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Exploring the Notion of The Finance Factory

By

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Last Revised – February 25, 2019 (DRAFT)

"If you have an apple and I have an apple and we exchange apples then you and I will still each have one apple. But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas." --- George Bernard Shaw

ABSTRACT: The notion of the Finance Factory was introduced by Deloitte. This paper expands on that basic notion, provides additional details, and ponders implementation details related to turning The Finance Factory into reality. The document also tries to show the important role that standards play in creating something like The Finance Factory.

The Finance Factory is an abstraction like many of the other abstractions that accountants work with every day: numbers, ledgers, journals, spreadsheets, etc. The Finance Factory is a useful shared reality. The Finance Factory, or something like the vision of The Finance Factory, will be created over the coming years. Professional accountants need to agree on (1) what that shared reality is and (2) what is its specific purpose.

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In his seminal work *Data and Reality*[1], William Kent provides an excellent summary that discusses the realities of sharing information. In Chapter 9: Philosophy in the Third Edition and Chapter 12: Philosophy in the First Edition[2] he paints a picture of why you want to go through the trouble of sharing information using machine-based processes and the realities of what that takes to do so.

Kent points out the benefits of creating a shared enough reality to achieve a specific purpose. He says, "Much of this 'learning' process is really a conditioning of his perceptions, so that he learns to accept as fact those assumptions needed to make the theory work, and to ignore or reject as trivial those cases where the theory fails."

Accounting is full of abstractions created by humans. Numbers themselves are abstractions created by humans. Between 5,000 and 10,000 years ago farmers in Mesopotamia, where agriculture was born, used physical object to count crops and animals[3]. The distinction between types of crops or animals was made by using different types and shapes of objects. Then, in about 3200 BC, around 5,000 years ago, the first spreadsheet was invented. These farmers began documenting information using clay tablets in the earliest form of human writing ever discovered called Cuneiform. They partitioned their clay tablet into rows, columns, and cells. The spreadsheet below documents an account of barley distribution[4]:

[1] William Kent, Data and Reality: A Timeless Perspective on Perceiving and Managing Information in Our Imprecise World, 3rd Edition, https://www.amazon.com/Data-Reality-Perspective-Perceiving-Information/dp/1935504215
[2] William Kent, *Data and Reality*, Technics Publications, (See this resource which has CHAPTER 12: Philosophy from the first version of this book, http://www.bkent.net/Doc/darxrp.htm)
[3] Denise Schmandt-Bessersat, *On the origins of writing*, YouTube.com, https://www.youtube.com/watch?v=kidWY-pJFb0
[4] Metropolitan Museum, Proto-Cuneiform tablet with seal impressions: administrative account of barley distribution with cylinder seal impression of a male figure, hunting dogs, and boars, https://www.metmuseum.org/art/collection/search/329081

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Numbers, writing, tables, spreadsheets, ledgers, and even financial reports themselves are abstractions created by humans. These abstractions work because humans agree on the abstractions. Humans agree on the abstractions because they need tools to make the institution of accountancy work to serve commerce.

Deloitte, to the best of my knowledge, coined the term **The Finance Factory**[5] in the way that they use the term[6]. The purpose of this paper is to brainstorm and think about the notion of The Finance Factory, describe its characteristics, expand on the details, examine what it takes to create it, and even show an implementation of some aspects of a Finance Factory.

The Finance Factory

Deloitte defines and describes The Finance Factory in two papers. First in, *Close, Consolidate and Report*[7] and then in *The Future of Operational Finance*[8]. Here is how Deloitte describes The Finance Factory:

> The finance factory handles core finance processes, and connects to finance centres of excellence and outsourcing partners in a hub-and-spoke model.
>
> There's no paper, anywhere. Employees use cloud-based apps on mobile devices to transact their business, and highly standardized, simplified, workflow-enabled business processes handle the rest. Automated controls and intelligent process monitoring and analytics keep watch over core, extended and outsourced process performance, exceptions and service levels to help minimize rework. Finance managers receive event-driven, real-time updates thanks to new integration tools and advances in in-memory processing.
>
> The close process is continuous, if not yet real-time. A daily soft close is the new norm, made possible by visual close management tools, integrated sub-ledgers, daily time capture, journal workflows, reconciliation tools, as well as automation of consolidation, foreign exchange, allocation and intercompany transfers. Finance teams now simulate pre-close results and can support the continuous development of the MD&A throughout the close process.

The description articulates a vision, I am not sure if any organization actually achieves the level of automation of tasks that is described in the paragraphs above. Certainly, automation of the

[5] *Deloitte's Vision: The Finance Factory*, http://xbrl.squarespace.com/journal/2019/2/20/deloittes-vision-the-finance-factory.html
[6] So actually, the term "Finance Factory" is used to mean something different. For example, https://financefactory.com/about/
[7] Deloitte, *Close, Consolidate and Report*, https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/cfo/deloitte-nl-cfo-point-of-view-close-consolidate-and-report.pdf
[8] Deloitte, *The Future of Operational Finance*, https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/strategy/deloitte-nl-so-the-future-of-operational-finance.pdf

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described functionality is not common place today. However, it would be hard to disagree with the vision being described. Further, I embrace the general ideas of Deloitte's vision of The Finance Factory.

One of the primary benefits of the notion of The Finance Factory is that rather than seeing each of these parts as being separate; using the term "factory" helps one understand these parts work together. The Finance Factory is a system. In fact, it might be better viewed as a system of systems.

A **system**[9] is a regularly interacting or interdependent group of items forming a unified whole. A **system of systems**[10] is a system where the elements and sub-assemblies of a system are themselves systems. A system of systems is a complex system or a set of interconnected and coordinated autonomous systems to satisfy specific capacity and functions that the systems could not achieve independently.

Absorbing the Information in this Document

If you truly want to absorb the information in this document, it is suggested that you first read the Deloitte document *Close, Consolidate, Report*[11] and then read this document. Ultimately I am going to create one document that describes the notion of The Finance Factory. But that document does not exist at this time. My focus will be on actually constructing a working Finance Factory.

Expanding on Deloitte's Finance Factory Definition

If you have the perspective of your specific organization the boundaries of the description of The Finance Factory provided by Deloitte seems fine. However, consider the following possible expansions of Deloitte's vision:

- Regulators, lenders, analysts, and investors would likely want to "plug in" to The Finance Factory. One of the outputs of The Finance Factory, an external financial report, would likely be an input into extension functionality which would be used to analyze reported financial information. This functionality would be very similar to benchmarking tasks performed by external financial reporting managers that compared information against peers or variance analysis performed by financial reporting managers, internal auditors, or external auditors.

[9] Wikipedia, *System*, https://en.wikipedia.org/wiki/System
[10] Wikipedia, *System of Systems*, https://en.wikipedia.org/wiki/System_of_systems
[11] Deloitte, *Close, Consolidate and Report*, https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/cfo/deloitte-nl-cfo-point-of-view-close-consolidate-and-report.pdf

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- Standards setters, regulators, and others that provide statutory and regulatory rules would likely "plug in" to The Finance Factory. These stakeholders provide the rules in the form of machine-readable metadata. The discipline of describing reporting rules in a form a computer algorithm can understand assists standards setters and regulators in writing clear rules and economic entities that report in understanding the reporting rules better; weeding out myths, misinterpretations, and misconceptions.
- Support for standards such as XBRL[12](Extensible Business Reporting Language), GLEI[13] (Global Legal Entity Identifier), FIBO[14] (Financial Industry Business Ontology), SBRM[15] (Standard Business Reporting Model), and such.
- Academics teaching new professional accountants to work with The Finance Factory, understand statutory and regulatory reporting requirements, etc.
- Internal auditors and external auditors creating automated processes that watch over accounting and reporting.

These are just a few of the obvious additions to the good base vision of The Finance Factory. These additions are pointed out not to disparage the Deloitte vision, but rather to provide a complete as possible vision including as many stakeholders/constituents within the supply chain as possible.

Generalizing The Finance Factory Vision

Again, not to disparage the Deloitte vision but to expand the vision and make it even more useful; consider the notion of what I might call **The Information Factory** as a generalization of the vision for financial and non-financial business reporting. Imagine that same notion but removing "finance" from the notion and applying the idea to the broader notion of business reporting in general. Another perspective is to use the notion of The Financial Report Factory as a more specific or specialized vision of The Finance Factory. The Financial Report Factory is part of a Finance Factory, used specifically to create external general purpose financial reports, internal financial reports, perhaps tax returns, statistical and other reports submitted to regulators, etc.

The Information Factory = Expert System "Shell"

In a paper published in 1993 by the Japanese Technology Evaluation Center titled *Knowledge Based Systems in Japan*, H. Penny Nii describes the notion of a standard expert system "shell" and a prescribed

[12] XBRL International, https://www.xbrl.org/
[13] Global Legal Entity Identifier, https://www.gleif.org/en/
[14] OMG, Financial Industry Business Ontology, https://www.omg.org/hot-topics/finance.htm
[15] OMG, Standard Business Reporting Model, https://omgwiki.org/SBRM/doku.php

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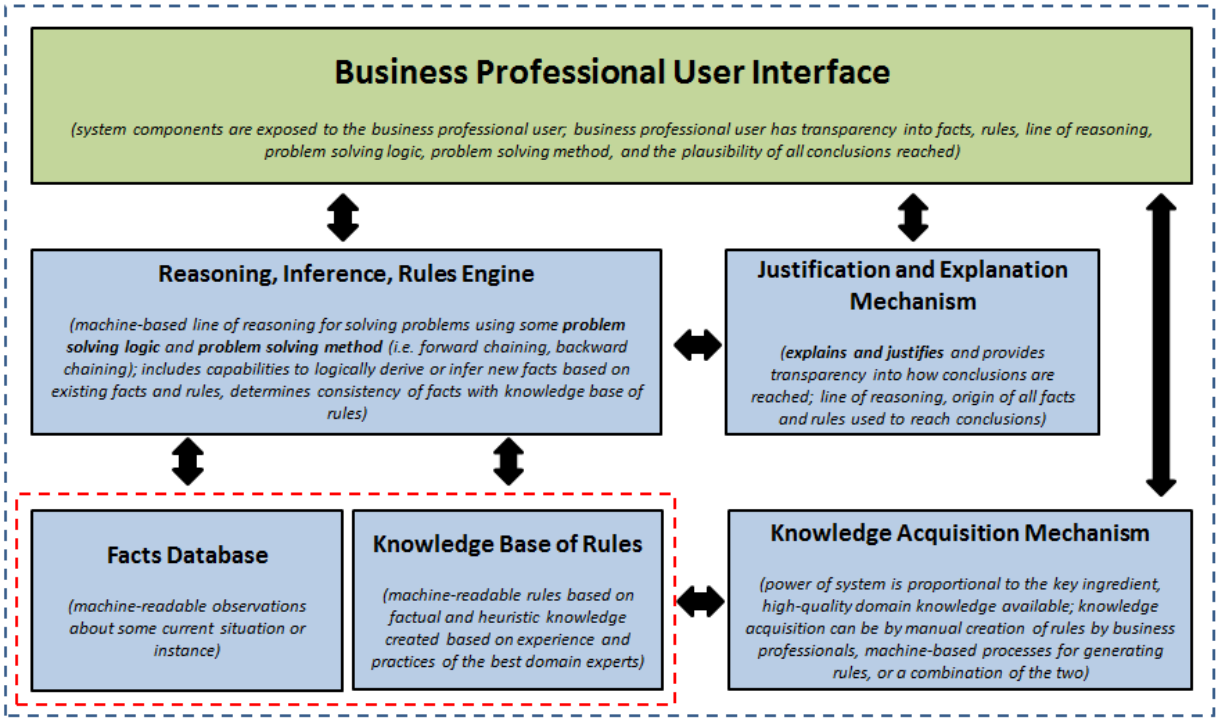
method for instantiating that standardized expert system[16]. Further, he describes each of the components of an expert system.

I took Nii's description, organized in a little differently, and elaborated on the description of the pieces of an expert system. I see the same pieces as Nii but I organized the diagram slightly differently. I also refer to the system as a knowledge based system rather than an expert system.

Knowledge Based System

Simply put, a **knowledge based system** is a system that draws upon the knowledge of human experts that has been represented in machine-readable form and stored in a **fact database** and **knowledge base**. The system applies **problem solving logic** using a **problem solving method** to solve problems that normally would require human effort and thought to solve. The knowledge based system supplies an **explanation and justification mechanism** to help system users to understand the **line of reasoning** used and support **conclusions reached** by the knowledge based system and presents that information to the user of the system.

Nothing in the system is a "black box"; rather every aspect of every decision made by a system is completely understandable to the business professional using the system. All information is traceable back to the origin of the information. Below is a graphic of the components of a knowledge based system:



[16] H. Penny Nii, Japanese Technology Evaluation Center, *EXPERT SYSTEMS BUILDING TOOLS: DEFINITIONS*, http://www.wtec.org/loyola/kb/c3_s2.htm

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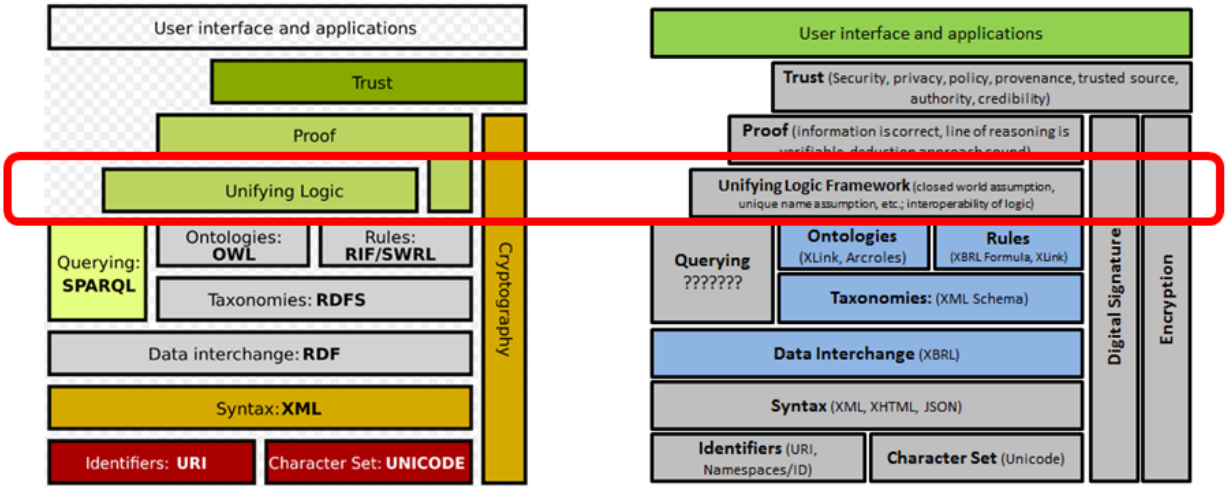
Multiple Technology Stacks

The primary challenge relating to figuring out the best approach to use to represent knowledge, as pointed out by John Sowa in his paper *Fads and Fallacies about Logic*[17], is not technical at all. Most issues relate to an even more formidable challenge related to fads, trends, arbitrary preferences, politics, fallacies, misinformation, and alternative completing standards.

As such, there will always be multiple technology stacks as opposed to every information technology professional using exactly the same approach to solving what amounts to be exactly the same problem.

Now, think back to the very beginning of this document where I pointed out William Kent's statement about "shared enough reality to achieve a specific purpose". The way human nature works, different people are going to take different approaches to implementing The Finance Factory. But where there is an opportunity to agree if one uses the logic of the system. Further, business professionals have an innate understanding of logic. With only a little bit of training, business professionals will be able to understand and discuss the functioning of the system at the level of logic.

Consider the comparison of these two technology architecture stacks[18]: Semantic Web Stack and XBRL Stack:



Imagine if Google, Apple, Microsoft, and Amazon all wanted to implement Finance Factories internally within their organizations. How would that work? Expand that to each of the approximately 7,000 public companies in the United States. Expand that to the approximately 10,000 listed companies that operate in the European Union. Add millions of private companies, state and local governmental entities (private sector), not-for-profits, federal governments, employee stock ownership plans; how exactly would that work?

[17] John F. Sowa, *Fads, Misinformation, Trends, Politics, Arbitrary Preferences, and Standards*, http://www.jfsowa.com/pubs/fflogic.pdf

[18] Unifying Logic Framework for Business, http://xbrl.squarespace.com/journal/2017/11/26/unifying-logic-framework-for-business.html

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The Accounting Equation

Invented in 1211 by an Italian bank and documented in 1494 by Italian mathematician, Franciscan friar Luca Pacioli[19], double-entry accounting and the accounting equation[20] are the foundation of financial information.

The foundational basis of double-entry accounting is straightforward. Quoting David Ellerman from his paper *The Math of Double-Entry Bookkeeping: Part I (scalars)*[21]:

"Given an equation w + … + x = y + … + z, it is not possible to change just one term in the equation and have it still hold. Two or more terms must be changed."

And so, the left hand side of the equation "w + … + x" (the DEBIT side) must always equal the right hand side of the equation "y + … + z" (the CREDIT side) in double-entry accounting. The reason that double-entry accounting is used, as contrast to single-entry accounting, is double-entry accounting's capability to detect unintended errors and to distinguish an unintended error from fraud.

The accounting equation is a global standard. All financial reporting schemes[22] are based on this one global standard equation. The document *Leveraging the Theoretical and Mathematical Underpinnings of a Financial Report*[23] shows other opportunities for leverage including mathematical rules such as the roll ups and roll forwards and other such mathematical relations.

Controlling Variability

Financial reports are not forms. As such variability needs to be supported and controlled in this special type of business report.

Information reported might not be uniform. But that is not to say the information does not follow identifiable patterns and is arbitrary and random. For example, various intermediate concepts (subtotals) might be used to summarize basic concepts in the financial reports of different economic entities in different ways. Flexibility is needed where flexibility is necessary. Flexibility in the wrong areas is not helpful. The controled reconfiguration of the model of a financial report within statutory and regulatory requirements is necessary. Financial reporting schemes might use more or might use less variability. But anywhere variability is allowed, that variability must be controlled.

Specific examples of variability include:

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[19] Wikipedia, *Luca Pacioli*, https://en.wikipedia.org/wiki/Luca_Pacioli
[20] Wikipedia, *Accounting Equation*, https://en.wikipedia.org/wiki/Accounting_equation
[21] David Ellerman, *The Math of Double-Entry Bookkeeping: Part I (scalars)*, http://www.ellerman.org/the-math-of-double-entry-bookkeeping-part-i-scalars/
[22] Charles Hoffman, CPA, *Comparison of Financial Reporting Schemes High Level Concepts*, http://xbrlsite.azurewebsites.net/2018/Library/ReportingSchemes-2018-12-30.pdf
[23] Charles Hoffman, CPA, *Leveraging the Theoretical and Mathematical Underpinnings of a Financial Report*, http://xbrlsite.azurewebsites.net/2018/Library/TheoreticalAndMathematicalUnderpinningsOfFinancialReport.pdf

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1. **Variability related to reporting style**: The income statement of, say, Microsoft and Wells Fargo are different. Financial institutions use interest based revenues, software companies do not. But income statements are not random or arbitrary. There are 9 identifiable income statement reporting styles that 87% of all US public companies use to report to the SEC[24]. All reporting styles can be identified[25].
2. **Variability related to explicitly reported facts (i.e. unreported high-level facts)**: Not all line items are explicitly reported in financial reports. For example, "Noncurrent assets" and "Total expenses" are often excluded. But, the majority of high-level line items are reported. When an important high-level line item is not explicitly reported, it must be derived using deductive reasoning. While if high-level subtotals are reported they can both act as a parity check for reported information (so it is better if these items are reported); all important high-level information can be derived. But, this does take extra programming effort.
3. **Variability related to class/type (i.e. improper concept use)**: Financial concepts are reported in specific allowable groupings. For example, the difference between direct operating expenses and indirect operating expenses is well understood by professional accountants. But, these reconfigurations can be a source of errors. This is managed by defining proper hierarchies of the different concept classes and allowed sub-classes of each class.

What is interesting is that 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. If one were to observe existing financial reports, the misconceptions of those creating financial reports become very clear when financial reports are digitized.

Method for Creating High-Quality Financial Reports

A general purpose financial report is a high-fidelity, high-resolution, high-quality information exchange mechanism. That mechanism has historically used the media of "paper". Over the past 50 years or so, that paper-based mechanism has given way to a new mechanism, "e-paper". By "e-paper" I mean PDF documents, HTML documents, Word documents and such.

XBRL is a new media, a new mechanism for creating a general purpose financial report. XBRL is a high-fidelity, high-resolution information exchange media that allows for the creation of high-quality financial reports. But, XBRL can also be used incorrectly.

[24] Charles Hoffman, CPA, US GAAP Reporting Styles, page 12, http://www.xbrlsite.com/2018/10K/US-GAAP-Reporting-Styles.pdf
[25] Charles Hoffman, CPA, *Making the Case for Reporting Styles*, http://xbrlsite.azurewebsites.net/2017/library/MakingTheCaseForReportingStyles.pdf

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I have developed a method for creating provably high-quality general purpose financial repots using the XBRL technical syntax[26]. This method has been tested using four different reporting schemes. The steps in the method are demonstrated using the International Public Sectory Accounting Standards (IPSAS)[27].

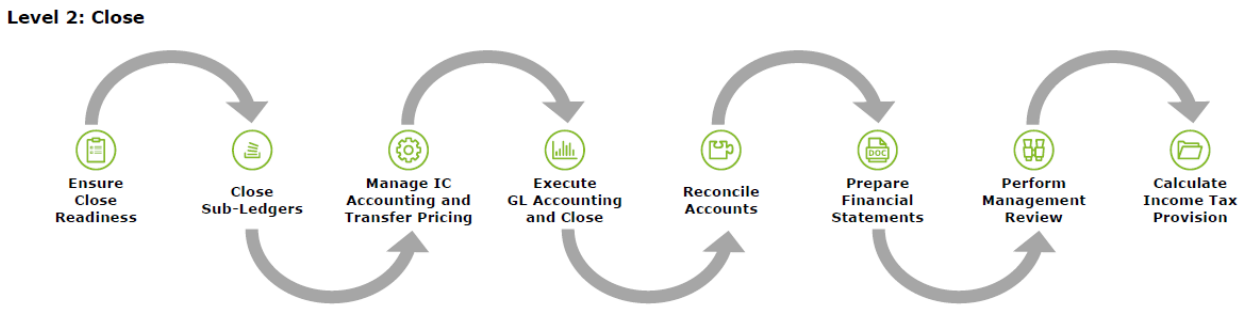
This method leverages Lean Six Sigma quality control techniques. It also uses a "factory" or "assembly line" type of mentality for creating the individual sub-assemblies that make up the complete financial report assembly. Each sub-assembly is tested, sub-assemblies are tested to be sure one sub-assembly does not conflict with or contridict another, and the full assembly is tested to be sure the report is correctly from a holistic perspective. All steps have been consciously engineered. Nothing is haphazard or done by chance.

Apply Ideas of Financial Reports to Other Report Creation Tasks

A financial report is not the entire system envisioned by The Finance Factory. However, the resulting external financial report is one output of that system. That output can provide valuable information about how other parts of The Finance Factory workflow, processes, and tasks can be effectively managed.

External Financial Report Creation Tasks

The following graphic is used by Deloitte The Netherlands in the document Close, Consolidate, Report[28] to describe the process of creating a financial report:



[26] *Method of Implementing a Standard Digital Financial Report Using the XBRL Syntax*, http://xbrl.squarespace.com/journal/2019/1/11/method-of-implementing-a-standard-digital-financial-report-u.html

[27] *International Public Sector Accounting Standards XBRL Taxonomy Prototype Project*, http://xbrl.squarespace.com/journal/2019/1/16/international-public-sector-accounting-standards-xbrl-taxono.html

[28] Deloitte The Netherlands, *Close, Consolidate, Report*, page 12, https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/cfo/deloitte-nl-cfo-point-of-view-close-consolidate-and-report.pdf

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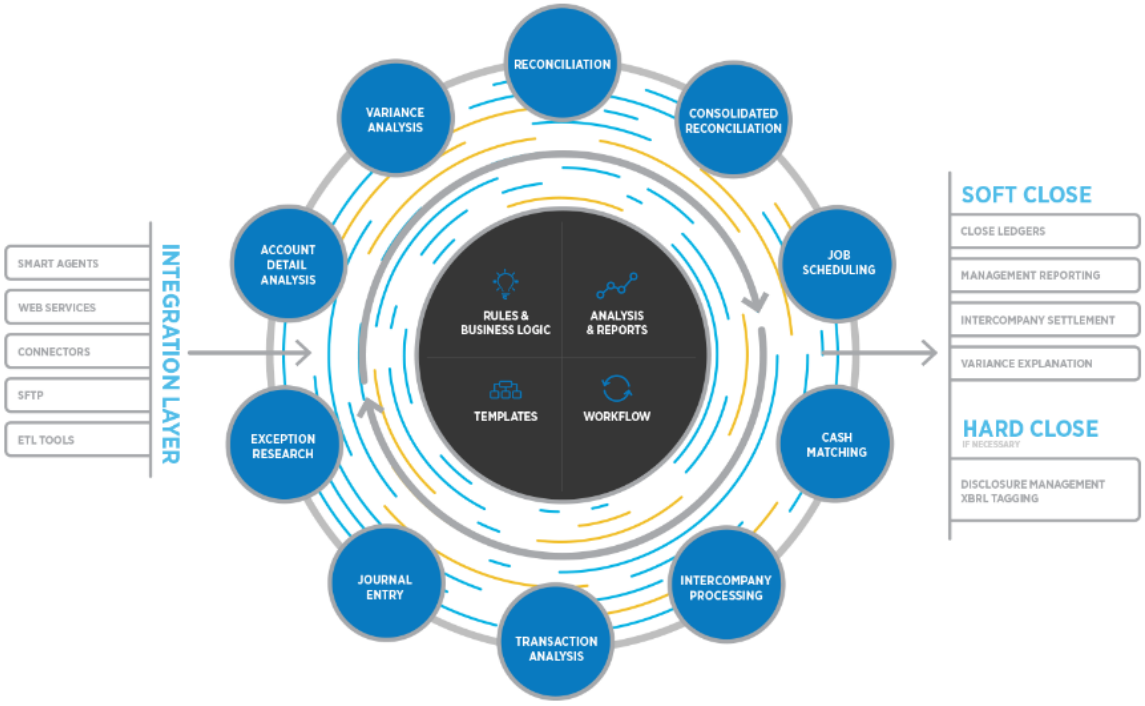
Blackline provides a similar graphic but which provides additional details[29]:



I provide an even more detailed graphic which shows the processes and tasks involved in creating an external financial report:

[29] Blackline, *The Modern Approach: Continuous Accounting*, https://www.blackline.com/continuous-accounting

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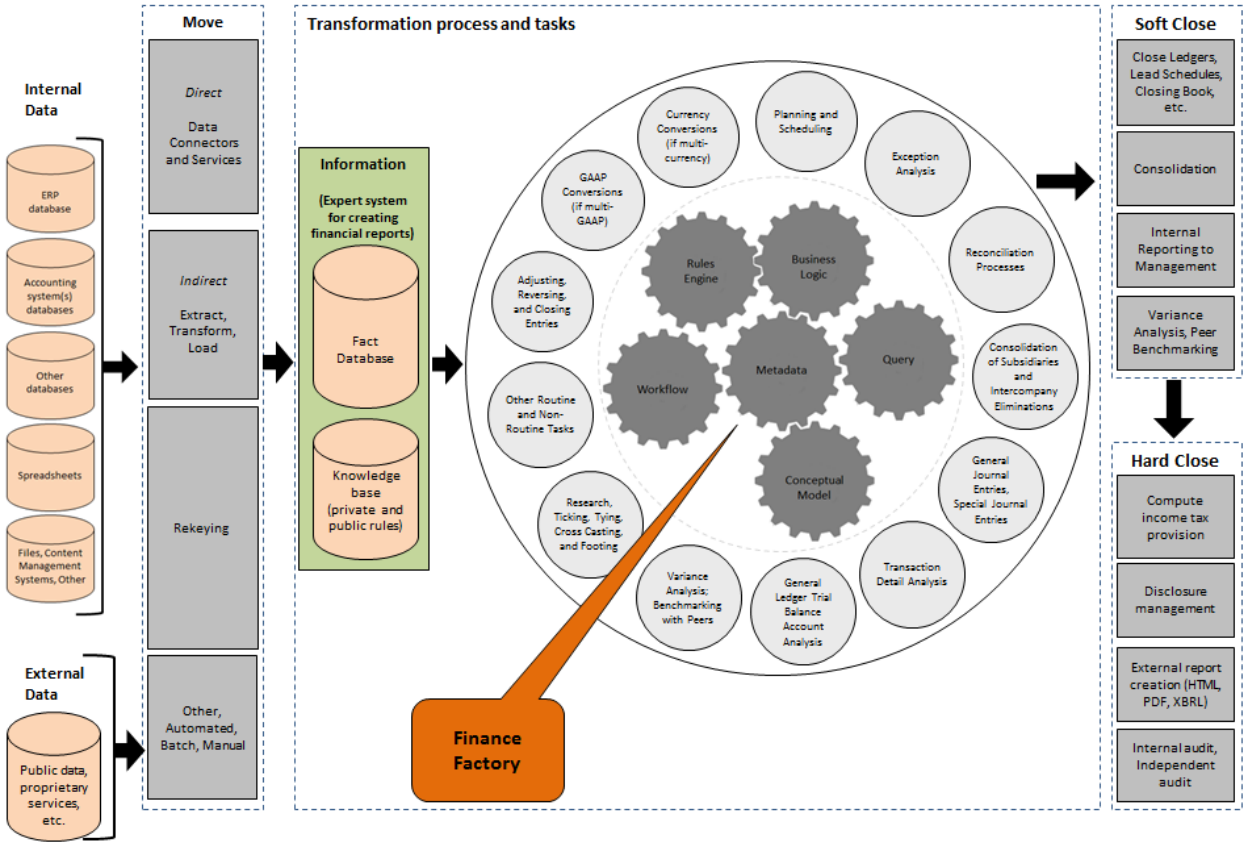

Note the orange callout which points to the gears in the center of the diagram labeled "Finance Factory". The gears represent the "knowledge based system" previously described in this document.

Digitized Operational Finance

The Deloitte document describes what they call digitized operational finance on page 4 of their document *Close, Consolidate, Report*[30] as follows: (highlighting is mine)

- **Rise of the Finance Factory**: Finance will be a utility function where day-to-day transactional finance —from payables, receivables and invoices to treasury transfers, journals, capital expenditures and the close cycle —will be managed centrally in "Finance Factories". These Finance Factories are fully automated/robotized process centers with continuous control and process visualization tools monitoring real-time on process exceptions.
- **What else**: There's no paper, anywhere. Employees use cloud-based apps on mobile devices to transact their business, and highly standardized, workflow-enabled business processes handle the rest. Finance managers receive event-driven, real-time updates thanks to new integration tools and advances in in-memory processing.

[30] Deloitte The Netherlands, *Close, Consolidate, Report*, page 4, https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/cfo/deloitte-nl-cfo-point-of-view-close-consolidate-and-report.pdf

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- **Information & Systems**: Integrated ERP systems will remain the backbone of companies' financial systems for some time. However we expect that Finance teams will be transformed by the rising use of robotics, mobile devices and cloud computing.
- **Close, Consolidate and Report**: One of the transactional Finance processes is the process by which organizations produce their internal management reports and external financial statements.

At the end of that page, the authors of the document make the following statement:

> "Reviewing the literature, global trends, innovations and based on conversations with solution providers about how they see Finance evolving, we developed our perspective on the future of Finance and the Close, Consolidate and Report process."

What they appear to be saying is that there perspective is based on discussion and reading the literature; i.e. not based on a proof of concept or working software.

I agree with Deloitte's observations, but my conclusion is reached by actually creating real, working software.

External Financial Reporting Subsystem

An external financial report is a subsystem of The Finance Factory. An application that I have helped to create called Pesseract[31], to the best of my knowledge, is the world's first software application that is an expert system for creating general purpose financial reports. This application helps one understand the difference between historical approaches to creating a financial report and new approaches that might be used with The Finance Factory.

Using the notion of a "factory" or "assembly line", you can break down the tasks that need to be performed into automatable and manual tasks. Certain tasks can be automated because report information is structured and therefore addressable by computer software applications. To the extent that machine readable rules can be created, you can:

- Make sure each report subassembly is 100% consistent with all machine-readable rules.
- The full assembly (i.e. the entire report) is 100% consistent with all machine-readable rules.
- Manually check everything else you cannot check using automated processes because:
    - There are no machine readable rules that can be used to automate a report creation task.
    - It is impossible to automate the task; therefore the task must be performed using a manual process because it is impossible to create machine-readable rules to enable automation.

[31] *Understanding Digital Financial Reporting using Pesseract*, http://xbrl.squarespace.com/journal/2018/10/14/understanding-digital-financial-reporting-using-pesseract.html

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Apply all rules to the assembly and each subassembly, and done. Your results would look like this: (This is a mockup, it will be a few days before I can actually run all of the rules.)

Subassembly (i.e. Block)	Model Structure Rules	Mathematical Relations Rules	Consistency Crosscheck Rules	Disclosure Mechanics Rules	Type/Class Rules	Other Constraints	Reporting Checklist Rules
Assets [Roll Up]	OK	OK	OK	OK	OK	OK	OK
Liabilities and Equity [Roll Up]	OK	OK	OK	OK	OK	OK	OK
Share Capital, by Class [Set]	OK	OK	OK	OK	OK	OK	OK
Surplus (Deficit) [Roll Up]	OK	OK	OK	OK	OK	OK	OK
Surplus (Deficit) from Continuing Operations [Roll Up]	OK	OK	OK	OK	OK	OK	OK
Surplus (Deficit) Breakdown [Roll Up]	OK	OK	OK	OK	OK	OK	OK
Accumulated Surpluses (Deficits), Prior Period Adjustments [Adjustment]	OK	OK	OK	OK	OK	OK	OK
Share Capital Reconciliation [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Reserves Reconciliation [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Accumulated Surpluses (Deficits) Reconciliation [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Noncontrolling Interest Reconciliation [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Net Assets/Equity Reconciliation [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Net Cash Flow [Roll Up]	OK	OK	OK	OK	OK	OK	OK
Cash and Cash Equivalents Reconciliation [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Property, Plant and Equipment, Net [Roll Up]	OK	OK	OK	OK	OK	OK	OK
Property, Plant, and Equipment, Net, Components [Roll Up]	OK	OK	OK	OK	OK	OK	OK
Land [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Buildings, Net [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Machinery, Net [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Furniture and Fixtures, Net [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Property, Plant and Equipment, Net [Roll Forward]	OK	OK	OK	OK	OK	OK	OK
Sales Analysis, by Customer [Set]	OK	OK	OK	OK	OK	OK	OK
Document Information [Set]	OK	OK	OK	OK	OK	OK	OK
Entity Information [Set]	OK	OK	OK	OK	OK	OK	OK

In the base automation of most tasks was impossible because financial report information was unstructured and therefore not reliably addressable by computer software applications. The structured nature of XBRL changes all of this[32].

Audit

In their paper, *Imagineering Audit 4.0*[33], Jun Dai and Miklos Vasarhelyi of Rutgers University provide a comprehensive and description of how industry will work in the future and why what they call "audit 4.0" will significantly change the auditing profession by automating current procedures, enlarging their scope, shortening timing, and eventually improve the overall assurance quality.

Similar to how The Finance Factory improves the efficiency and effectiveness of the finance department, technologies will be used to dramatically improve the efficiency and effectiveness of businesses and other organizations in general. Audit will also adapt.

[32] YouTube.com, Charles Hoffman, CPA, *How XBRL Works*, https://www.youtube.com/watch?v=nATJBPOiTxM
[33] Jun Dai and Miklos Vasarhelyi of Rutgers University, *Imagineering Audit 4.0*, https://aaajournals.org/doi/full/10.2308/jeta-10494

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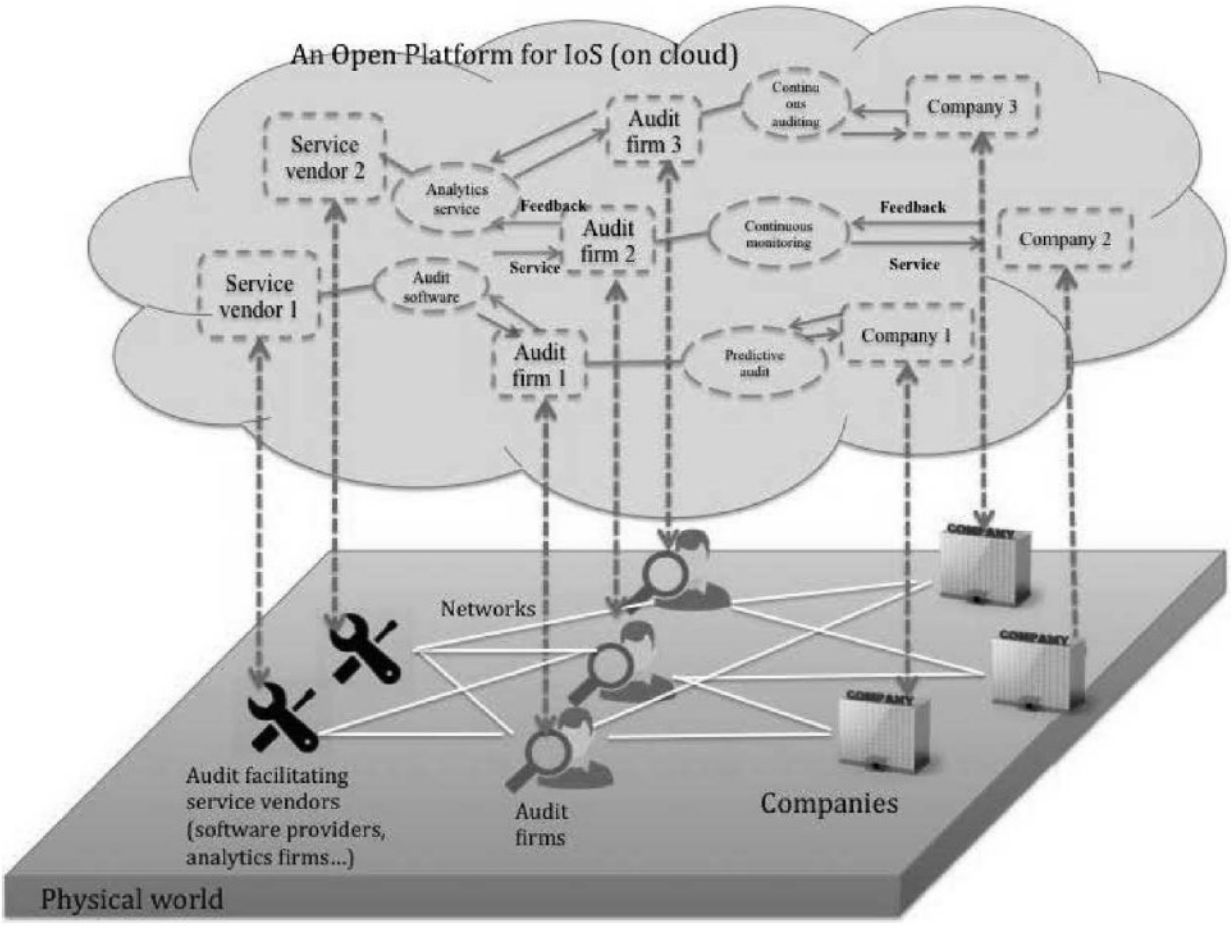
Dai and Vasarhelyi use the notion of a “mirror world” to describe the use of technology to create a virtual copy of the real world. A mirror world is defined as an ''informationally-enhanced virtual models or reflections of the physical world.''

The transaction cycles of a company and the interaction between the systems of the company and its customer, supplier, and bank are shown in the physical world on the bottom and the mirror world on the top in the cloud.

FIGURE 5
Audit 4.0 Regarding Audit Service



These mirror worlds exist today in the databases that hold transaction information. Within a company there tends to be fairly good integration. Between companies in a supply chain is a different story.

The extent that the real world can be represented within some mirror world and automation can be achieve is open for debated. Dai and Vasarhelyi explain how layers of technology will be used to manage, perform internal audits, and perform external audits of an economic entity.

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Auditchain envisions new approaches to financial reporting and assurance of such reports. In their whitepaper, *Auditchain: Decentralized Continuous Audit & Reporting Protocol Ecosystem*[34]summarizes their vision or real-time assurance and real-time financial reporting.

Analysis of Financial Information

One of the outputs of The Finance Factory would likely be a general purpose financial report. A general purpose financial report is a high-fidelity, high-resolution, high-quality information exchange mechanism. The report is a compendium of complex logical information required by statutory requirements and regulatory rules plus whatever management of an economic entity wants to voluntarily disclose. The report represents quantitative and qualitative information about the financial condition and financial performance of an economic entity. There are a number of different financial reporting schemes: US GAAP, IFRS, IPSAS, GAS, FAS, etc.

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

The following principles seem self-evident with regard to a general purpose financial report:

1. A general purpose financial report is a high-fidelity, high-resolution, high-quality information exchange mechanism.
2. Prudence dictates that using information from a financial report should not be a guessing game.
3. All formats conveying information should convey the exact same meaning be that format paper, e-paper, or some machine readable format.
4. Explicitly stated information from information bearers or reliably derived information is preferable to requiring information receivers to make assumptions.
5. Double entry accounting enables processes that allow for the detection of information errors and to distinguish errors (unintentional) from fraud (intentional).
6. Catastrophic logical failures are to be avoided at all cost as they cause systems to completely fail.

[34] Auditchain, *Auditchain: Decentralized Continuous Audit & Reporting Protocol Ecosystem*, https://auditchain.com/Auditchain-Whitepaper.pdf

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The ultimate use of information from a general purpose financial report is analysis of an economic entity. There are many different approaches to analysis. One specific approach is an unlevered discounted cash flow model[35]. As such, analysis of financial information should be part of The Finance Factory.

Technologies that Enable The Financial Factory

So what exactly has changed? There are four specific technologies that can be leveraged with affect to significantly improve and modernize accounting, reporting, auditing, and analysis processes and tasks and that enable the vision of The Finance Factory to actually become a reality. Those four technologies are:

1. **Change from unstructured information to structured information**. Historically, general purpose financial reports have been represented as unstructured information. That means that computer based processes cannot reliably work with those reports, therefore such reports and other complex information is only usable by humans. Today, it is possible to create general purpose financial reports and other sets of complex information that is still readable by humans but is also now readable by machine-based processes. This allows for the possibility for automation of specific work tasks.
2. **Increasing capabilities of specialized artificial intelligence**: Historically, computers have been able to perform very useful work. What has changed is that computers are becoming even more adept at doing useful work for professional accountants, other business professionals, and in general. The primary new capability that will enable this is "specialized artificial intelligence" also called cognitive computing. What that means is that software applications can with ever increasing effectiveness augment the skills of an accountant, similar to how a calculator augments your skills for doing math. Add to that change #1, the increase volume of structured information, and this change is amplified even more.
3. **Digital distributed ledgers**: Whether it is blockchain based or hashgraph based or one of the many other digital distributed ledger formats available; digital distributed ledgers will have a big impact. The primary thing that digital distributed ledgers do is to turn proprietary, locally available databases into standard, public databases and make sharing information significantly easier. Digital distributed ledgers is a method of making even more structured information available (#1) which means that you will have more information that AI applications (#2) can work with.
4. **Automation of accounting, reporting, auditing, and analysis processes**: Enabled by #1, #2, and #3 above; financial transformation and moving to a more modern finance platform is a no brainer. For example, The Finance Factory.

[35] *Representing Unlevered Discounted Cash Flow Model Using XBRL*, http://xbrl.squarespace.com/journal/2018/9/4/representing-unlevered-discounted-cash-flow-model-using-xbrl.html

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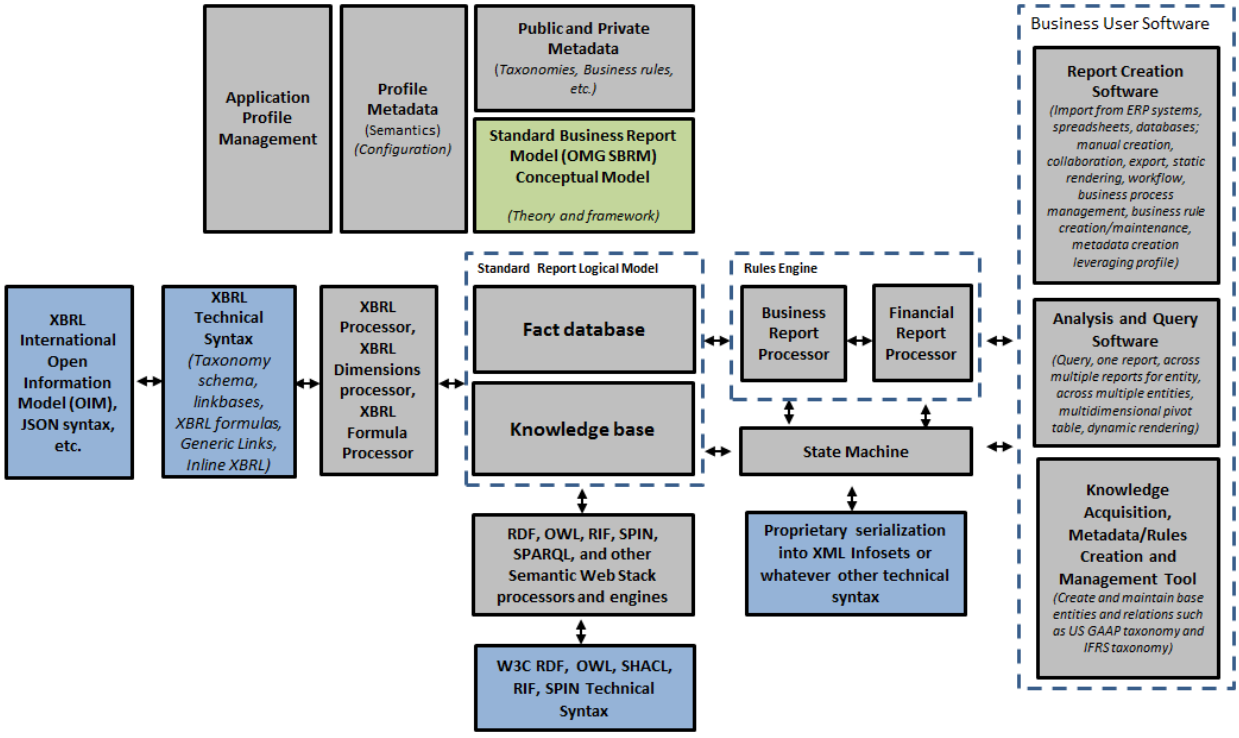
While the four enables listed above are probably the most significant, there are hundreds if not thousands of smaller changes that help enable a transformation and a move to more modern accounting, reporting, auditing, and analysis processes.

Important Role of Standards

Without standards, the best that we can hope for from The Finance Factory are one-off peer solutions, software vendor product lock in to proprietary approaches, and the full potential of a well-coordinated, well-orchestrated supply chain being less that fully realized. Standards make markets[36]. Standards[37] are a set of technical specifications that provide or intend to provide a common design for a product or process. Standardization can be across organizations or even within an organization.

What would the world be like without the global standard ISO shipping container? Could the current level of global trade be realized? Very likely not.

The technical syntax used by The Finance Factory might be XBRL, RDF + OWL + SHACL, JSON-LD, or other technical syntax that is currently in vogue. Technical syntaxes come and go. What persists longer term is business logic.



[36] Standards Make Markets, http://xbrl.squarespace.com/journal/2018/12/22/standards-make-markets.html
[37] The Innovation Policy Platform, *Standards and IP*, https://www.innovationpolicyplatform.org/content/standards-and-ip?topic-filters=12292

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Supporting All Transactions Cycles

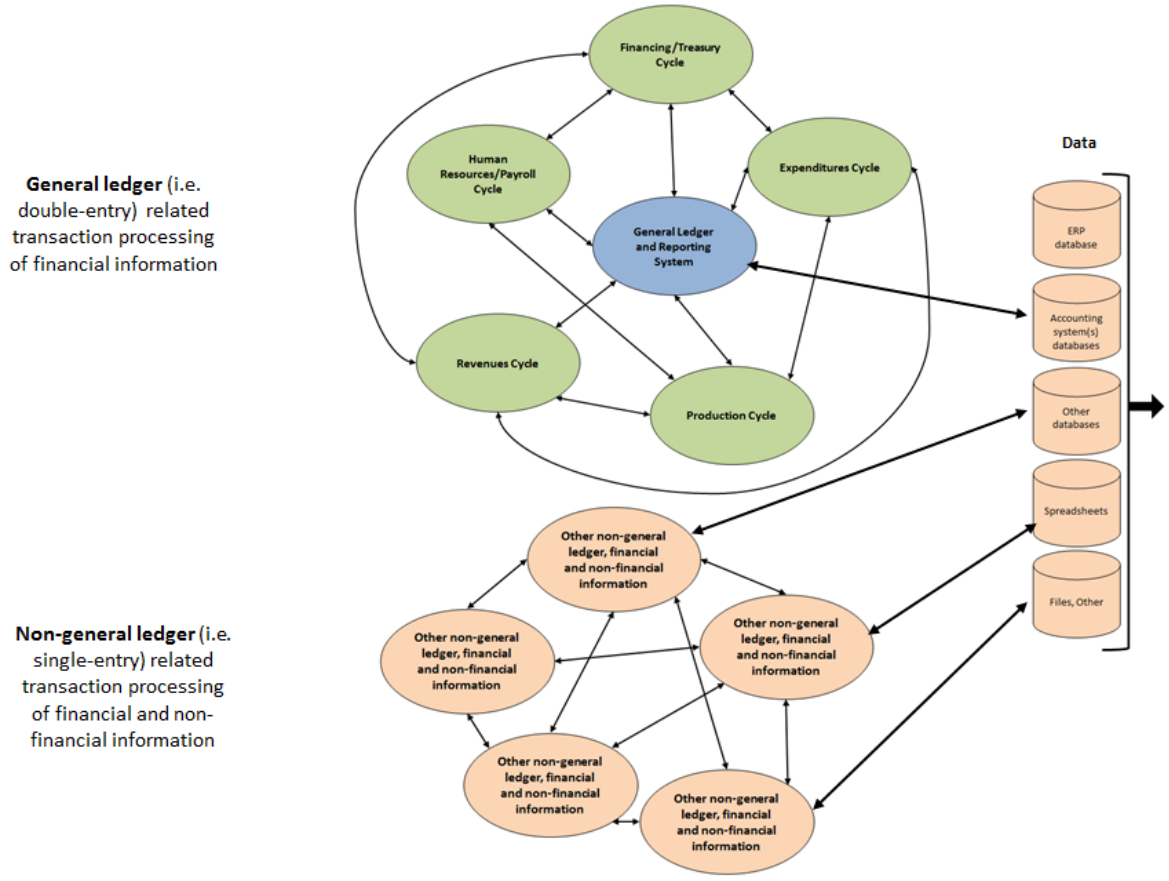
The focus of my implementation of The Finance Factory has been from the journals and ledgers that feed the external financial report and not just the external financial report itself. Creation of internal financial reports benefits directly from this same effort as there is little difference between external and internal financial reports really.

Key to putting all these pieces together appears to be what I call a semantic spreadsheet[38]. A semantic spreadsheet is similar to today's electronic spreadsheets in many ways. However, semantic spreadsheets have one significant difference from today's electronic spreadsheets.

Today's electronic spreadsheets are held together via presentation oriented artifacts such as the notion of a "workbook", a "sheet", a "row", a "column" and a "cell". Things can be linked together using the physical location within an electronic spreadsheet.

But a semantic spreadsheet is held together by business logic. It is structural, mathematical, accounting, and other such logical rules that hold the information contained in a semantic spreadsheet together.

Transaction Cycles Feed Information into Databases and Other Storage Devices



[38] *Semantic Spreadsheet*, http://xbrl.squarespace.com/journal/2013/4/18/semantic-spreadsheets.html

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Importance of Ease of Use

There are tools that can be used to create The Finance Factory that exist today. TopBraid[39] offered by TopQuadrant, ErgoAI[40] from CoherentKnowledge, Fluent Editor offered by Cognitum[41] are just a few such tools; there are many others. The typical business professional could never use the tools above effectively, they are too complex.

Business professionals need to understand the ***Law of Conservation of Complexity***[42] which states that complexity can never be removed from a system, but complexity can be moved. The *Law of Conservation of Complexity* states: "Every application has an inherent amount of irreducible complexity. The only question is: Who will have to deal with it - the user, the application developer, or the platform developer?"

Business professionals also need to understand the notion of **irreducible complexity.** Irreducible complexity[43] 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.

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 kluge, a term from the engineering and computer science world, refers to something that is convoluted and messy but gets the job done. Anyone can create something that is complex. But it is hard work to create something that is simple.

Simple and simplistic are not the same thing.

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

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[39] TopQuadrant, *TopBraid Products*, https://www.topquadrant.com/products/
[40] CoherentKnowledge, *ErgoAI*, http://coherentknowledge.com/product-overview-ergoai-platform/
[41] Cognitum, *Fluent Editor*, https://www.cognitum.eu/semantics/FluentEditor/
[42] Understanding the Law of Conservation of Complexity, http://xbrl.squarespace.com/journal/2015/5/24/understanding-the-law-of-conservation-of-complexity.html
[43] Wikipedia, *Irreducible Complexity*, https://en.wikipedia.org/wiki/Irreducible_complexity

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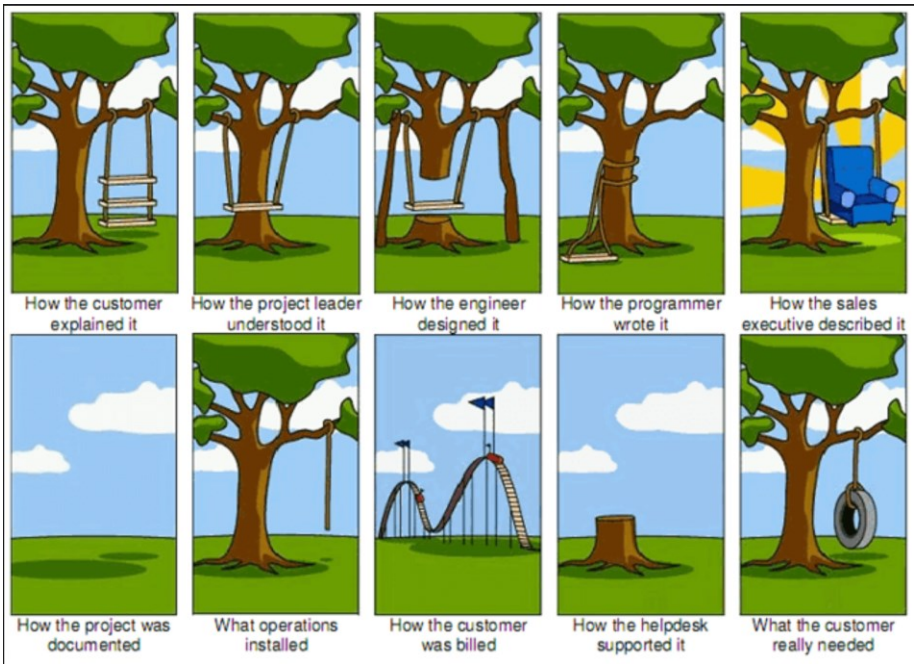
Simple is something that is not complicated, that is easy to understand or do. Simple means without complications. An explanation of something can be consistent with the real world, consider all important subtleties and nuances, and still be simple, straight forward, and therefore easy to understand.

There are well known and understood techniques for creating software systems that are both powerful and at the same time easy to use. Accounting professionals need to understand the true moving parts of the puzzle that is the pieces of The Finance Factory. Over the past 10 years or so, I have been trying to figure out what those moving parts are and the best ideas for creating what Deloitte packages together as their vision of The Finance Factory. I have summarized all of this information into a single document that I call ***Computer Empathy***[44]. I would encourage any professional accountant providing information to software engineers that will provide direction as to what The Finance Factory is and how to construct it to read that document.

The following cartoon[45] is used to show the importance of effective communications in any project:



In contrast, effective communication leads to a result that looks more like the following:

[44] Charles Hoffman, CPA, *Computer Empathy*, http://xbrlsite.azurewebsites.net/2018/Library/ComputerEmpathy.pdf
[45] Zentao, *Project Management - A Tree Swing Story*, https://www.zentao.pm/share/treeswingpm-97.html

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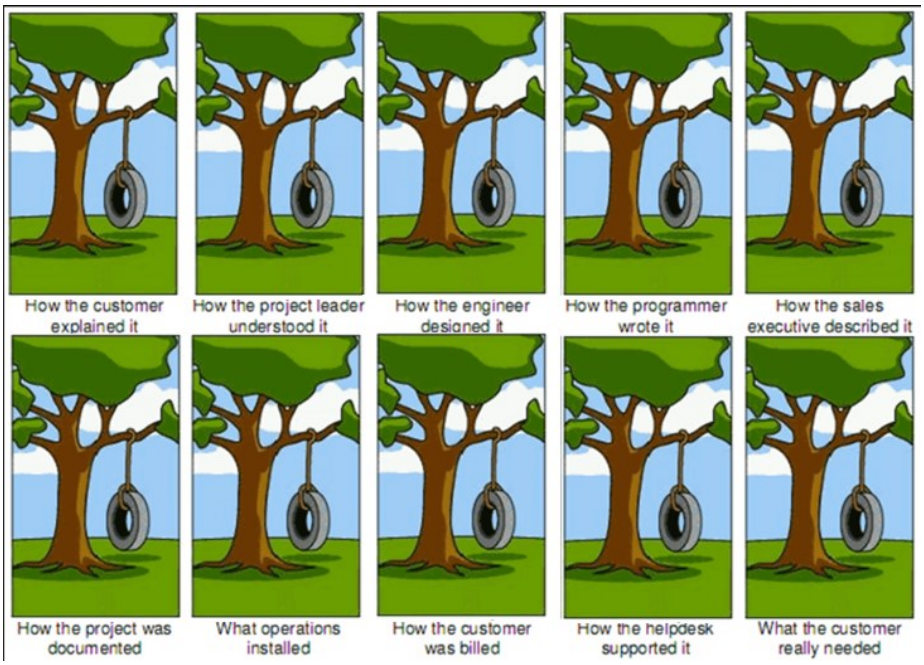

Don't confuse your perceived meaning of the picture that I showed as the common result in the second graphic with the intent of the picture. You can pick whatever version of the project that you want. The important thing is that everyone is on the same page.

Conclusion

Deloitte created the notion of that they call ***The Finance Factory*** to "package" these ideas of digital accounting, reporting, auditing, and analysis. One type of practical knowledge is **know-how**; how to accomplish something. This document explains not only The Finance Factory vision but also helps you understand details of how this vision can be effectively implemented.

The Finance Factory, or something like it, will be created over the coming years. Professional accountants need to participate in that project/process so that they get what they want and need. Professional accountants need to educate themselves as to the true moving parts of the puzzle.

As I pointed out in the beginning of this document, William Kent points out "the benefits of creating a shared enough reality to achieve a specific purpose." Professional accountants need to agree on (1) what that shared reality is and (2) what is its specific purpose.

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Other Helpful Resources

The following is a set of additional resources that are likely helpful to those endeavoring to better understand The Finance Factory and how to implement it. These resources provide helpful background information, additional details, samples, examples, and so forth:

- ***Method of Implementing a Standard Digital Financial Report Using the XBRL Syntax***[46]: This document strives to illuminate the structure and dynamics of a financial report for software engineers.
- ***Open Source Framework for Implementing XBRL-based Digital Financial Reporting***[47]: The *Open Source Framework for Implementing XBRL-based Digital Financial Reporting* is a freely available technical framework for implementing a software ecosystem for the creation of financial reports using US GAAP, IFRS, or any other reporting scheme. The framework is well engineered, rigorously tested, proven to be safe and reliable, and based on the global standard XBRL technical syntax.
- ***Accounting Process Automation Using XBRL***[48]: Background information related to using XBRL for accounting process automation.
- ***General Ledger Trial Balance to External Financial Report***[49]: Step-by-step guide to creating a modern financial statement creation platform for internal and external financial reporting.
- ***Introduction to the Fact Ledger***[50]: General purpose ledger for use in accounting process automation and automation of financial report creation.
- ***Theoretical and Mathematical Underpinnings of a Financial Report***[51]: Points out how I have been able to leverage the theoretical and mathematical underpinnings of a financial report to detect and leverage patterns that exist in financial reports that might not be apparent to most software engineers.

[46] Charles Hoffman, CPA and Rene van Egmond, *Method of Implementing a Standard Digital Financial Report Using the XBRL Syntax*, http://xbrlsite.azurewebsites.net/2019/Library/MethodForImplementingStandardFinancialReportUsingXBRL.pdf
[47] Charles Hoffman, CPA, et. al., *Open Source Framework for Implementing XBRL-based Digital Financial Reporting*, http://xbrlsite.azurewebsites.net/2018/Library/OpenSourceFrameworkForImplementingXBRLBasedFinancialReporting-2018-12-05.pdf
[48] *Accounting Process Automation Using XBRL*, http://xbrlsite.azurewebsites.net/2018/Library/AccountingProcessAutomationUsingXBRL.pdf
[49] *General Ledger Trial Balance to External Financial Report*, http://xbrlsite.azurewebsites.net/2018/RoboticFinance/TrialBalanceToReport.pdf
[50] *Introduction to the Fact Ledger*, http://xbrlsite.azurewebsites.net/2018/Library/IntroductionToTheFactLedger.pdf
[51] *Theoretical and Mathematical Underpinnings of a Financial Report*, http://xbrlsite.azurewebsites.net/2018/Library/TheoreticalAndMathematicalUnderpinningsOfFinancialReport.pdf

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- ***Blueprint for Creating Zero-Defect XBRL-based Digital Financial Reports***[52]: Explains how to use automated and manual processes professional accountants need to evaluate and measure the quality of an XBRL-based financial report.
- ***Guide to Building an Expert System for Creating Financial Reports***[53]: Detailed description of a software implementation that leverages the method articulated in this document.
- ***Intelligent XBRL-based Digital Financial Reporting***[54]: Everything you would ever want to know about intelligent XBRL-based digital financial reporting in one place.

Acknowledgements

Most of the ideas in this document come from discussions and feedback that I received over the past 15 or so years from many, many colleagues who are too numerous to list here. That input was critical to shaping the thoughts expressed in this document. Thank you to the entire XBRL community!

[52] *Blueprint for Creating Zero-Defect XBRL-based Digital Financial Reports*, http://xbrlsite.azurewebsites.net/2017/Library/BlueprintForZeroDefectDigitalFinancialReports.pdf
[53] *Guide to Building an Expert System for Creating Financial Reports*, http://xbrlsite.azurewebsites.net/2018/Library/GuideToBuildingAnExpertSystemForCreatingFinancialReports.pdf
[54] *Intelligent XBRL-based Digital Financial Reporting*, http://xbrl.squarespace.com/intelligent-xbrl/