Digital Financial Reporting Manifesto

by

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This *Digital Financial Reporting Manifesto*[1] is intended to help professional accountants and other business professionals to contemplate, discuss, otherwise think about, and ultimately understand why and that **an option can and should exist to express a general purpose financial report digitally**.

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

An XBRL-based digital general purpose financial report is readable by humans and also readable by machines such as the computer. An XBRL-based digital financial report is structured so that a computer can effectively address and work with the individual pieces of such a report. This structured nature enables computer software to provide enhanced functionality to the users of the report such as dynamic presentation of information within the report, automated comparisons of information between periods for an economic entity, or comparisons across different economic entities. Enhancements for creators of digital financial reports include the possibility to automate certain financial report creation tasks and the use of expert systems in the process of creating such reports.

Other names that digital financial reports go by include *interactive data* or *structured data* used by the U.S. Securities and Exchange Commission[2], *structured digital reporting* used by the IFRS Foundation[3] and the CFA Institute[4], disclosure management used by PWC[5], or *Extensible Business Reporting Language (XBRL)* as used by XBRL International[6].

This manifesto provides a helpful set of principles that are useful in contemplating

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[1] *Digital Financial Reporting Manifesto* home page, http://xbrl.squarespace.com/digital-financial-reporting-ma/

[2] *The Benefits of Structured Data for Investors*, Rick A. Fleming, Investor Advocate, SEC, http://www.sec.gov/news/speech/032415-spch-rf.html

[3] *Structured digital reporting = Digital financial reporting*, http://xbrl.squarespace.com/journal/2015/8/20/structured-digital-reporting-digital-financial-reporting.html

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

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

[6] *Financial Statements in XBRL*, XBRL International, Retrieved November 7, 2015; https://www.xbrl.org/the-standard/what/financial-statement-data/

and creating XBRL-based, structured, digital financial reporting. A framework for XBRL-based digital financial reports should be consciously, deliberately, skillfully, rigorously engineered; rather than an unconscious or even haphazard process. This information will contribute to its successful creation and other important information related to finding the path that eventually will lead to success in such an endeavor.

Ultimately, the responsibility for creating and the opportunity to get a digital financial report to work as accounting and other business professionals might desire it to work rests with accounting and other business professionals. Exactly how a digital financial report should work must be a conscious choice based on well-thought-out ideas of accounting and business professionals who understand precisely what they desire and why they desire it. Then, information technology professionals and knowledge engineering professionals apply sound architectural and engineering principles and choices to implement those well-thought-out ideas. Unconsciously delegating important responsibilities related to what accounting and business professionals want from digital financial reporting to information technology professionals and/or knowledge engineering professionals simply by neglecting these responsibilities is not an appropriate course of action.

This document creates no new information really. The value this document adds is accumulating important information scattered in many places, organizing that information, summarizing it, and synthesizing the information into a form that is useable by business professionals. This information is also helpful to information technology professionals and knowledge engineering professionals.

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Preamble

> *"I am enough of an artist to draw freely upon my imagination. Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution."*
>
> *--Albert Einstein*

A manifesto[7] is a clear statement of the views, intensions, and motives of the issuer of the manifesto.

The *Digital Financial Reporting Manifesto* proposes to the global community of professional accountants that a digital version of a general purpose financial report can and ought to exist.

This manifesto points out the obvious when it explains that such digital financial report must work correctly, the meaning conveyed by such a digital financial report should be no different than historical non-digital forms of the same information, and that using information from such a digital financial report should not be a complicated guessing game.

Software for creating and using digital financial reports and the information they contain can, and will, be simple and easy for professional accountants and other business professionals to use without such professionals understanding the many times complex technical issues and details related to the inner workings of such digital financial reports. Properly communicating how digital financial reports must work to information technology professionals and knowledge engineering professionals will contribute to the creation of simple and easy to use software. There is no need to "dumb down" financial reporting what-so-ever to make digital financial reporting work.

This manifesto is intended to help professional accountants and financial analysts in particular and other business professionals in general contemplate, discuss, otherwise think about, and ultimately that an option can exist and should exist to express a general purpose financial report digitally; and also to help professional accountants and financial analysts think through how they choose digital general purpose financial reports to work.

[7] *Wikipedia* defines manifesto as: A manifesto is a published verbal declaration of the intentions, motives, or views of the issuer, be it an individual, group, political party or government. A manifesto usually accepts a previously published opinion or public consensus and/or promotes a new idea with prescriptive notions for carrying out changes the author believes should be made. See, https://en.wikipedia.org/wiki/Manifesto

Ultimately, the responsibility for creating and the opportunity to get a digital financial report to work as specified, as accounting and other business professionals might desire such reports to work, rests with those professionals.

Exactly how a digital financial report works should be a conscious choice based on sound and rigorously tested, well-thought-out ideas of accounting and business professionals who understand exactly what they desire. Then information technology professionals and knowledge engineering professionals can apply sound architectural and engineering principles and choices to implement those well-thought-out ideas.

Unconsciously delegating important responsibilities related to what accounting and business professionals want from digital financial reporting to information technology professionals and/or knowledge engineering professionals by neglecting these responsibilities is not appropriate.

The point is that technology professionals without a strong background and understanding of accounting principles and practices may make less than optimum choices as they attempt to convert business reports into usable digital financial reports.

Empirical evidence exists today that supports that digital financial reporting can in fact work[8]. However, few have attempted to sort through the existing empirical evidence and assembled the individual pieces appropriately into one working system[9] that provides functionality which accounting and other business professionals find practical, helpful, or otherwise useful. In fact, most accounting and other business professionals are not convinced that digital financial reporting could ever replace their existing practices for creating and sharing financial information.

XBRL-based digital financial reports created by public companies and submitted to the U.S. Securities and Exchange Commission, if skillfully analyzed by a knowledge observer, shows precisely what is necessary to make such digital financial reports work. Ultimately, it is simply a matter of making a few rather basic "tweaks" that will allow digital financial reporting to work as promised.

Higher quality, less cost, more timely

The specific tweaks necessary to make digital financial reporting work appropriately can leverage this extensive treasure-trove of prior work created by regulators such as the U.S. Securities and Exchange Commission, the FASB, among others. Implementing those tweaks is in no way dependent on the regulators. The

[8] *Financial Report Semantics and Dynamics Theory*, page 28; http://www.xbrlsite.com/2012/Library/Theory-2012-07-20.pdf

[9] *A Theory of a System for Educators and Managers* , a video by Dr. W. Edwards Deming, provides an excellent refresher on how to think about systems. See http://xbrl.squarespace.com/journal/2015/7/24/deming-a-theory-of-a-system-for-educators-and-managers.html

market can provide useful digital financial reporting. If this is done correctly then the market for digital financial reporting could expand from the current SEC mandate that about 10,000 public companies employ XBRL-based digital financial reporting to approximately 28 million private companies in the United States alone who would very likely find such technology useful. However, to take advantage of this opportunity the market must make digital financial reporting work and provide benefits and other value which makes digital financial reporting of higher quality, less costly, more timely than the current paradigm of unstructured general purpose financial reporting.

With only a little resolve and determination plus being empowered with a good understanding of what it takes to make such technology work as deemed necessary, skillful software vendors can create useful products related to digital financial reporting and ultimately a market for products that add value, products that professional accountants would desire to purchase because they are helpful.

Opportunity exists for those who seek to take the risk, who believe and understand how to make digital financial reporting work. If digital financial reporting is created, if it does work appropriately, and if it does bring added value to the market; then a transformational change would occur and the transformation would create business opportunities for those that had the necessary software tools to enable digital financial reporting.

And so, that is the motivation behind this document: to help people see a path toward digital financial reporting that provides value to accounting professionals and other business professionals. Software vendors and others can decide for themselves whether to choose to take this path.

It is not only my intension to take this path myself, rather I have been working to understand, evolve, and otherwise tune this path and helping a handful of software vendors do the same. It is my intension to document what I have learned, open up an appropriate dialog, and help expand the number of software vendors and accounting professionals who understand these ideas, to help these professionals skillfully execute these ideas.

Having a limited vision and seeing XBRL-based digital financial reports as only “a way to provide information to regulators without the need to rekey the information” is shortsighted and misses the real opportunity. Digital financial reports are much more than not rekeying information; rather they are a completely new approach to creating and interacting with a financial report.

These same approaches can be utilized to also make IFRS-based financial reporting work correctly.

And so, at least I will try this path and attempt to make digital financial reporting work broadly in the United States. Perhaps others will employ these ideas for IFRS

and expand these ideas globally. My personal focus will be US GAAP reporting for private companies in the United States.

Just as other supply chains such as photography, books, music, films, maps, and others have "gone digital"; so too should financial reporting go digital. In fact, digital financial reporting is inevitable if you think about it.

This document summarizes, organizes, and synthesizes information from many, many other resources. Links and references are provided to those resources which enable you to obtain additional detailed information.

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Part I: Important background information related to how computers work

This section provides important background information that serves as a foundation upon which other sections are built. While this information might be stating the obvious, the intension is to bring these ideas into the forefront of one's mind so they can be considered when thinking about digital financial reports.

Computers are machines. Computers sometimes seem to perform magic. Computers do not create that magic. The way the "magic" is created is by skilled craftsmen wielding their tools effectively to make these machines perform useful work. Computers simply follow instructions. Computer science is the domain in which information technologies operate. Notice the "science" part of the term "computer science". Ultimately, making a computer perform work distills down to logic and mathematics.

Computers have four fundamental strengths[10]:

- **Storage**: Computers can store tremendous amounts of information reliably and efficiently.
- **Retrieval**: Computers can retrieve tremendous amounts of information reliably and efficiently.
- **Processing**: Computers can process stored information reliably and efficiently, mechanically repeating the same process over and over, thus taking stored information, retrieving that information, transforming the information, and restoring it.
- **Ubiquitous information distribution**: Computers can make information instantly accessible to individuals and more importantly other machine-based processes anywhere on the planet in real time via the internet, simultaneously to all individuals.

There are a number of major obstacles[11] to harnessing the power of computers to perform work. These major obstacles must be overcome. This is a summary of those major obstacles:

- **Business professional idiosyncrasies**: Different business professionals use different terminologies to refer to exactly the same thing.
- **Information technology idiosyncrasies**: Information technology professionals use different technology options, techniques, and formats to encode and store or retrieve exactly the same information.
- **Inconsistent domain understanding of and technology's limitations in expressing interconnections**: A third obstacle is that information is not just a long list of facts, but rather these facts are logically interconnected and

[10] Andrew D. Spear, *Ontology for the Twenty First Century: An Introduction with Recommendations*; page 4, http://ifomis.uni-saarland.de/bfo/documents/manual.pdf#Page=4

[11] Ibid.; page 4

generally used within sets which can be dynamic and used one way by one business professional and some other way by another business professional or by the same business professional at some different point in time. These relations are many times more detailed and complex than the typical computer database can express or handle. Business professionals sometimes do not understand or are otherwise unaware that certain relations even exist.

- **Computers are dumb beasts**[12]: The forth obstacle is that computers don't understand themselves, the programs they run, or the information that they work with. Computers are dumb beasts. What computers do can sometimes seem magical. But in reality, computers are only as smart as the metadata they are given to work with, the programs that humans create, and the data that exists in databases that the computers work with.

As stated, computers are machines; computers are tools. If business professionals, information technology professionals, and knowledge engineers successfully communicate and collaborate and overcome the major obstacles; then useful tools can be created to help business professionals perform useful work such as storing, retrieving, processing, and distributing information. Conscious thought, skillful and well-orchestrated execution will deliver software tools that are simple and elegant; and yet sophisticated and powerful.

And so, how do we build those tools? Information in digital financial reports must be deliberately created to provide clear, consistent, logically coherent, and otherwise unambiguous to make sure a guessing game never takes place. All of the following should be considered when evaluating the functionality or solutions that a tool provides:

- *Complete* solutions are better than *incomplete* solutions.
- *Less expensive* solutions are better than *more expensive* solutions.
- *Powerful* solutions are better than *simplistic* solutions.
- *Easy to maintain* solutions are better than *hard to maintain* solutions.
- *Easy to use* solutions are better than *hard to use* solutions.
- *Good solution performance* is better than *poor solution performance.*
- *More scalable* solutions are better than *less scalable* solutions.
- *Standard* solutions are better than *proprietary* solutions.

Anyone can create something that is sophisticated and complex. It is much harder to create something that is sophisticated and simple. Simple is not the same thing as simplistic. "Simple" is not about doing simple things. Simple is the ultimate sophistication. Simple is elegant.

[12] Ibid.; page 5

Simplicity is "dumbing down" a problem to make the problem easier to solve. That is not what simple is about. *Simple* is about beating down complexity in order to make sophisticated things simple to use. Making something simple is hard work. Making something complex is easy.

The goal is not to have endless theoretical/philosophical debates about *how* things could be. The goal is to create something that works and is useful: a shared view of reality that will enable us to create a common enough shared reality to achieve some working purpose. The goal is to create useful tools which make things better, faster, and/or cheaper[13].

Part II: Knowledge engineering basics for accounting professionals

The following is a summary of basic information related to knowledge engineering in terms understandable by accounting professionals:

1. **Ontologies are tools for representing knowledge, knowledge representation languages.** The term ontology has been used in philosophy for thousands of years going back to the father of formal logic, Aristotle[14] (400 B.C.). Ontology is defined as the study of the things and the relations between things that exist in reality. The goal of philosophical ontology is to provide deliberate, clear, coherent and rigorously worked out accounts of the basic structures found in reality. In more current times, the term ontology has become prominent in the area of computer science and information science. In computer science the term ontology generally refers to the standardization of a terminology framework such that information repositories can be constructed. Ontologies used by philosophers such as Aristotle were not machine-readable. Ontologies used by computers are machine-readable. The problem that ontologies solve is not that of simply coming up with a set of terms such as a dictionary or creating basic relations between terms such as a thesaurus or even more complex relations between terms expressed by a taxonomy. Rather, an ontology defines terms, organizes the terms into categories or classes, and determines as many important universal relations as practical and necessary between the categories or classes within some business problem domain. The central function of an ontology is to represent reality of the *problem domain* comprehensively, precisely, and accurately.

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[13] William Kent, *Data and Reality: A Timeless Perspective on Perceiving and Managing Information in Our Imprecise World*, 3rd Edition, page 149, http://www.bkent.net/Doc/darxrp.htm

[14] *Term Logic*, Wikipedia, retrieved October 10, 2015, https://en.wikipedia.org/wiki/Term_logic

2. **Ontologies are formal languages generally based on first-order logic[15]**. OWL 2 DL is a state-of-the-art ontology language which is a W3C recommendation. Another term for first-order logic[16] is predicate logic[17]. Mathematics is based on formal logic. A truth table[18] is used to help determine if some set of facts is logically valid. The bottom line is that first-order logic is a formal system for describing something precisely which follows the rules of logic.
3. **The general purpose financial report is part of the financial reporting business *problem domain*.** A general purpose financial report can be formally described using the rules of logic in a machine-readable form using an ontology. In addition, other aspects of financial reporting can likewise be described using ontologies.
4. **US GAAP and IFRS are both financial reporting schemes.** While what goes into a general purpose financial report changes if one uses US GAAP based reporting or IFRS based reporting; the financial report structure itself does not change.
5. **An ontology accurately represents reality**. An ontology is a salient collection of the classes and subclasses of a problem domain or area of concern. An ontology expresses universally true relations between classes and subclasses. The goal of an ontology is to provide a deliberate, rigorously and methodically worked out, description of the important things and relations between things which is clear, consistent, logically coherent, and unambiguous.
6. **Every classification system ever devised by man has issues.** There is a significant difference between a dictionary and an ontology. The focus should not be a definition (like a dictionary) but rather the focus should be on the purpose of a concept and its relationships with other concepts in some knowledge domain (like an ontology). There is no single definition that is "the truth"; rather there could many definitions, depending on the context of a concept. And so, there is both a glossary and knowledge models that reference each other. A flexible graph of knowledge is the result rather than one rigid dictionary. At the same time we say that ontologies are powerful tools, we also need to point out that every classification system ever devised by humans has deficiencies of some sort. Every classification system reflects the biases of those that created the classification system. The role of metadata is allowing you to create your own custom classification system so that you can have the view of something that you want.
7. **Another term for relation is business rule.** A business rule expresses an allowed or disallowed relation. Relations generally fit into three broad categories: "is-a-subtype-of" some class, "has-property" and "part-of" some

[15] W3C, *OWL 2 Web Ontology Language Document Overview* (Second Edition), http://www.w3.org/TR/owl2-overview/#Semantics

[16] *First-Order Logic*, Wikipedia, retrieved October 10, 2015, https://en.wikipedia.org/wiki/First-order_logic

[17] *Predicate Logic*, Wikipedia, retrieved October 10, 2015, https://en.wikipedia.org/wiki/Predicate_logic

[18] *Truth Table*, Wikipedia, retrieved October 10, 2015, https://en.wikipedia.org/wiki/Truth_table

whole. For example, a business rule to classify "cash and cash equivalents" as a type of asset would be an "is-a-subtype-of" business rule.

8. **Business professionals can distinguish between an important nuance, as subtle distinction, and an unimportant negligible difference**. Business professionals are not always perfect. The only way to make sure things are right is to test and experiment. The following terms help illustrate the difference between an important nuance and an unimportant negligible difference. **Nuance**: a subtle difference in or shade of meaning, expression, or sound; a subtle distinction or variation; **Subtle**: so delicate or precise as to be difficult to analyze or describe; hard to notice or see; not obvious; **Negligible**: so small or unimportant as to be not worth considering; insignificant; so small or unimportant or of so little consequence as to warrant little or no attention.
9. **Every inconsistency should be explainable**. Every inconsistency should have some underlying reason which explains the inconsistency. Two things that appear to be inconsistent without an underlying reason are most likely consistent. Said another way, every inconsistency should have an underlying reason that explains the reasoning behind the inconsistency (the difference).
10. **Agreement and making the system work is the goal**. It is only through deliberate, methodical, rigorous and conscious collaboration, cooperation and coordination by the participants of the financial reporting supply chain that XBRL-based digital financial reporting will work safely, reliably, predictably, repeatedly, effectively, and efficiently. That is the goal. *This goal will not be achieved by accident*. Consider the definitions of arbitrary and standard: **Arbitrary**: based on random choice or personal whim, rather than any reason or system; depending on individual discretion (as of a judge) and not fixed by law; **Standard**: used or accepted as normal; something established by authority, custom, or general consent as a model or example. Is the purpose for each individual participant in the financial reporting supply chain to dig their heels into the ground and insist that their arbitrary reality is the only reality? Or is the purpose to consciously create a coordinated, shared, commonly accepted, standard, useful view of reality to achieve a specific purpose? Is that reality objective and stable enough yet nuanced enough to be useful so that information can be used safely, reliably, predictably, repeatedly by both human and automated machine-based processes? The desired system state is one of balance or equilibrium and consistency.
11. **No knowledge representation language is 100% complete**. Each has limitations. One must be conscious of such limitations when creating a representation of some problem domain in machine-readable form.
12. **General purpose, low-level ontology creation and maintenance tools are too technical for accounting and business professionals because of their flexibility**. Specific purpose tools for creating and maintaining financial reporting specific ontologies can be significantly easier to use because they are more specific, they are higher-level tools, they leverage financial reporting domain specific patterns, and they leverage the theory

and framework[19] which explains digital financial reporting. Accounting professionals working with the appropriately created high-level tools need only financial reporting knowledge and an understanding of a small, specific basic set knowledge engineering principles[20].

Part III: Basic, common sense information about digitizing financial reports

The following is a summary of basic, common sense notions related to structured information or digitizing a general purpose financial report:

13. **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 meaning of financial information as they might choose; the meaning itself should be objective and not be subject to interpretation.
14. **General purpose financial reports should be a true and fair representations of the economic entity providing such a report**. They are *complete*, *accurate*, *consistent*, have *fidelity* (properly reproduce the financial and nonfinancial facts of the economic entity), the report has internal *integrity* (pieces fit together), and other such qualities. These qualities are independent of the format of the general purpose financial report (i.e. HTML, PDF, XBRL, or other format).
15. **Structured information enables digital representation of financial information**. Structured information[21] can be employed to represent financial information digitally. Properly represented financial information can be rendered within software applications and standard presentation mediums (i.e. HTML, PDF, word processing documents, spreadsheets) in a manner that the information is understandable to accounting and other business professionals.
16. **Digital general purpose financial reports provide benefits**. Given the increasing volume, complexity, and importance of financial information; enabling and harnessing automated machine-based processes where possible is sensible. The general purpose financial report can, and ought to be, readable by both human-based processes and machine-based processes. *Disclosure management* is another term for digital financial report[22].

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[19] For more information on understanding what a theory and framework are, see http://xbrl.squarespace.com/journal/2015/9/20/understanding-the-need-for-a-framework-and-theory.html

[20] This point is important to get across. Another example is comparing a high-level language such as Visual Basic or C++ to assembly language. Having a business professional trying to create an ontology is similar to asking a programmer to program in assembly language. Higher-level languages are significantly easier to use than creating programs in assembly language.

[21] Note that the terms 'structured digital reporting' and 'digital financial reporting' mean the same thing, see http://xbrl.squarespace.com/journal/2015/8/20/structured-digital-reporting-digital-financial-reporting.html

[22] Mike Willis, PWC, *Disclosure management: Streamlining the Last Mile*, http://www.pwc.com/gx/en/xbrl/pdf/pwc-streamlining-last-mile-report.pdf

17. **Successful meaningful exchange of information requires preexisting rules**. Prudence dictates that using the information contained in a digital financial report should not be a guessing game. Safe, reliable, repeatable, predictable, reuse of reported financial information using automated machine-based processes is obviously preferable to a guessing game.
18. **Prerequisites for achieving a meaningful exchange of information are well understood**. The only way a meaningful exchange of information can occur is with the prior existence of agreed upon technical syntax rules, business domain semantics rules, and business process workflow rules[23]. Preferably, these rules should be expressed in machine-readable form. It is these agreed upon rules which enables a successful meaningful exchange of information by clearly and unambiguously *describing* how information is to be represented and by enabling automated machine-based verification processes which assure that represented information is *consistent* with such description. Automated verification processes highlight information that is inconsistent with the description so that humans can intervene and investigate the nature of such inconsistencies.
19. **Consistent meaning across presentation medium is necessary**. The meaning represented by any form of financial report must not change based on which medium is used to present that financial information. Information presented on paper, in word processor document, in HTML, a dynamic pivot table or other software application or any other form should convey the exact same meaning irrespective of the medium employed to present the information.
20. **One global standard technical syntax for digital financial reporting is preferable, but not necessary**. A digital financial report can, and ought, to use one global standard technical syntax to represent such report. Alternatively, some minimum number of technical syntax could be employed and converting from each technical syntax to the other must be clear and obvious. Which technical syntax employed is not relevant to business professionals as long as that technical syntax meets the expressive needs of business professionals to represent financial reports digitally. Examples of technical syntax include XML and JSON.
21. **One common global standard semantics theory and framework is necessary to describe a digital financial report.** All digital financial reports should share the same financial report-level semantics (theory and framework). Whereas the metadata within a digital financial report may change based on the reporting scheme used by the report; for example, US GAAP, IFRS, other basis; the report framework between all digital financial reports can and should be the same.
22. **Business rules are maintained by professional accountants and other business professionals (i.e. not information technical professionals)**. The business domain semantic rules employed to both describe and verify

[23] This HL7 does a good job of explaining this, http://xbrl.squarespace.com/journal/2010/8/29/into-to-hl7-video-can-help-you-understand-xbrl.html

the consistency of represented financial information against that description must be understandable by professional accountants and other business professionals who make use of such reported financial information. Only if such rules are understandable to business and accounting professionals can such rules be deemed to be correct or incorrect by such business professionals. Another term for business rules is metadata.

23. **Business domain metadata available determines how much work a machine can provide**. The more machine-readable metadata available to a computer, the more a computer can do to assist accounting professionals in performing work. There is a direct correlation between expressed metadata and the reasoning capacity of machine-based processes.
24. **System used by business professionals must be complete**. Digital financial reports contain a very large quantity of detailed information that must be managed by accounting and other business professionals using a combination of manual and automated machine-based processes[24]. While per the *Law of Conservation of Complexity*[25], the complexities involved in the proper management of structured information within software applications can never be reduced; complexity can be moved and absorbed by software as not to require accounting and business professionals to get involved with the technical details of working with such information. Per the *notion of irreducible complexity*[26], all aspects of managing such structured information must exist and be available to accounting and business professionals working with structured financial information using such software. Employment of the proper creative and clever software creation architectures and strategies can enable accounting and business professionals to be successful in creating, managing, analyzing, and otherwise interacting with structured digital financial reports.
25. **Models and theories can be used to reduce complexity**[27]. The structural pieces that make up a financial report are identifiable. Those structural pieces have relations between one another. Those relationships, patterns that exist and identified, and other information can be explained by a theory that describes how a financial report works. Such a theory provides a framework[28] that can then be leveraged by software developers creating software to interact with such digital financial information. The theory, framework, patterns, and clever software creation ideas reduce the complexity related to the technical details of working with a digital financial report within software applications.

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[24] *Disclosure checklist*, http://www.xbrlsite.com/2015/Library/DisclosureChecklist.jpg (shows automatable and manual verification tasks)

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

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

[27] Emanuel Derman, *Models.Behaving.Badly*, page 5 (explains the difference between a theory, a model, and intuition; also see http://xbrl.squarespace.com/journal/2014/7/20/updated-financial-report-semantics-and-dynamics-theory.html

[28] *Understanding the Need for a Framework and Theory*, http://xbrl.squarespace.com/journal/2015/9/20/understanding-the-need-for-a-framework-and-theory.html

26. **Metadata stores "memories"**. Most people know what data is, but they don't understand the term metadata[29]. Metadata is data about data. Metadata helps business users work with data. There is also the idea of meta-metadata[30] that enables interoperability[31] between systems. While these distinctions might be hard for people to grasp, all that you need to understand is that metadata is very much like memory. Metadata stores things like the list of disclosures that can exist in a financial report (similar to a disclosure checklist), what is required to be disclosed and when (similar to the Accounting Standards Codification), and the difference between a roll up (A + B + C = Total), a roll forward (beginning balance + changes = ending balance), and an adjustment (originally stated balance + adjustments = restated balance). This metadata and meta-metadata can be leveraged to make software both easier to use and increase the work the software can perform.
27. **While the content of a digital financial report can be subjective in many cases, the digital financial report itself is objective and therefore mechanical**. Digital financial reports contain thousands and sometimes many thousands of individual pieces or structures. These structures, commonly formatted in machine-readable form using XBRL, are used to represent the information contained in the digital financial report. There are two different aspects of these details that are important to recognize: **objective aspects** which are mechanical and do not require judgment; **subjective aspects** which require the professional judgment of a skilled accountant, therefore they must be managed by humans. While what should be included in a financial report is often subjective thus requiring professional judgment, the report itself is completely objective and therefore mechanical[32].
28. **A financial report is a system**. As Dr. W. Edwards Deming points out[33], "Working together is the main contribution to systemic thinking as opposed to working apart separately." Analysis of a system can help you understand how a system works. But analysis of a system does not tell you *why* a system works. Synthesis helps you understand *why* a system works. All parts working together is what a digital financial report needs.

Part IV: Creating digital financial reporting software

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[29] *Metadata*, Wikipedia, retrieved October 10, 2015, https://en.wikipedia.org/wiki/Metadata

[30] This starts to get technical but if this is not understood then fundamental architectural issues will cause interoperability problems; See OMG Meta Object Facility, https://en.wikipedia.org/wiki/Meta-Object_Facility; and ISO/IEC/IEEE 42010 Model and Metamodel, http://www.iso-architecture.org/ieee-1471/meta/

[31] See *Understanding Interoperability*, http://xbrl.squarespace.com/journal/2014/4/1/understanding-interoperability.html

[32] For more information see *Understanding the Basic Mechanics of a Financial Report*, http://xbrl.squarespace.com/journal/2015/2/7/understanding-the-basic-mechanics-of-a-financial-report.html; and *Understanding the Mechanics of an SEC Type XBRL-based Digital Financial Report*, http://www.xbrlsite.com/2015/Library/UnderstandingTheMechanicsOfAnSECTypeDigitalFinancialReport.pdf

[33] Dr. W. Edwards Deming, *A Theory of a System for Educators and Managers*, (Video), https://www.youtube.com/watch?v=2MJ3lGJ4OFo

Digital financial reporting is not something that is added to current financial reporting processes; rather it is a complete paradigm shift. Just like CAD/CAM software changed how architects, engineers, designers, builders, and processes could interact with blueprints in much the same way digital financial reports will change of professionals interact with financial reports.

29. **Digital financial report creation software is an expert system**. Expert systems[34] are computer programs that are built to mimic human behavior and knowledge. An expert system is computer application that performs a task that would otherwise be performed by a human expert. There are three types of expert systems[35]: classification/diagnosis type, construction type, and simulation type. Digital financial report creation software is a construction type expert system that leverages machine-readable knowledge about creating a financial report. This machine-readable knowledge, also called metadata, assists professional accountants in the process of creating financial reports.
30. **Digital financial report creation software understands financial reports**. Neither Microsoft Word nor Microsoft Excel understands financial reports[36]. Word understands word processing documents and Excel understands what a spreadsheet is. For example, Excel understands that a workbook contains spreadsheets; a spreadsheet contains rows, columns, and cells; and that values go into cells and one cell can be related to another cell or cells. Digital financial report creation software understands that financial reports contain balance sheets and income statements, that balance sheets contain "assets" and "liabilities and equity" and that balance sheets balance (assets = liabilities and equity) among other things about financial reports.
31. **Expert systems leverage metadata**. Recall that metadata is in essence stored "memories" or knowledge. Expert systems read machine-readable metadata which describes a financial report, how the pieces of a financial report are interrelated, the process of constructing a financial report, templates of best practices of how to disclose information, exemplars of how other economic entities disclosed information, etc.; and leverage that metadata to perform work for users of the expert system. Experts systems are essentially driven by such metadata. The more metadata, the more an expert system can do. Said another way, the more metadata, the more knowledgeable the expert system is[37].

[34] *Understanding Expert Systems Applicability to Financial Reporting*, http://xbrl.squarespace.com/journal/2015/7/15/understanding-expert-systems-applicability-to-financial-repo.html

[35] Frank Puppe, *Systematic Introduction to Expert Systems, Knowledge Representations and Problem-Solving Methods*, page 11

[36] *Understanding Digital Financial Reporting and its Benefits*, http://xbrl.squarespace.com/journal/2015/6/25/understanding-digital-financial-reporting-and-its-benefits.html

[37] It is important to recognize that current software applications used to create financial reports such as Microsoft Word and Excel don't understand anything about financial reports.

Part V: Technical and engineering considerations

This section relates to somewhat technical ideas, but you won't need a technical background to understand these points. The purpose of providing this information is to help accounting professionals have precise conversations with technical professionals that build digital financial reporting software applications.

Digital financial report creation tools do not employ "machine learning". Digital financial report creation software does not have to utilize "artificial intelligence" (but there might be certain specific tasks where artificial intelligence could assist accounting professionals). Most information technology professionals don't realize this. How to create a financial report is knowledge that most accountants gather over the period of many, many years. Machines will never be able to figure out this knowledge without such professionals providing base guidance. Machines will then use that base knowledge to build additional knowledge.

While it is the responsibility of information technology professionals to architect and engineer technical systems, if the correct requirements for such systems are not articulated to information technology professionals poor architectural and engineering choices can be made.

32. **Obtaining knowledge can be achieved in two ways; each way has pros and cons**. There are two ways knowledge of some domain can be obtained and then expressed in machine-readable form: (a) those with the knowledge of that domain can provide the "recipe" and deliberately and rigorously express that knowledge using sound knowledge engineering principles and practices; (b) a machine can figure out the knowledge of the domain. Computer scientists have tried for 40 or 60 years to try and achieve "(b)" but have never been successful. Knowledge related to financial reporting to be employed by digital financial reporting must be deliberately and rigorously created by accounting professionals using sound, proven knowledge engineering principles and practices.
33. **No technical syntax is perfectly expressible**[38]. No technical syntax is perfect in its ability to express the needs of a business domain to represent domain information in machine-readable form. Each technical syntax has identifiable pros and cons. A balance must be struck and equilibrium must be reached in order to create a system which meets the needs of the business users of that system and the ability of the system to capture necessary machine-readable information. Striking the correct balance must be a conscious, deliberate effort.
34. **A specific subset of first-order predicate logic is the most expressive tool for representing meaning (semantics) in a form readable by a**

[38] *Comparison of Knowledge Representation Language Expressiveness and Relative Automation/Reasoning Capacity*, http://www.xbrlsite.com/2015/Library/KnowledgeRepresentationLanguageExpressiveness.jpg

computer. First-order predicate logic is the most expressive tool for representing meaning to a machine such as a computer. Second-order predicate logic is more expressive that first-order predicate logic, but it cannot be successfully implemented so that computers can understand it effectively, second-order predicate logic is too complex for a computer to successfully process. However, as mentioned parts of first-order predicate logic are likewise unsafe in that they allow "logical catastrophes"[39] (undecidability, infinite loops, unbounded systems, and so on) to occur. As such, only a specific limited subset of first-order predicate logic must be employed to represent digital financial report metadata as to not cause machine-based computer processes to become unreliable or unpredictable.

35. **Z Notation is a formal model-based global standard language for describing the behavior of a system precisely, such as the theory and framework that makes up the system of financial reporting**. Z Notation[40] employs the rules of mathematics and uses first-order predicate logic. The problem that formal languages such as Z Notion solve is the reduction of ambiguity and preciseness to describe systems. However, Z Notation is not understandable to the average accounting or business professional and is not machine-readable. As such, an abstraction layer must be created to allow accounting and business professionals to successfully interact with tools such as Z Notation.
36. **PROLOG[41] is a declarative general purpose programming language that is based on a restricted set of first-order predicate logic (Horn clauses)**. However, PROLOG still allows some logical catastrophes to exist. XBRL Formula processors are fundamentally based on PROLOG.
37. **DATALOG[42] is a further restricted set of PROLOG**. Every valid DATALOG statement is also a valid PROLOG statement; however, not every PROLOG statement is valid DATALOG.
38. **OWL 2 DL is based on SROIQ Description Logic**[43]. OWL 2 DL is decidable (eliminates that specific logical catastrophe). However OWL 2 DL specifically excludes the ability to express mathematical relations because some mathematical relations are not decidable. As such, OWL 2 DL does not meet the expressive needs if mathematical relations need to be expressed. However, "safe" SWRL can be used to represent mathematical relations and other relations necessary but that are not expressible using OWL 2 DL.

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[39] *Brainstorming Idea of Logical Catastrophes or Failure Points*, http://xbrl.squarespace.com/journal/2015/7/25/brainstorming-idea-of-logical-catastrophes-or-failure-points.html

[40] *Understanding the Importance of Z Notation*, http://xbrl.squarespace.com/journal/2015/9/4/understanding-the-importance-of-z-notation.html

[41] *Understanding the Importance of PROLOG to Digital Financial Reporting*, http://xbrl.squarespace.com/journal/2015/7/23/understanding-the-importance-of-prolog-to-digital-financial.html

[42] *Understanding the Utility of a Reasoner or Inference Engine*, http://xbrl.squarespace.com/journal/2015/7/30/understanding-the-utility-of-a-reasoner-or-inference-engine.html

[43] *Understanding the Importance of Description Logic*, http://xbrl.squarespace.com/journal/2015/1/8/understanding-the-importance-of-description-logic.html

Further, OWL 2 DL does not provide a global-standard multidimensional model but a dimensional model can be created using OWL 2 DL[44].

39. **The specific restricted set of first-order predicate logic that is reliable, predictable, and avoids all logical catastrophes is unknown at this time**. (At least unknown to me.) However, this restricted set is knowable based on comprehensive testing of digital financial reports. Determining this specific set is an act of balancing and setting the appropriate equilibrium to meet specific business domain requirements. Safety cannot be compromised.
40. **What appears to be necessary is a Chomsky Type-3[45] regular language that enables finite-state automation[46]**. The language should be decidable (i.e. not recursive). The language, a finite-state machine which has an intimate understanding of the language and metadata are key pieces to software working with digital financial reports.
41. **The best way of assuring that a machine-readable representation is not dysfunctional, irrational, nonsensical, illogical, and inconsistent or has some other issue is comprehensive, thorough, deliberate, rigorous testing**[47]. Another is examining empirical evidence. Testing is a robust and pragmatic approach to checking understanding and determining if communication has taken place between domain experts, knowledge engineers, and software engineers who ultimately must implement software.
42. **A digital financial report can be broken down into fragments and each fragment is essentially a hypercube**. There are two levels to a digital financial report: the business report framework (a financial report is a type of business report) and the stuff that goes into the financial report. All this is explained by the architecture of the technical implementation of the report. The architecture can be seen as an implementation profile. For example, the way XBRL-based digital financial reports must be created per the SEC and US GAAP XBRL Taxonomy rules is a profile. The *Not Only SQL Analytical Processing (NOLAP) XBRL Application Profile*[48] is a general purpose approach to specifying an XBRL valid architecture that is also 100% SEC/US GAAP XBRL taxonomy compliant, but adding more restrictions to make that architecture better. Essentially, the NOLAP profile explains this. A NOLAP cube is essentially a semantic spreadsheet[49].

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[44] *The RDF Data Cube Vocabulary*, W3C, Retrieved November 7, 2015; http://www.w3.org/TR/vocab-data-cube/

[45] *Chomsky Hierarchy*, Wikipedia, retrieved November 8, 2015; https://en.wikipedia.org/wiki/Chomsky_hierarchy#Summary

[46] *Finite-state Automation*, Wikipedia, retrieved November 8, 2015; https://en.wikipedia.org/wiki/Finite-state_machine

[47] *Knowledge Engineering Basics for Accounting Professionals*, page 34, http://www.xbrlsite.com/DigitalFinancialReporting/Book2015/DigitalFinancialReporting-2015-04-29-C04.pdf#page=34

[48] *Not Only SQL Analytical Processing (NOLAP) XBRL Application Profile*, http://www.xbrlsite.com/2014/Library/NOLAP-2014-07-01.pdf

[49] *Need for a new global standard spreadsheet alternative,* http://xbrl.squarespace.com/journal/2014/5/3/need-for-new-global-standard-spreadsheet-alternative.html

Part VI: Proof of the digital financial report theory and framework

The best way to achieve the correct balance, to arrive at the appropriate equilibrium is to rigorously, consciously, thoroughly, and skillfully test existing digital financial reports and gather empirical evidence that supports specific decisions and choices.

43. **Public company XBRL-base digital financial reports to the SEC proves the theory and framework articulated by the *Financial Report Semantics and Dynamics Theory***[50]. The publicly available XBRL-based digital financial reports of 7,000 U.S. public companies prove the theory and framework. Successfully loading these reports into the model which is explained by the framework and theory offers strong evidence. Details of this proof can be found in the *Financial Report Semantics and Dynamics Theory*[51].
44. **A set of digital financial reporting principles exists that are universally applicable to every digital financial report**. These common-sense digital financial reporting principles are self-evident[52] and are common to every XBRL-based public company financial filing to the SEC.
45. **A set of minimum criteria exists for reading information from a digital financial report**[53]. If each of these minimum criteria are not met, then information reported in a digital financial report is at a minimum unreliable and potentially unusable. These minimum criteria are observable and testable in XBRL-based digital financial reports submitted to the SEC.
46. **A set of fundamental accounting concept relations which never change exist and are universally applicable across all digital financial reports**[54]. The 7,000 publicly available XBRL-based digital financial reports provide empirical evidence to support these basic, common sense relations between reported facts. The ideas shown by the basic, common sense fundamental accounting concept relations can be employed in other areas of a digital financial report. They are examples of principles.
47. **Financial reporting conceptual frameworks documented using books can contain ambiguities and inconsistencies**[55]. Because financial reporting conceptual frameworks are written in books (i.e. not in machine-readable terms); testing the conceptual preciseness of the conceptual framework can prove difficult. However, if the conceptual framework of a

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[50] Rene van Egmond and Charles Hoffman, *Financial Report Semantics and Dynamics Theory*, http://xbrl.squarespace.com/fin-report-sem-dyn-theory/

[51] Ibid.; page 28.

[52] *Digital Financial Reporting Principles*, http://www.xbrlsite.com/2015/Library/DigitalFinancialReportingPrinciples-2015-01-05.pdf

[53] *Arriving at 2014 Digital Financial Reporting All Stars: Summary*, page 2, http://www.xbrlsite.com/2015/Library/AnalysisSummary2014_ArrivingAtDigitalFinancialReportingAllStars.pdf

[54] *Public Company Quality Continues to Improve, Two Generators at 90%*, http://xbrl.squarespace.com/journal/2015/10/1/public-company-quality-continues-to-improve-two-generators-a.html

[55] *Differentiating Alternatives from Ambiguity*, http://www.xbrlsite.com/2015/Library/DifferentiatingAlternativesFromAmbiguity.pdf

reporting scheme (such as US GAAP, IFRS, etc.) is articulated in machine-readable form, such as a machine-readable ontology; computers can be leveraged to test the conceptual framework of the reporting scheme, reducing ambiguity and increasing the preciseness of the conceptual framework. Any vagueness, inconsistencies, logically incoherent, and ambiguities in the definitions and principles used in financial reporting standards should not be seen as "alternatives" or "options"; they are unintended errors in the standards.

48. **Concepts can be organized into distinct classes**[56]. For example "current assets" is a class of concept that is different than the "revenues" class of concepts.
49. **Extension concepts created must relate to some existing class of concept or member of such class and should explicitly indicate which class or class member**[57]. If an economic entity feels the need and can justify the creation of a concept that does not exist in the US GAAP XBRL Taxonomy; the economic entity should provide this justification in the documentation for the extension concept it creates and should create an XBRL definition relation of the type "general-special" to explicitly indicate which class or member of a class to which the extension belongs.

[56] *Phenomenon Points to Need for Global Standard Way to Define a Class using XBRL*, http://xbrl.squarespace.com/journal/2014/9/19/phenomenon-points-to-need-for-global-standard-way-to-define.html

[57] See generally, http://www.xbrlsite.com/2015/fro/us-gaap/html/Classes; and specifically, http://www.xbrlsite.com/2015/fro/us-gaap/html/Classes/index_Summary.html; and http://xbrl.squarespace.com/journal/2014/9/1/understanding-the-problem-of-changing-a-concept-class.html

Part VII: Conclusion

This *Digital Financial Reporting Manifesto* proposes to the global community of professional accountants that a digital machine-readable version of a general purpose financial report *can* and *ought to* exist.

XBRL-based digital financial reports by public companies to the U. S. Securities and Exchange Commission are the best example of and provide excellent empirical evidence as to what digital financial reports are, how they work, what it takes to make them work, and for testing ideas to prove that the ideas are sound.

Those XBRL-based digital financial reports do contain imperfections, but they also contain many, many correct examples. Skillfully distinguishing the correct from the incorrect and figuring out why something is incorrect helps one determine what "correct" looks like and how to achieve "correct".

There are only a handful of tweaks that are necessary in order to make XBRL-based public company financial reports to the SEC work for private companies. Mainly, those tweaks relate to making the framework used explicit and obvious. The following is a summary of those minimum specific tweaks:

1. Make explicit the currently implied notion of *class* in the US GAAP XBRL Financial Reporting Taxonomy, the definition of which should be consistent with the OWL 2 DL definition of *class*[58].
2. Assure that every element[59] in the US GAAP Financial Reporting XBRL Taxonomy is part of one or more Class. (i.e. there are "class-subclass" relations).
3. Never allow a reporting economic entity to change an element's class. (i.e. reporting economic entities cannot randomly move elements around).
4. Every economic entity extension element created MUST be explicitly tied to some existing US GAAP Financial Reporting XBRL Taxonomy concept or concept class. (this can be achieved using XBRL definition "general-special" relations.
5. Maximize the number of business rules which formally describe the relations between US GAAP Financial Reporting XBRL Taxonomy elements and unchangeable relations that exist within US GAAP.

If software vendors understand the information in this document and use these ideas they can create software that makes digital financial reporting better than current approaches to creating a financial report.

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[58] *Frame Language*, Wikipedia, retrieved October 10, 2015, https://en.wikipedia.org/wiki/Frame_language (Note that the object oriented programming and UML definitions of "class" and the frame language definition of "class" are different. The OWL 2 DL definition of class is consistent with the frame language definition of class)

[59] Note that the term "element" refers to one of: [Table], [Axis], [Member], [Line Items], Concept or [Abstract]. [Table] = Hypercube; [Axis]=Dimension; [Line Items] = Primary Items.

The quality of XBRL-based digital financial reports has been improving for several years[60]. There are specific reasons for these improvements. The tweaks articulated above will expedite the quality improvement process by making issues conscious to both software vendors and creators of XBRL-based digital financial reports.

Once "works" has been properly defined and consciously understood by creators of XBRL-based digital financial reports, then such reports will be *effective*. But then software vendors will understand how to make their product both *effective*, but also *efficient*. Then, digital financial reports will begin showing their benefits.

While this might not seem intuitive, if one considers the difference between manually created blueprints and blueprints created using CAD/CAM software then one could imagine the benefits offered by digital financial reporting[61].

[60] See comparison of 2014, 2014, and through May of 2015, Retrieved November 7, 2015; http://www.xbrlsite.com/2015/Library/ComparePeriods.jpg

[61] *Understanding Digital Financial Reporting and its Benefits*, http://xbrl.squarespace.com/journal/2015/6/25/understanding-digital-financial-reporting-and-its-benefits.html

Part VIII: Principles

The following section condenses the information in this document into a succinct set of principles.

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 are the same? How useful is such an XBRL-based financial report to automated machine-based processes if the reports contain defects?

2. **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 what is an acceptable defect rate? The Six Sigma[62] philosophy offers a target defect rate of 0.00034% or 99.99966% of information in an XBRL-based digital financial report being correct. Something along those lines is appropriate.

Defects can be identified by taking measurements. But how do you distinguish between something that is not a defect and something that is a defect? Rules.

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 prevent anarchy.

Rules guide, control, suggest, or influence behavior. Rules cause things to happen, prevent things from happing, 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.

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

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.

4. **The only way to achieve a meaningful exchange of information without disputes 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 relates to exchange without disputes as to precise meaning, it means unambiguous interpretation, it means resolving conflicts and inconsistencies.

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.

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 mathematics. Facts can be true or facts can be false; but a fact cannot be both true and false in the same system. 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 people can arrive at two different answers to the same question. 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.

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 defect free. Beyond those machine-readable business rules, manual processes are necessary to detect and correct defects.

7. **When possible to effectively create, machine-based automated processes tend to be more desirable than human-based manual processes because they 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.

8. **Computers have limited reasoning capacity**.

Computers are machines. 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.

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

Article 9 of the *Business Rules Manifesto*[63] 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, and manage rules. Business

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

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[64], Barak Obama, 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?"

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?

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.

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 reliable. Computer systems tend to be implemented using a safe subset of first-order logic because 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.

[64] 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/

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

The Law of Conservation of Complexity 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.

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.

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

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 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.

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

Appendix – Extremely Helpful Resources

The following is a summary of the most helpful resources that I have come across that are readable by business professionals, tend to provide both big picture and detailed information, and heavily influence the information in this document. I have provided the name of the resource and a summary of what understanding I got out of the resource. Information technology professionals will likely find the two accounting resources particularly helpful if they want to really understand the software they are building.

Data and Reality[65], by William Kent: (162 pages) While the first and last chapters of this book are the best, the entire book is very useful. The primary message of the *Data and Reality* book is in the last chapter, Chapter 9: Philosophy. The rest of the book is excellent for anyone creating a taxonomy/ontology and it is good to understand, but what you don't want to do is get discouraged by the detail and then miss the primary point of the book. The primary point of this book can be summarized: The goal is not to have endless theoretical/philosophical debates about how things could be. The goal is to create something that works and is useful. A shared view of reality. Something that enable us to create a common enough shared reality to achieve some working purpose.

Everything is Miscellaneous[66], by David Wenberger: (277 pages) This entire book is useful. This is very easy to read book that has two primary messages: (1) Every classification system has problems. The best thing to do is create a flexible enough classification system to let people classify things how they might want to classify them, usually in ways unanticipated by the creators of the classification system. (2) The difference between the first order of order, second order of order, and the third order of order; the power of metadata.

Models. Behaving. Badly.[67], by Emanual Derman: (231 pages) The first 100 pages of this book are the most useful. If you read the *Financial Report Semantics and Dynamics Theory*, you got most of what you need to understand from this book. But the book is still worth reading. It explains extremely well how it is generally one person who puts in a ton of work, figures something out, then expresses extremely complex stuff in terms of a very simple model and then thousands or millions of people can understand that otherwise complex phenomenon.

Semantic Web for the Working Ontologist[68], by Dean Allenmang and Jim Hendler: (354 pages) The first two chapters are the most useful. This is a rather technical book, but the first chapter (only 11 pages) explains the big picture of "smart applications". It also explains the difference between the power of a query language

[65] See, http://xbrl.squarespace.com/journal/2014/7/28/data-and-reality-what-is-the-purpose-of-sec-xbrl-financial-f.html
[66] See, http://xbrl.squarespace.com/journal/2011/1/31/us-gaap-taxonomy-build-it-to-allow-reoganization.html
[67] See, http://xbrl.squarespace.com/journal/2014/7/20/updated-financial-report-semantics-and-dynamics-theory.html
[68] See, http://www.amazon.com/Semantic-Web-Working-Ontologist-Effective/dp/0123735564

like SQL (relational database) which most people tend to be familiar with and a graph pattern matching language (like XQuery) which fewer people tend to understand. Querying can be an order of magnitude more powerful if the information is organized correctly.

Ontology for the Twenty First Century: An Introduction with Recommendations[69], by Andrew D. Spear: (132 pages) The introduction, basically the first 45 pages, are the most useful. This resource explains what computers can do and the major obstacles that must be overcome in order to get computers to do those things. The last section can be very challenging to make your way through but if you really want to understand all of the issues in creating useful ontologies, then reading this is worth the effort.

Systematic Introduction to Expert Systems: Knowledge Representation and Problem Solving Methods[70], by Frank Puppe: (350 pages) The first three chapters of this book, about 25 pages, are an excellent introduction to expert systems and is easily understandable to a business professional. The second section of this book explains how expert systems work and the moving pieces of expert systems, it is also fairly straight forward to grasp. The last to sections get technical, but are still understandable, and provide what amounts to an inventory of problem solving approaches and how to best implement those approaches in software. Information technology professionals would find this more useful.

Intermediate Accounting, Seventh Edition, by J. David Spiceland, James F. Sepe, and Mark W. Nelson: (1339 pages) This is a college textbook. The most useful chapter is Chapter 1: *Environment and Theoretical Structure of Financial Accounting*; particularly PART B, The Conceptual Framework. That first chapter is only 35 pages. Every accountant learns this information. Very few seem to remember it though.

Wiley GAAP 2011, Interpretation and Application of Generally Accepted Accounting Principles, by Steven M. Bragg: (1351 pages) This resource is very helpful to accountants. Again, the most useful chapter is Chapter 1 Researching GAAP Matters covers the conceptual framework of GAAP (i.e. US GAAP).

[69] See, http://ifomis.uni-saarland.de/bfo/documents/manual.pdf

[70] See, http://xbrl.squarespace.com/journal/2015/7/15/understanding-expert-systems-applicability-to-financial-repo.html