# 1. Principles

This section provides a set of principles that helps the reader think about XBRL-based digital financial reports.

Principles help you think about something thoroughly and consistently. Overcoming disagreements between stakeholders and even within groups of stakeholders is important. Agreement between stakeholder groups and within stakeholder groups contributes to harmony. Lack of agreement contributes to dissonance. Principles help in the communications process.

I would argue that a first step, if not the first step, of arriving at harmony is **outlining the interests, perceptions, positions, and risks** of each constituency/stakeholder group[1].

A "stakeholder" is anyone that has a vested interest. Another term for stakeholder is "constituent". A "constituent" is a component part of something.

Foundational to arriving at harmony is having a common conceptual framework including a set of consistent principles or assumptions or world view for thinking about the system. For example, accounting and financial reporting have such a conceptual framework including principles/assumptions such as "materiality" and "going concern" and "conservatism".

This "framework for agreeing" helps the communications process which increases harmony and decreases dissonance. This is about bringing the system into balance, consciously creating the appropriate equilibrium/balance.

The following is a set of principles which professional accountants can use to understand their perceptions, positions, and risks when it comes to financial reports. None of these principles is technical, all should be easy to understand.

## *1.1. Prudence dictates that using financial information from an XBRL-based digital financial report should not be a guessing game.*

Safe, reliable, predictable, automated reuse of reported financial information by machine-based processes is preferable to creating a guessing game. Imagine numerous different software developers creating algorithms to use XBRL-based financial information. What helps guarantee that the results returned by each software algorithm are the same where they should be the same? How useful is such an XBRL-based financial report to automated machine-based processes if the reports contain defects?

General purpose financial reports tell a story. Different business professionals using different software tools must derive the same meaning from the same financial report. While business professionals are free to interpret the conveyed meaning of financial information as they might choose; the conveyed meaning itself should be objective and not be subject to interpretation.

[1] Charles Hoffman, CPA, *Professional Accountant's Interests, Perspective, Position, and Risks*, http://www.xbrlsite.com/mastering/Part01_Chapter02.I_ProfessionalAccountantsPerspective.pdf

## 1.2. A near zero defect financial report is useful, a defective financial report is not.

It is difficult, perhaps even impossible, for humans to create things that don't have errors. But a conscious command of rigorous processes and standards of excellence can contribute to minimizing defects[2]. But what is an acceptable defect rate?

The Six Sigma[3] philosophy offers a target acceptable defect rate of 0.00034% or 99.99966% correct. This philosophy can be applied to the information contained within an XBRL-based digital financial report. Something along those lines is likely appropriate.

Defects can be identified by taking measurements. The extent to which something is correct can likewise be determined using measurements. But how do you distinguish between something that is correct (i.e. not a defect) and something that is a defect? The answer is rules.

## 1.3. Rules prevent anarchy.

Anarchy is defined 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." Rules[4] prevent anarchy.

Rules guide, control, suggest, or influence behavior. 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. Rules help shape judgment, help make decisions, help evaluate, help shape behavior, and help reach conclusions.

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

Don't make the mistake of thinking that 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, suggestions, and influence offered by rules is a choice of business professionals.

The meaning of a business rule is separate from the level of enforcement someone might apply to the rule.

## 1.4. The only way to achieve a meaningful exchange of information without dispute is with the prior existence of and agreement as to a standard set of technical syntax rules, business semantics rules, and workflow rules.

Meaningful exchange[5] relates to exchange without disputes as to precise meaning, it means unambiguous interpretation, it means resolving conflicts and inconsistencies.

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[2] Charles Hoffman, CPA, *Method*, http://www.xbrlsite.com/mastering/Part02_Chapter05.N1_Method.pdf

[3] Wikipedia, *Six Sigma, Sigma Levels*, retrieved November 25, 2016, https://en.wikipedia.org/wiki/Six_Sigma#Sigma_levels

[4] Charles Hoffman, CPA, *Rules*, http://www.xbrlsite.com/mastering/Part02_Chapter05.F_Rules.pdf

Consider this scenario: Two public companies, A and B, each have some knowledge about their financial position and financial condition. They must communicate their knowledge 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 are using a common set of basic logical principles (facts known to be true, deductive reasoning, inductive reasoning, etc.) and common financial reporting standards (i.e. US GAAP, IFRS, etc.), so they should be able to communicate this information fully, so that any inferences which, say, the investor draws from public company A's input should also be derivable by public company A using basic logical principles and common financial reporting standards, and vice versa; and similarly for the investor and public company B.

What goes into a financial report can be subjective, subject to professional judgement. How the report itself functions is completely objective, subject to logical, mechanical, and mathematical rules. Creators and users of such information should understand the intended logical interpretation of the information.

## *1.5. Explicitly stated information or reliably derived information is preferable to implicit information.*

The rules of logic are well developed and understood. Formal logic is used to precisely describe complex systems such as safety critical railway signaling, medical device functionality, and nuclear power systems, or our system of mathematics.

Facts can be true or facts can be false; but a fact cannot be both true and false in the same system[6]. The well-established rules of deductive reasoning and inductive reasoning can be used to reliably derive new facts from existing facts. Logical deduction and induction is a completely different process from implying information. Implying is basically making an educated guess based on incomplete explicit or derived facts. When information is implied, two different rational people can arrive at two different answers to the same question and both can be correct. The important point here is that explicitly provided facts, logically derived facts, and implying information are different processes.

Basically, if information is vague, ambiguous, contradictory, or unclear; a computer process working with such information can, at best, return something that is vague, ambiguous, contradictory, unclear, or nothing at all. It is really that straight forward.

## *1.6. Digital financial reports can be guaranteed to be defect free using automated processes to the extent that machine-readable business rules exist.*

Point #4 above states that meaning can be exchange reliably only to the extent that business rules are provided. Those business rules can come in two forms: human-readable and machine-readable. It is only to the extent that machine-readable business rules are available to automated machine-based processes that those automated processes can guarantee an XBRL-based digital financial report to be

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[5] Charles Hoffman, CPA, *Exchanging Complex Financial Information*, http://www.xbrlsite.com/mastering/Part02_Chapter05.A_ExchangingComplexFinancialInformation.pdf

[6] Charles Hoffman, CPA, *Logical Systems*, http://www.xbrlsite.com/mastering/Part02_Chapter05.A_LogicalSystems.pdf

defect free. Defect free is defined as the objectivize logical, mechanical, and mathematical relations between reported facts. Beyond those machine-readable business rules, manual processes are necessary to detect and correct defects.

## *1.7. When possible to effectively create, machine-based automated processes tend to be more desirable than human-based manual processes because machine processes are more reliable and cost less.*

Machines are good at performing repetitive tasks. Humans are good at other things. Machines should do what machines are good at and can effectively do; humans should do what humans are good at and humans can effectively do and what machine-based automated processes cannot do.

Humans augmented by machine capabilities, much like an electronic calculator enabling a human to do math quicker, will empower knowledge workers who know how to leverage the use of those machines.

## *1.8. Computers have limited reasoning capacity.*

Computers are machines[7]. Computers are good at performing repetitive tasks, over and over, reliably. Computers are not good at: intuition, creativity, innovation, improvisation, exploration, imagination, judgement, politics, law, unstructured problem solving, non-routine tasks, identifying and acquiring new relevant information, compassion. Machines should do things that machines are good at, humans should do things that humans are good at.

## *1.9. Business rules should be created by knowledgeable business professionals, not information technology professionals.*

Article 9 of the *Business Rules Manifesto*[8] states, that business rules are of, by, and for business people, not information technology people. Business rules should arise from knowledgeable business people. Business people should have tools available to help them formulate, validate, maintain, and otherwise manage rules. Business people should have tools available to help them verify business rules against each other for consistency.

Business professionals need to learn how to create, debug, and maintain the business rules that drives the digital age.

In an interview with *Wired* magazine[9], Barak Obama, then president of the United States, discussing artificial intelligence made the following statement about self-driving cars:

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[7] Charles Hoffman, CPA, *Computational Thinking*, http://www.xbrlsite.com/mastering/Part00_Chapter01.C_ComputerEmpathy.pdf

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

[9] 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/

> "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?"

This example which relates to self-driving cars points out two things that accounting professionals need to consider when thinking about XBRL-based digital financial reports: (1) who writes the rules, the logic, which software follows, (2) how do you write those rules and put them into machine readable form? Do you want software developers creating your rules?

## *1.10. The stronger the problem solving logic, the more a machine can achieve.*

Problem solving logic is basically the extent to which a business rules engine can solve problems. Other terms for problem solving logic are expressive power or reasoning capacity. There are two inputs to solving problems: (1) the rules which can be expressed in machine-readable form and (2) the ability of a business rules engine to process those rules. Business rules engines have a problem solving method the most common being forward chaining.

## *1.11. Catastrophic logical failures are to be avoided at all cost; they cause systems to completely fail.*

If a system can break or cease to operate for unknown reasons or at any time, the system is not predictable and therefore not reliable. Computer systems tend to be implemented using a safe subset of first-order logic because classical higher-order logics cannot be safely and reliably implemented in the form of software programs. An easy way to understand this is to think of an infinite loop. If a computer program gets into an infinite loop from which it cannot escape, the program ceases to function. While the maximum problem solving logic is desirable, that must be balanced on the side of safety, predictability, and reliability; erroring on the side of safety.

## *1.12. Complexity cannot be removed from a system, but complexity can be moved.*

The *Law of Conservation of Complexity*[10] states that every software application has an inherent amount of irreducible complexity. That complexity cannot be removed from the software application. However, complexity can be moved. The question is: Who will have to deal with the complexity? Will it be the application user, the application developer, or the platform developer which the application leverages? Poor choices mean hard to use software.

## *1.13. Part of a system is not really that useful.*

Irreducible complexity is explained as follows: A single system which is composed of several interacting parts that contribute to the basic function, and where the removal of any one of the parts causes the system to effectively cease functioning.

[10] Larry Tesler, *Law of Conservation of Complexity*, http://www.nomodes.com/Larry_Tesler_Consulting/Complexity_Law.html

So for example, consider a simple mechanism such as a mousetrap. That mousetrap is composed of several different parts each of which is essential to the proper functioning of the mousetrap: a flat wooden base, a spring, a horizontal bar, a catch bar, the catch, and staples that hold the parts to the wooden base. If you have all the parts and the parts are assembled together properly, the mousetrap works as it was designed to work.

But say you remove one of the parts of the mousetrap. The mousetrap will no longer function as it was designed, it will not work. That is irreducible complexity: the complexity of the design requires that it can't be reduced any farther without losing functionality.

A non-functioning system is not useful. A partially functioning system is only partially useful.

## *1.14. Simplicity and simplistic are not the same thing.*

Simplistic entails 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 works.

Simple is something that is not complicated, that is easy to understand or do. Simple means "without complication". 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.

Creating something that is complex is easy. Creating something that is simple is hard and requires more work.

A kluge, a term from the engineering and computer science world, refers to something that is convoluted and messy but gets the job done.

## *1.15. Apply double-entry bookkeeping procedures, processes, and techniques to digital financial reports.*

Single-entry bookkeeping[11] is how 'everyone' would do accounting. In fact, that is how accounting was done before double-entry bookkeeping was invented[12].

Double-entry bookkeeping[13] adds an additional important property to the accounting system, that of a clear strategy to identify errors and to remove them from the system. Even better, it has a side effect of clearly firewalling errors as either accident or fraud. This then leads to an audit strategy. Double-entry bookkeeping is how professional accountants do accounting.

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[11] Wikipedia, *Single-entry Bookkeeping System*, retrieved August 30, 2016, https://en.wikipedia.org/wiki/Single-entry_bookkeeping_system

[12] Charles Hoffman, CPA, *Essence of Accounting*, http://www.xbrlsite.com/mastering/Part00_Chapter01.D_EssenceOfAccounting.pdf

[13] Wikipedia, *Double-entry Bookkeeping System*, retrieved August 30, 2016, https://en.wikipedia.org/wiki/Double-entry_bookkeeping_system

Double-entry bookkeeping was the invention of medieval merchants and was first documented by the Italian mathematician and Franciscan Friar Luca Pacioli[14]. Double-entry bookkeeping is one of the greatest discoveries of commerce and its significance is difficult to overstate.

Which came first, double-entry bookkeeping or the enterprise[15]? Was it double-entry bookkeeping and what it offered that enable the large enterprise to exist; or did the large enterprise create the need for double-entry bookkeeping?

Accountants think differently than non-accountants, it is part of their training. Non-accountants don't realize this and accountants tend to forget or take this for granted. The quality difference between the set of facts that makes up a financial report and all the support for that financial report tends to be much higher than the quality level of non-financial information that is managed by a non-accountant. Why? Because double-entry bookkeeping is ingrained in the processes, procedures, and techniques of professional accountants.

What information technology professionals see as redundancies and opportunities for error are really more similar to a parity check[16] or a checksum[17] and opportunities for making certain that you are not making a mistake.

Every accountant learns that when analyzing an account: beginning balance + additions – subtractions = ending balance. If you know any three values, you can always find the fourth value. But if you know all four values then you can prove that all the values are accurate. The same is true about the facts contained within a financial report. Say *Revenues*, *Cost of Revenues*, and *Gross Profit* are reported in a financial report. If you know those three facts and you know that there is a business rule that specifies that *Gross Profit = Revenues – Cost of Revenues* and the facts and the business rule are consistent with your expectation; you can rely on the information as being accurate. Apply this technique to all the facts of an XBRL-based digital financial report and you get a near zero defect report.

Accountants, don't under estimate the value of double-entry bookkeeping and the other processes, procedures, and techniques employed to make sure that everything "ticks and ties" and "cross casts and foots". These useful techniques, even perhaps better referred to as ingrained medieval traditions, should make their way into XBRL-based digital financial reports. These medieval techniques are still very relevant even in the digital age.

# 2. Ten Keys to Creating a Universal Digital Financial Reporting Framework

As explained in the book *The Great Upheaval*[18], the world is in the midst of a "great upheaval" where the world is transitioning from an analog, industrial economy to a digital, knowledge economy.

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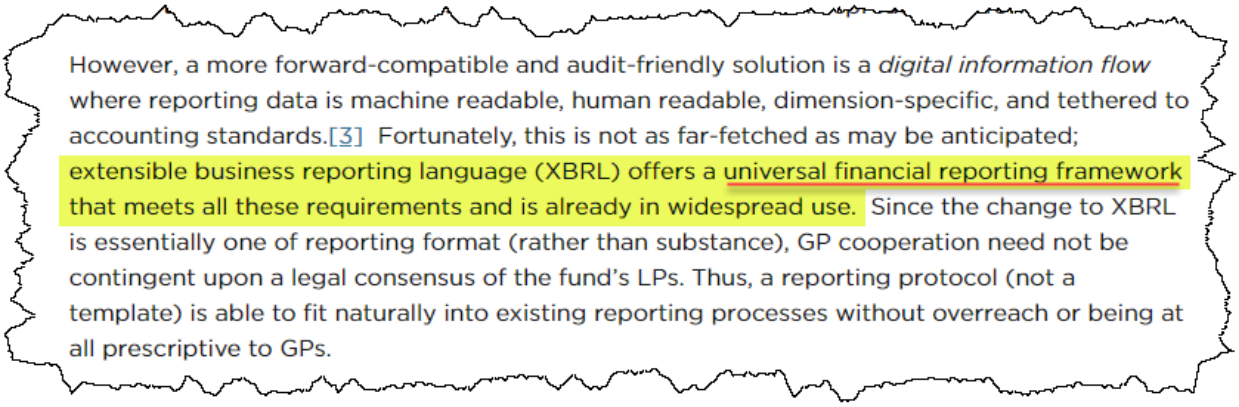
[14] Wikipedia, *Luca Pacioli*, retrieved August 30, 2016, https://en.wikipedia.org/wiki/Luca_Pacioli

[15] Ian Grigg, *Triple Entry Accounting, A Very Brief History of Accounting, Which Came First - Double Entry or the Enterprise?,* http://iang.org/papers/triple_entry.html

[16] Wikipedia, *Parity check*, retrieved December 6, 2016, https://en.wikipedia.org/wiki/Parity_bit

[17] Wikipedia, *Checksum*, retrieved December 6, 2016, https://en.wikipedia.org/wiki/Checksum

The article, *An Economic Case for Transparency in Private Equity*[19], which is an abridged version of the academic paper, *An Economic Case for Transparency in Private Equity: Data Science, Interest Alignment and Organic Finance*[20], points out that XBRL offers the opportunity to create a **Universal Digital Financial Reporting Framework**.




This document points out ten keys to making this transformation to digital general purpose financial reporting effectively and enabling what would amount to a universal digital financial reporting framework[21].

## 2.1. Key 1: Accounting and Reporting Rules Served by Immutable Standards based Machine Readable Declarative Rules

The coming transformation of financial reporting requires some of the rules and regulations related to financial accounting and financial reporting to be represented in an immutable standards-based machine-readable declarative form.

Rules and regulations, some of them not all of them, can be represented in machine-readable form using a global standard, such as XBRL, placed on the Inter-Planetary File System[22] (IPFS) so they will always be available, be instantiated as an NFT, or non-fungible token, and then reliably used by software applications. This article, *What Are NTFs and How Do They Work*[23], points out these characteristics of NFTs which help you understand what they are:

- **Non-interoperable**: NFTs are unique and unlike fungible tokens which are all the same basically and any one is just as good as any other; NFTs are not interchangeable.

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[18] Author Levine and Scott J. van Pelt, *The Great Upheaval*, https://www.amazon.com/Great-Upheaval-Educations-Present-Uncertain/dp/1421442574

[19] Ashby Monk, Sheridan Porter, Rajiv Sharma, *An Economic Case for Transparency in Private Equity*, https://caia.org/blog/2021/11/07/economic-case-transparency-private-equity

[20] Ashby Monk, Sheridan Porter, Rajiv Sharma, *An Economic Case for Transparency in Private Equity: Data Science, Interest Alignment and Organic Finance*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3931906

[21] *Universal Digital Financial Reporting Framework*, http://xbrl.squarespace.com/journal/2021/3/4/universal-digital-financial-reporting-framework.html

[22] IPFS.io, *How IPFS Works*, https://ipfs.io/#how

[23] Coindesk, *What are NFTs and How Do They Work*, https://www.coindesk.com/what-are-nfts

- **Indivisible**: NFTs cannot be divided into smaller denominations.
- **Indestructible**: NFTs are stored on the blockchain and can never be destroyed.
- **Verifiable**: Because NFTs exist on a blockchain they can be traced back to the original creator.

However, this does not subordinate accountants, reporting entities, auditors, financial analysts, investors, standards setters or regulators and the rules and regulations to the constraints of computer science. The information communicated by a financial report and the rules and regulations that govern such reports is, and always will be, the legal agreement, not the computer code. The code can only refer to, or facilitate the transmission of, those professional work products that bring a financial report into being. It does not seem productive to attempt to translate legal and regulatory technical complexity into code when adjudication, in the case of default, will revert not to code but to the judiciary.

As pointed out by the *Business Rules Manifesto*, Article 4[24];

- Rules should be expressed declaratively in natural-language sentences for the business audience.
- If something cannot be expressed, then it is not a rule.
- A set of statements is declarative only if the set has no implicit sequencing.
- Any statements of rules that require constructs other than terms and facts imply assumptions about a system implementation.
- A rule is distinct from any enforcement defined for it. A rule and its enforcement are separate concerns.
- Rules should be defined independently of responsibility for the who, where, when, or how of their enforcement. Rulemaking is a separate responsibility from rule enforcement.
- Exceptions to rules are expressed by other rules.

## 2.2. Key 2: Ease of Use is Required

Digital financial reporting will only emerge if the technology developers allow those market participants that create, read, or otherwise make use of such digital financial reports like accountants, business professionals, investors, auditors, financial analysts, regulators, data aggregators, attorneys, and commercial loan officers, who are not computer scientists or coders, and never want to be computer scientists or coders. Software in support of digital financial reporting must be built around the needs of its users.

Notwithstanding the digitization of the "paper" process or "e-paper" such as PDF, HTML, word processing documents, creating digital financial reports requires that existing workflows, business processes, audits, and financial analysis be maintained in a way that users can accept, understand, and integrate into existing processes. The widespread adoption of blockchain technology in financial reporting is dependent on an expansion of the user base amongst existing practitioners in the marketplace.

[24] Business Rules Group, Business Rules Manifesto, Article 4, https://www.businessrulesgroup.org/brmanifesto.htm

This will require digitization of these financial reporting related artifacts in a way that is accessible to all participants that are involved in this process.

Ease of use is required by taking the complexities of digital financial reporting and burying those complexities within software applications or within platforms that serve those software applications and their users. Creative and clever use of explainable rules-based artificial intelligence by software engineers can simplify software use.

Simplistic software will not do. Attempting to remove what might be considered a complex or sophisticated task or process from software to make developing such software easier will never be acceptable. The law of irreducible complexity mandates that all necessary parts of the system exist.

## 2.3. Key 3: Clear, Understandable Accounting and Reporting Logic

The terminology, rules, and other logic used in accounting and financial reporting must be clear and understandable because computers simply cannot work effectively with ambiguity.

Remember, computers are machines. Computers have no intelligence until they are instructed by humans. Computers only appear smart when humans create standards and agree to do things in a similar manner in order to achieve some higher purpose. A machine such as a computer can only mimic what humans tell the machine to do via machine-readable information.

A logical system enables a community of stakeholders trying to achieve a specific goal or objective or a range of goals/objectives to agree on important common models, structures, and statements for capturing meaning or representing a shared understanding of and knowledge in some area of knowledge. Such logical systems can be explained using a logical theory. Logical theories can be tested to prove if the theory described is true of false.

A financial report is a logical system. Financial reports represent economic events, activities, and other circumstances in words and numbers. A financial report is a true and fair representation of a set of claims made by an economic entity about the financial position and financial performance of that economic entity. Financial reports are not arbitrary, not random, and not illogical.

A logical theory is made up of a set of logical models, logical structures, logical terms, logical associations, logical rules, and logical facts. Such logic must be clear and understandable.

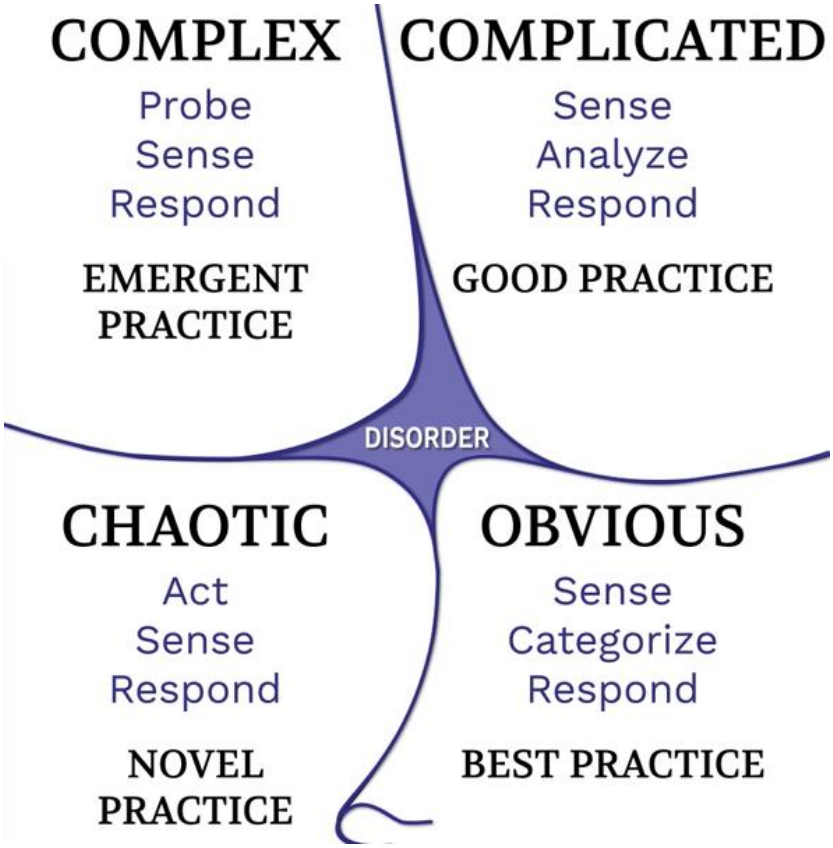
## 2.4. Key 4: Good Practices and Best Practices

An area of knowledge is a highly organized socially constructed aggregation of shared knowledge for a distinct subject matter. An area of knowledge has a specialized insider vocabulary, jargon, underlying assumptions (axioms, theorems, constraints), and persistent open questions that have not necessarily been resolved (i.e. flexibility is necessary).

Accounting is an area of knowledge. You can explain aspects of the accounting area of knowledge, such as the nature of a financial report, using a logical theory which explains a logical model. A logical theory can be tested and proven by providing a proof.

Knowledge can be represented in human-readable form, in machine-readable form, or in a machine-readable form that can be effectively converted into human-readable form.

The knowledge within an area of knowledge can be explained using tools such as the Cynefin Framework[25] which is a sensemaking process[26].




Some accounting knowledge related to the repetitive, mechanical, mathematical, and logical aspects of accounting, reporting, auditing, and analysis are obvious and can be explained in terms of "best practices" or are complicated and can be analyzed by those with accounting expertise and explained as a set of "good practices". There are other frameworks similar to Cynefin that help one make sense of things[27] such as ISO-9000 quality frameworks.

## *2.5. Key 5: Clear, Understandable Terms, Associations, Rules, Facts*

Double entry bookkeeping is an ancient best practices technique that is in global use today and commerce and global multinational organizations could not exist without that ancient best practice[28]. Double entry bookkeeping is a mathematical model[29].

[25] YouTube.com, CognitiveEdge, *Cynefin Framework*, https://youtu.be/N7oz366X0-8

[26] Wikipedia, *Sensemaking*, https://en.wikipedia.org/wiki/Sensemaking

[27] Tom Graves / Tetradian, *And more 'Cynefin-like' cross-maps ('Beyond-Cynefin' series)*, http://weblog.tetradian.com/2010/02/28/and-more-crossmaps/

[28] Amazon.com, Jane Gleeson-White, *Double Entry: How the Merchants of Venice Created Modern Finance*, https://www.amazon.com/gp/product/B007Q6XKA8/

That double entry bookkeeping mathematical model is the foundation for robust financial reporting schemes such as U.S. Generally Accepted Accounting Principles[30] (US GAAP) and International Financial Reporting Standards[31] (IFRS) among others[32]. Both US GAAP and IFRS are grounded in a version of the accounting equation[33]. Both US GAAP[34] and IFRS[35] define a core set of interrelated elements of financial statements that form a conceptual framework for financial reporting using that financial reporting framework. The semantics of US GAAP has been maturing for almost 100 years and IFRS for almost 50 years.

These interrelated elements of financial statements are the building blocks with which financial statements are constructed. Both US GAAP and IFRS discuss the notions of "articulation" which relates to the intentional interconnectedness of each of the primary financial statements and "intermediate components" which relates to the notion that different reporting entities are permitted to use different subtotals and report line items to represent the financial position and financial performance of that economic entity. This flexibility is intentional, by design, encouraged for specific reasons; and must be considered when creating software applications.

Triple-entry accounting[36] takes double-entry accounting to an entirely new level. Double-entry accounting and triple-entry accounting work together to create an even stronger system. Combined, double- and triple-entry accounting creates bullet proof accounting systems for aggressive uses and users.

It is worth mentioning that some point out that "triple-entry accounting" is something different than how blockchain enthusiasts use the term[37]. What we mean is that there are considerable benefits in writing transaction information into an immutable ledger on a blockchain.

## 2.6. Key 6: Control of Report Model Modifications to Maintain High Report Quality

Financial reporting using both/either US GAAP and IFRS encourages comparability with consistency. What this means is that financial statements are not, should not, and need not be forms. Rather, within the boundaries of these, and other similar,

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[29] Mathematics Magazine, David Ellerman, *The Mathematics of Double Entry Bookkeeping*, https://ellerman.org/wp-content/uploads/2012/12/DEB-Math-Mag.CV_.pdf

[30] Wikipedia, *Generally Accepted Accounting Principles (United States)*, https://en.wikipedia.org/wiki/Generally_Accepted_Accounting_Principles_(United_States)

[31] Wikipedia, International Financial Reporting Standards, https://en.wikipedia.org/wiki/International_Financial_Reporting_Standards

[32] Charles Hoffman, CPA, *Comparison of Elements of Financial Statement*, http://xbrlsite.azurewebsites.net/2020/master/ElementsOfFinancialStatements.pdf

[33] Wikipedia, *Accounting Equation*, https://en.wikipedia.org/wiki/Accounting_equation

[34] FASB, Statement of Financial Accounting Concepts No. 8, December 2021, Conceptual Framework for Financial Reporting, Chapter 4, *Elements of Financial Statements*, https://fasb.org/Page/document?pdf=Concepts_Statement_8-Chapter_4-Elements.pdf

[35] IFRS Foundation, Conceptual Framework, *Chapter 4 Elements of Financial Statements*, PDF page 25, https://www.ifrs.org/content/dam/ifrs/publications/pdf-standards/english/2021/issued/part-a/conceptual-framework-for-financial-reporting.pdf

[36] Ian Grigg, *Triple-entry Accounting*, https://www.researchgate.net/publication/308640258_Triple_Entry_Accounting

[37] Forbes, *Triple-Entry Accounting And Blockchain: A Common Misconception*, https://www.forbes.com/sites/forbesfinancecouncil/2017/11/28/triple-entry-accounting-and-blockchain-a-common-misconception/?sh=418e2bb3190f

financial reporting schemes; flexibility is provided to economic entities to create their financial reports to effectively describe their economic entities including important unique aspects of the economic entities. As such, reporting economic entities are permitted to modify their report models within permitted boundaries. As such, software applications that enable the creation of such financial reports must control the software users to help keep those software users within these permitted boundaries.

Accounting, like manufacturing, is a process. Accounting processes can benefit from Lean Six Sigma[38] techniques and practices to manage report quality. Financial reports must be accurate, complete, consistent, and the integrity should be intact. If they have those characteristics, they are deemed to be of high quality; true and fair representations. Reporting entities need to minimize any risk of noncompliance with rules and regulations.

Control is provided using the machine-readable accounting and reporting rules described previously in Key 1.

Rules are used to articulate allowed variability and "channel" creators of financial reports in the right direction and therefore control variability, keeping the variability within standard limits. That keeps quality where it needs to be. Rules enable things like preventing a user from using a concept meant to represent one thing from unintentionally being used to represent something different.

Further, the discipline of describing something in a form a computer algorithm can understand also assists you in understanding the world better; weeding out flaws in your understanding, myths, and misconceptions about accounting and reporting standards. This helps accountants be better accountants.

## 2.7. Key 7: Tamper Proof Audit Trail

Digital financial reporting will involve thousands of machine-readable rules, machine-readable report models and reports, provided by tens of thousands of economic entities, thousands of auditors, tens of thousands of analysts and investors; you get the point.

How can you be sure rules, reports, and other technical artifacts have not been tampered with? How do you know an inadvertent mistake, or an intentional manipulation has not been induced into the system? How can you be sure that software is working correctly and giving you the right answers such that you can rely on automated processes provided by the software?

All of these issues can be effectively handled using immutable digital distributed ledger technologies such as blockchain. Writing information into an immutable digital public ledger offers significant advantages.

Financial reports can be created at different levels, a spectrum of quality and reliability and machine readability, these levels are explained in the document *Financial Report Levels*[39]. Each level builds on the preceding level:

- Level 0 – Provided physically, such as on printed paper, not machine readable
- Level 1 – Provided digitally, but are really "e-paper"; PDF, HTML, Word, etc.

[38] Lean Six Sigma, http://www.xbrlsite.com/mastering/Part01_Chapter02.K_LeanSixSigma.pdf

[39] Auditchain, *Financial Report Levels*, http://accounting.auditchain.finance/library/FinancialReportLevels.pdf

- Level 2 – Structured for meaning, as contrast to structure for presentation
- Level 3 – Structured for meaning using global standard
- Level 4 – Provide a common dictionary
- Level 5 – Provide a complete set of rules
- Level 6 – Provide report level trust related to where complete set of rules came from and assurances that the rules have not been tampered with
- Level 7 – Provide transaction level trust related to rules and transaction information

| Integrity Level | Machine-Readable | Machine-Understandable (Structured for meaning) | Standardized Syntax | Controlled Vocabulary (Dictionary of Terms) | Standard Report Metamodel (Report logic) | Complete Set of Associations | Complete Set of Rules | Complete Set of Type-subtype Associations | Complete Set of Consistency Cross Checks | Complete Disclosure Mechanics and Reporting Checklist | Merkle Tree of Report Model and Report | Merkle Tree of Report Model, Report, and Transactions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Level 0 (Provide physically) | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Level 1 (Provide digitally) | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Level 2 (Structure for meaning) | ✓ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Level 3 (Standard structure) | ✓ | ✓ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Level 4 (Provide common dictionary) | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Level 5 (Complete set of rules) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ |
| Level 6 (Trust report logic) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| Level 7 (Trust transaction provenance) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

Only reports at Levels 5 and above can be proven to actually work effectively. Using the good practices (see Key 4) provided by the *Seattle Method*[40], controlled processes (see Key 6) can be created that effectively and provably work. Financial report Level 6 adds increased trust that digital artifacts have not been tampered with and a complete audit trail can be provided and dependability of the digital artifacts. Level 7 applies similar techniques at the accounting systems transaction level.

## 2.8. Key 8: Standards Convertible into Multiple Technology Stacks

Standards are necessary for effective digital financial reporting at a global scale. The Extensible Business Reporting Language, XBRL[41], is the de facto standard for digital financial reporting and business reporting with over 180 XBRL projects[42] in 60 different countries.

Standard methods for implementing XBRL have also emerged including the ISO Data Point Model[43] (DPM), Standard Business Reporting[44] (SBR), OMG's Standard Business Report Model[45] (SBRM), European Single Electronic Format[46] (ESEF), and the Seattle Method[47]. There are other approaches to representing XBRL-based digital financial reports.

[40] Charles Hoffman, CPA, *Seattle Method*, http://xbrlsite.com/seattlemethod/SeattleMethod.pdf

[41] XBRL International, https://www.xbrl.org/

[42] XBRL International, *XBRL Project Directory*, https://www.xbrl.org/the-standard/why/xbrl-project-directory/

[43] ISO, *ISO Datapoint Methodology*, https://www.iso.org/standard/80873.html

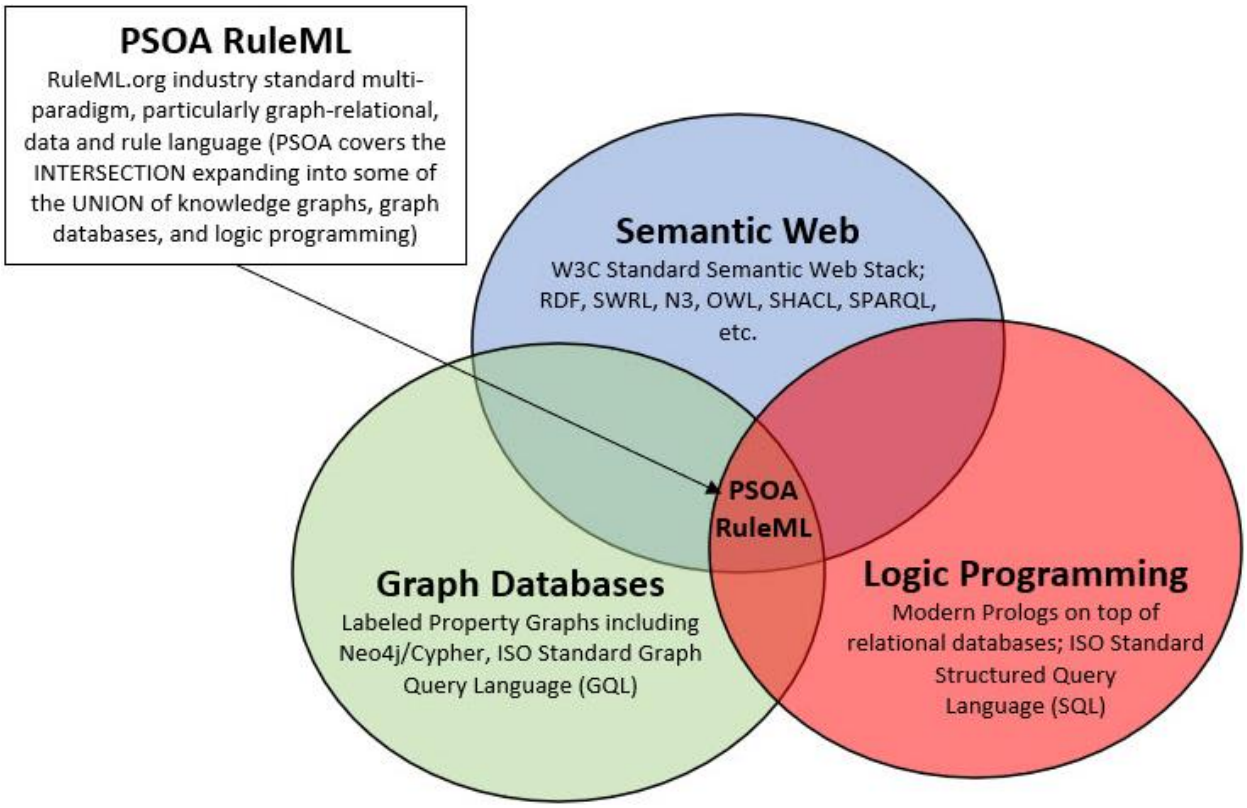
[44] Wikipedia, Standard Business Reporting, https://en.wikipedia.org/wiki/Standard_Business_Reporting

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

[46] ESMA, European Single Electronic Format, https://www.esma.europa.eu/policy-activities/corporate-disclosure/european-single-electronic-format

[47] Charles Hoffman, CPA, Seattle Method, http://xbrlsite.com/seattlemethod/

But enterprises have different preferences for technology stacks that they use to implement technologies within their individual organizations. The industry standards group RuleML[48] points out that there tends to be three primary problem solving logic implementation approaches:




RuleML also offers up a very safe "sweet spot"[49] which is a where each of the three primary problem solving logic approaches can be bi-directionally transferred between implementation technical syntaxes. DATALOG[50] seems to be the safest logic processor.

## 2.9. Key 9: Nothing is a "Black Box"

Accounting is about, well, about accounting for things. As such, any accounting or reporting system must be able to explain and justify everything, every detail. Transparency into how conclusions are reached, what rules where used, lines of reasoning, origin of facts and rules used to reach conclusions, and information about the problem-solving method used for any logical deduction or derivation are non-negotiable; they must be provided to creators of information, consumers of information, and all intermediaries involved in the process.

Explainable artificial intelligence[51] (XAI) that is rules base is the tool of choice.

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[48] RuleML.org, *Graph-Relational Data, Ontologies, and Rules*, http://wiki.ruleml.org/index.php/Graph-Relational_Data,_Ontologies,_and_Rules

[49] RuleML.org, PSOA RuleML, http://wiki.ruleml.org/index.php/PSOA_RuleML

[50] Wikipedia, Datalog, https://en.wikipedia.org/wiki/Datalog

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

## 2.10. Key 10: High Level Logical Meta Model

In order to achieve several of the other keys, a high-level meta model of a business report is necessary, such as the OMG Standard Business Report Model[52] (SBRM) or the *Logical Theory Describing Financial Report*[53]. The high level logical meta model serves as the consistent model (meta model) that any report model will fit into. The high-level meta model also enables the creation of an abstraction that enables the technical syntax, which is hard to understand, can disappear into the background; business users making use of software would deal at the logic level only, never exposed to technical details.

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

[53] Charles Hoffman, CPA, *Logical Theory Describing Financial Report*, http://xbrlsite.com/seattlemethod/LogicalTheoryDescribingFinancialReport_Terse.pdf