http://xbrlsite.azurewebsites.net/2016/Library/ComprehensiveIntroductionToNotionOfProblemSolvingLogicForProfessionalAccountants.pdf

[27] Wikipedia, *Six Sigma, Sigma Levels*, retrieved November 12, 2016, https://en.wikipedia.org/wiki/Six_Sigma#Sigma_levels

fundamental rule of accounting. Now, this one rule is provided only as a basic and easy to understand example.

1.13. Benefits offered by expert systems

In the future, the accounting and reporting rules will exist in both human-readable and machine-readable form and will drive the expert systems and intelligent software agents which professional accountants use to create financial reports. Benefits from the use of expert systems and intelligent software agents include:

- **Automation**: elimination of routine, boring, repetitive, mundane, mechanical tasks that can be automated
- **Consistency**: computers are good at performing repetitive, mechanical tasks without variation whereas humans are not; computers do not make mistakes and are good at repeating exactly the same thing each time
- **Diligence and tenacity**: computers excel at paying attention to detail; they never get bored or overwhelmed and they are always available and will keep doing their job until the task is complete with the same attention to detail
- **Reduced down-time**: computer based expert systems are tireless and do not get distracted
- **Availability**: such computer based expert systems are always available simultaneously in multiple places at one time; you get quick response times and can replace absent or scarce experts
- **Training**: the best practices of the best practitioners can be available to those that are new to and learning about a domain of knowledge
- **Longevity and persistence**: computer based expert systems do not change jobs or retire so knowledge gathered by an organization can remain within that organization
- **Productivity**: computer based expert systems are cheaper that hiring experts and costs can be reduced a the same time that quality increases resulting in increased productivity
- **Multiple opinions**: Systems can integrate the view of multiple experts within a single system and choose between the preferred view of multiple expert opinions in the same system
- **Objectivity**: computers apply the same inductive and deductive logic consistently; emotion and personal preferences can be eliminated where they should be eliminated

Critical to understanding the sorts of tasks that expert systems will be capable of performing and should not or will never be able to perform takes the understanding of a domain professional. While computer based expert systems can effectively automate some work, this does not imply that these systems will automate all work or replace humans. They simply won't because they cannot. Computers are dumb beasts. There is a difference between subjectivity and objectivity; there is a difference between a mechanical task and a

task requiring professional judgement. Professional accountants need to understand the difference[28].

1.14. Automating "the last mile" of disclosure management

So exactly what can be automated? A lot of people are referring to what we call digital financial reporting as disclosure management.

Mike Willis, a PWC partner, wrote an article *Disclosure management: Streamlining the Last Mile*[29] which explains how software applications can enable a streamlining of current "last mile" manual financial report assembly and review processes. He points out that companies can increase net benefits by gaining a clear understanding of common areas where opportunities exist for financial reporting process enhancement. This is a summary of what a disclosure management system needs to do, per Mike Willis:

An effective disclosure management implementation should enable many of the capabilities and process enhancements such as:

- automated spreadsheet assembly;
- automated report assembly;
- automated report validation;
- automated narrative text generation;
- contextual review process;
- automated XBRL reports;
- automated benchmarking;
- explicit references;
- collaborative review processes;
- virtual service center.

What Mike Willis is pointing out is only the tip of a much bigger iceberg.

1.15. Digitizing financial reports

In an interview with *Wired* magazine[30], Barak Obama (yes, the president of the United States discussing artificial intelligence) made the following statement about self-driving cars:

> "There are gonna be a bunch of choices that you have to make, the classic problem being: If the car is driving, you can swerve to avoid hitting a pedestrian, but then you might hit a wall and kill yourself. It's a moral decision, and who's setting up those rules?"

And so, how do you actually make digital financial reporting work? This example which relates to self-driving cars points out something important that accounting professionals

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[28] *Comprehensive Introduction to Knowledge Engineering for Professional Accountants*, http://xbrlsite.azurewebsites.net/2016/Library/ComprehensiveIntroductionToKnowledgeEngineeringForProfessionalAccountants.pdf

[29] Mike Willis, CPA, PWC, *Disclosure Management: Streamlining the Last Mile*, https://www.pwc.com/gx/en/xbrl/pdf/pwc-streamlining-last-mile-report.pdf

[30] Wired, *Barack Obama, Neural Nets, Self-driving Cars, and the Future of the World*, https://www.wired.com/2016/10/president-obama-mit-joi-ito-interview/

need to consider when thinking about XBRL-based digital financial reports: who writes the rules?

Professional accountants have to understand that this is an engineering process. Professional accountants need to understand a few things about knowledge engineering[31]. Professional accountants need to understand how a problem solving logic works and how the rules and logic interact to make computers do their work. This will help them understand how to get computers to serve their needs. Second, you have to have a framework and theory[32] to think about digital financial reports. Without a framework and theory, all that you have to work with is the XBRL technical syntax. That will not work because that level of digital financial reporting is too technical and impossible for the average business professional to understand. That is why professional accountants need to learn a few new things and understand the framework and theory of a digital financial report.

Anyone can create something that is complex[33]. But it is hard work to create something that is simple. As Steve Jobs put it, creating something that is simple and elegant to use is the ultimate sophistication.

> "It takes a lot of hard work," Jobs said, "to make something simple, to truly understand the underlying challenges and come up with elegant solutions." As the headline of Apple's first marketing brochure proclaimed in 1977, "Simplicity is the ultimate sophistication."

Simplistic is dumbing down a problem in order to make the problem easier to solve. Simplistic ignores complexity in order to solve a problem which can get you into trouble. Simplistic is over-simplifying. Simplistic means that you have a naïve understanding of the world, you don't understand the complexities of the world. Removing or forgetting complicated things does not allow for the creation of a real world solution that actually work.

Simple is something that is not complicated, that is easy to understand or do. Simple means without complications. An explanation of something can be consistent with the real world, consider all important subtleties and nuances, and still be simple, straight forward, and therefore easy to understand.

1.16. Digitizing financial report audit schedules

In a paper *Data and Technology: Transforming the Financial Information Landscape*[34], the CFA Institute describes the currently inefficient system used to create financial reports and calls for a broader and deeper use of structured data to achieve greater efficiencies.

Further, the CFA Institute points out that the financial report audit process can be more effective and efficient if a standardized data model for commonly requested audit and other

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[31] *Comprehensive Introduction to Knowledge Engineering for Professional Accountants*, http://xbrlsite.azurewebsites.net/2016/Library/ComprehensiveIntroductionToKnowledgeEngineeringForProfessionalAccountants.pdf

[32] *Financial Report Semantics and Dynamics Theory*, http://xbrl.squarespace.com/fin-report-sem-dyn-theory/

[33] *Understanding the Law of Conservation of Complexity*, http://xbrl.squarespace.com/journal/2015/5/24/understanding-the-law-of-conservation-of-complexity.html

[34] CFA Institute, *Data and Technology: Transforming the Financial Information Landscape*, page 5, https://www.amazon.com/Data-Technology-Transforming-Financial-Information/dp/194271324X/

information were used. The CFA Institute points[35] to the American Institute of Certified Public Accountants (AICPA) *Audit Data Standards*[36] as a set of such standard audit schedules.

1.17. Broader trend of digital business reporting

A financial report is a type of business report. Digital financial reporting is part of a much broader trend which is digital business reporting. A digital business report is the electronic spreadsheet[37] reimagined. Add to this the technology offered by digital distributed ledgers[38]. Some people use the term triple-entry accounting[39].

Imagine a sematic spreadsheet which is like a mini-expert system which any business professional can create and use.

We won't go into any more detail at this point; we only wanted to mention this broader trend to help you tie all these pieces together in your mind.

1.18. Risk of multiple digital financial report standards

Unless someone consciously and explicitly creates one global standard digital financial report specification then there is a risk that multiple digital financial report specifications will exist. While consciously and explicitly creating one global standard digital financial report specification is no guarantee that only one such specification will exist; if no one specification is created it is at least highly likely that multiple specifications will come into existence and those digital financial report specifications may or may not be interoperable. Further, if one global standard specification is not created it opens up the possibility of multiple proprietary standards which are even less likely to be interoperable.

While it is not the end of the world if there are two or perhaps even a few more global standards for digital financial reporting it is the business professional who will ultimately pay the price for redundant and potentially non-interoperable global standards. And this is not to say that if two global standards exist for conscious reasons and with explicit differences in functionality which someone can point to and explain. There is nothing wrong with two global standards if business professionals require two global standards.

What would be a travesty is if there were 10 global standards when 1 global standard would have done and business professionals pay for the inattention which caused that problem to occur with higher priced software.

Imagine a bank trying to implement digital financial reporting in order to reduce the costs of collecting and managing financial information in support of a commercial loan. Say that digital financial reporting was adopted and that for one reason or another 10 different standards for creating a digital financial report existed. Say the bank had 10,000 customers

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[35] CFA Institute, *Data and Technology: Transforming the Financial Information Landscape*, page 14, https://www.amazon.com/Data-Technology-Transforming-Financial-Information/dp/194271324X/

[36] American Institute of Certified Public Accountants (AICPA), *Audit Data Standards Library*, https://www.aicpa.org/interestareas/frc/assuranceadvisoryservices/pages/auditdatastandardworkinggroup.aspx

[37] *Understanding Cell Stores and NOLAP, the Future of the Spreadsheet*, http://xbrl.squarespace.com/journal/2014/11/14/understanding-cell-stores-and-nolap-the-future-of-the-spread.html

[38] *Understanding Digital Distributed Ledgers*, http://xbrl.squarespace.com/journal/2015/12/3/understanding-digital-distributed-ledgers.html

[39] *Triple-entry Accounting System*, http://xbrl.squarespace.com/journal/2015/11/30/triple-entry-accounting-system.html

who had loans and who now must submit digital financial reports to the bank. Say the 10 different standards where used equally, 1,000 customers used each of the 10 different formats. How would that work out for the bank which needed to deal with 10 different formats?

1.19. Framework for understanding digital financial report mechanics

A framework is a set of principles, assumptions, ideas, concepts, values, rules, laws, agreements, and practices that establishes the way something operates. A theory is a tool for understanding, explaining, and making predictions about a system. What is conspicuously missing from the minds of most professional accountants and auditors are a framework and a theory relating to how to think about digital financial reports. The *Financial Report Semantics and Dynamics Theory*[40] is what Rene van Egmond and I created to provide this framework.

[40] *Financial Report Semantics and Dynamics Theory*, http://xbrlsite.azurewebsites.net/2016/Library/Theory-2016-08-31.pdf