Essence of Accounting

A logical description of the record to report process:
accounting, reporting, auditing, analysis

By

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December 17, 2024 (DRAFT)

"Truth is ever to be found in simplicity; and not in the multiplicity and confusion of things."   Sir Isaac Newton

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Introduction

Accounting was the world's first communications technology[1]. Of the three most important social technologies; literacy, numeracy, and accounting[2]; accounting was the first to be invented, about 7,000 years ago. Double entry bookkeeping is an industry standard documented in 1494 and contributed to the switch from Roman to Arabic numerals throughout Europe.

The purpose of this document is to provide a logical description of the essence of accounting and to demonstrate how accounting, reporting, auditing, and analysis can be performed digitally using a best practice-based method which employs an XBRL-based machine-readable representation of accounting information.

Essence is described as the core intrinsic nature or indispensable basic quality of something that determines its character.

An area of knowledge is a highly organized socially constructed aggregation of shared knowledge for a distinct subject matter. An area of knowledge has a specialized insider vocabulary, underlying assumptions, and persistent open questions that have not necessarily been resolved. Accounting is an area of knowledge.

We will cover important specific details of financial accounting, reporting, auditing, and analysis.

This document strives to explain accounting to non-accountants such as computer scientists. Sometimes accountants are criticized for providing jargon filled explanations. I try and not make that mistake.

While there are people that say that old-school financial reporting processes need to be improved[3] and plenty of very good academic papers that help explain how accounting, reporting, auditing, and analysis in a digital environment might work including *Imagineering*

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[1] Jane Gleeson-White, *Double Entry: How the Merchants of Venice Created Modern Finance*, page 10, https://www.amazon.com/Double-Entry-Merchants-Created-Finance/dp/0393346595/

[2] Peter Frampton & Mark Robilliard, *The Joy of Accounting*, https://www.amazon.com/Joy-Accounting-Game-Changing-Approach-Makes/dp/1735312924/

[3] *Changing Old School Financial Report Creation Processes*, http://xbrl.squarespace.com/journal/2017/2/14/changing-old-school-financial-report-creation-processes.html

Audit 4.0[4] and *Toward Blockchain-Based Accounting and Assurance*[5]; there is less information on exactly how to make these ideas work in software. This resource hopes to help fill that gap by providing a reliable and repeatable best practices-based method.

1.1. Fourth Industrial Revolution

Accounting evolves.   Transactions were documented using physical objects before writing was invented. Clay tablets were employed at one point. Then papyrus. Then paper. Then e-paper such as PDF and HTML. Now comes machine-readable information.

Each of the four largest public accounting firms in one way or another tell their clients to get ready for big changes caused by the fourth industrial revolution[6].   One of those firms, Deloitte, articulates a particularly good vision which they refer to as *The Finance Factory*[7]. Deloitte envisions things like paperless core finance processes with a continuous, if not real time, financial close.

Another public accounting firm, PWC, predicts that global GDP will be 14% higher in 2030 as a result of artificial intelligence – the equivalent of an additional $15.7 trillion increase in GDP which makes AI the biggest commercial opportunity in today's economy[8]. PWC is investing $3 billion to upskill their staff[9].

Accountants, don't under estimate the value of double-entry bookkeeping and the other processes, procedures, and techniques employed to make sure that everything "ticks and ties" and "cross casts and foots". These useful techniques, even perhaps better referred to as ingrained medieval traditions, should make their way into these new modern accounting techniques and methods.   These successful and

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[4] Jun Dai and Miklos Vasarhelyi, Rutgers University, *Imagineering Audit 4.0*, http://aaajournals.org/doi/abs/10.2308/jeta-10494?code=aaan-site

[5] Jun Dai and Miklos Vasarhelyi, Rutgers University, *Toward Blockchain-Based Accounting and Assurance*, http://aaajournals.org/doi/10.2308/isys-51804

[6] Charles Hoffman, CPA, *Adapting to Changes Caused by the Fourth Industrial Revolution*, http://xbrl.squarespace.com/journal/2019/8/4/adapting-to-changes-caused-by-the-fourth-industrial-revoluti.html

[7] Charles Hoffman, CPA, *Deloitte's Vision: The Finance Factory*, http://xbrl.squarespace.com/journal/2019/2/20/deloittes-vision-the-finance-factory.html

[8] Charles Hoffman, CPA, *Artificial Intelligence Done Right*, http://xbrl.squarespace.com/journal/2019/10/19/artificial-intelligence-done-right.html

[9] Charles Hoffman, CPA, *PWC to Invest $3 Billion in Upgrading Skills*, http://xbrl.squarespace.com/journal/2019/10/12/pwc-to-invest-3-billion-in-upgrading-skills.html

important medieval techniques are still very relevant even in the digital age.

Accounting, reporting, auditing, and analysis are going through a great upheaval, transitioning from an analog-based system used during the industrial age to a digital-based system as we become a knowledge economy[10].

1.2. *Three Key Technologies Building on Medieval Traditions*

Accounting, which has existed for about 7,000 years[11], even before the creation of formal number systems, is constantly evolving. Accounting is about to go through another significant phase in that evolution process.

There are three specific new enabling technologies that can be leveraged to significantly improve and modernize accounting, reporting, auditing, and analysis. Those technologies will transition into the mainstream over the coming years. Those three technologies are[12]:

- **Structured information** such as XBRL-based structured digital financial reports and other such machine-readable information formats for exchanging information[13] commonly referred to as knowledge graphs[14].

- **Knowledge-based systems** and other applications of artificial intelligence; at first primarily rules-based systems (deductive reasoning) and then ultimately patterns-based systems (i.e. machine learning; inductive reasoning, abductive reasoning)[15].

- **Digital distributed ledgers** using blockchain, hashgraph, hyperledger, or other such technologies that enable the creation

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

[11] Wikipedia, History of Accounting, retrieved June 10, 2017, https://en.wikipedia.org/wiki/History_of_accounting

[12] Charles Hoffman, CPA, *Modernizing Accounting and Auditing: Three Technology Trends*, http://xbrl.squarespace.com/journal/2017/5/27/modernizing-accounting-and-auditing-three-technology-trends.html

[13] Charles Hoffman, CPA, *Special Theory of Machine-based Automated Communication of Semantic Information of Financial Statements*, http://xbrlsite.azurewebsites.net/2019/Library/SpecialTheoryOfSemanticCommunicationOfFinancialInformation.pdf

[14] *Knowledge Assembly*, https://digitalfinancialreporting.blogspot.com/2023/08/knowledge-assembly.html

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

of immutable public or private ledgers[16] enhanced by smart contracts[17] and logic contracts[18].

Trying to understand these changes from the perspective of today's accounting, reporting, auditing, and analysis practices will not help you understand these coming changes.

The territory has changed. A paradigm shift has occurred. But, by understanding the essence of accounting it is possible to understand possible futures of accounting, reporting, auditing, and analysis.

1.3. Area of Knowledge

An **area of knowledge** is a highly organized socially constructed aggregation of shared knowledge for a distinct subject matter. An area of knowledge has a specialized insider vocabulary (i.e. jargon), underlying assumptions (axioms, theorems, constraints, assertions, restrictions), and perhaps some persistent open questions that have not necessarily been resolved within that area of knowledge (i.e. flexibility is necessary, change occurs). Subject matter experts (SMEs) create, use, and maintain an area of knowledge.

Accounting is an area of knowledge. You can explain aspects of the accounting area of knowledge, such as the nature of a financial report, using a logical theory which explains a logical model. A logical theory can be tested and proven by providing a proof. When all the details are worked out, you have a best practice based proven method.

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

You can think about an area of knowledge as being characterized in a spectrum with two extremes:

- **Kind area of knowledge**: clear information, clear rules, lots of patterns, lots of rules, repetitive patterns, and typically unchanging tasks.

- **Wicked area of knowledge**: obscure data, few or no rules, constantly changing tasks, and abstract ideas.

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[16] Charles Hoffman, CPA, Digital Distributed Ledgers, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part01_Chapter02.71_DistributedLedgers.pdf

[17] Wikipedia, *Smart Contracts*, https://en.wikipedia.org/wiki/Smart_contract

[18] *Logical Contracts*, http://logicalcontracts.com/

An area of knowledge can have aspects of both extremes, but tends to lean toward one side of the spectrum or the other. Financial accounting and reporting tend to lean more toward the "kind" end in many ways, particularly the quantitative aspects of accounting and reporting. The qualitative aspects may be more in the wicked side of the spectrum.

Another term for area of knowledge is a knowledge domain or simply domain.

1.4. Systems

A **system**[19] is a cohesive conglomeration of interrelated and interdependent parts that is either natural or man-made. **Logic** is thinking according to a set of consistent and coherence rules. A logical system (a.k.a. formal system, axiomatic system, conceptual model) enables a community of stakeholders trying to achieve a specific goal or objective or a range of goals/objectives to agree on important common models, structures, and statements for capturing meaning or representing a shared understanding of and knowledge in some universe of discourse.

A general purpose financial report is a complicated logical system[20] invented by humans to achieve a specific purpose.

1.5. System Complexity and Order

Difference systems have different levels of complexity. Systems can also be ordered or disordered. The Cynefin Framework[21] is a conceptual framework that helps you understand the dynamics that are at work within different types of systems. The framework was created in 1999 by David Snowden of IBM Global Services to help IBM to manage intellectual capital.

The following graphic helps one understand the different levels of complexity: simple, complicated, complex, and chaotic. The graphic also helps one understand the difference between disorder and order.

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[19] *System Thinking*, https://digitalfinancialreporting.blogspot.com/2023/09/systems-thinking.html

[20] *Logical Systems for Business Professionals*,
https://digitalfinancialreporting.blogspot.com/2023/09/logical-systems-for-business.html

[21] Cynefin Framework, http://xbrl.squarespace.com/journal/2021/3/21/cynefin-framework.html

The video *Using Cynefin to Prioritize and Analyze Features, User Stories, and Functional Requirements*[22] provides an excellent walk through of these ideas.

Different skill sets are necessary to be able to create simple, complicated, and complex systems that work effectively.

The majority of accounting and reporting knowledge tends to be simple and complicated per the definitions of the Cynefin framework.

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[22] Using Cynefin to Prioritize and Analyze Features, User Stories, and Functional Requirements, https://www.youtube.com/watch?v=L5fnxahydXM

1.6. Change

Things change, even financial reporting standards. This discussion paper, *Preliminary Views on Financial Statement Presentation*[23], provides insight as to how the FASB thinks about financial statements.

2. Brief History of Accounting

Between 5,000 and 10,000 years ago farmers in Mesopotamia, where agriculture was born, used physical objects to count crops and animals[24]. 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.

2.1. Spreadsheets

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. These farmers used single-entry accounting. The spreadsheet below documents an account of barley distribution[25]:

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[23] FASB, *Preliminary Views on Financial Statement Presentation*, https://www.fasb.org/DP_Financial_Statement_Presentation.pdf

[24] Denise Schmandt-Bessersat, *On the origins of writing*, YouTube.com, https://www.youtube.com/watch?v=kidWY-pJFb0

[25] 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

Spreadsheets have evolved since then and they are very likely to continue to evolve to serve the needs of accountants[26].

2.2. Invention and Documentation of Double-entry System

In 1211 AD a bank in Florence was the first documented use of double-entry accounting[27]. Around 1300 AD double-entry accounting came of age. In 1494 AD during the Renaissance, Venetian mathematician and Franciscan friar Luca Pacioli[28] published a book, *Summa de arithmetica, geometria. Proportioni et proportionalita* (Sum of Arithmetic, Geometry, Proportion and Proportionality)[29].

That book documented an approach to accounting now called double-entry bookkeeping[30] and recommended that others use this approach. The approach allowed for better error detection and the ability to differentiate unintended errors from fraud. Accountants adopted that new approach.

Another book documenting double-entry accounting was *Della mercatura e del mercante perfetto[31]* (translated *Of commerce and the perfect merchant*) which was written by Benedetto Cotrugli in 1458 but it was not published until 1573. (a.k.a. Benedikt Kotruljevic, a.k.a. Benedetto Cotrugli Raguseo)[32]

2.3. Double-entry Bookkeeping Model

At the foundation of every financial reporting scheme is the double-entry bookkeeping model[33]. Simply stated, that model is: **DEBITS = CREDITS**. The double-entry bookkeeping model is a mathematical

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[26] *Special Purpose Logical Spreadsheet for Accountants*, http://www.xbrlsite.com/2023/Library/SpecialPurposeLogicalSpreadsheetsForAccountants.pdf

[27] Geoffrky Alan Lee, *The Development of Italian Bookkeeping 1211–1300*, Wiley, https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1467-6281.1973.tb00183.x

[28] Wikipedia, Luca Pacioli, https://en.wikipedia.org/wiki/Luca_Pacioli

[29] Wikipedia, Summa de arithmetica, https://en.wikipedia.org/wiki/Summa_de_arithmetica

[30] Ancient double-entry bookkeeping. Lucas Pacioli's treatise (A. D. 1494--the earliest known writer on bookkeeping) reproduced and translated with reproductions, notes and abstracts from Manzoni, Pietra, Mainardi, Ympyn, Stevin and Dafforne, https://archive.org/details/ancientdoubleent00geij/page/n3/mode/2up

[31] Wikipedia, *Della mercatura e del mercante perfetto*, https://en.wikipedia.org/wiki/Della_mercatura_e_del_mercante_perfetto

[32] Croatian World Network, *Croation Inventions*, https://www.croatia.org/crown/articles/6268/1/E-CROATIAN-INVENTIONS.html

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

model. (If you don't understand this double-entry bookkeeping, this video is helpful[34]!)

Single-entry bookkeeping[35] is how 'everyone' would do accounting. In fact, that is how accounting was done before double-entry bookkeeping was invented. Single-entry bookkeeping simply uses one list to record information about transactions.

Double-entry bookkeeping in essence uses two lists of information and the two lists are compared/synchronized to one another and the two lists must agree.

Double-entry bookkeeping[36] adds an additional important property to an accounting system, that of a clear strategy to identify errors and to remove the errors from the system.

Even better, it has a side effect of clearly firewalling errors as either accident or fraud[37]. This then leads to the ability to specify an audit strategy.

Double-entry bookkeeping is how professional accountants do accounting.

And so, double-entry bookkeeping was the invention of medieval merchants and was first documented by the Italian mathematician and Franciscan Friar Luca Pacioli[38]. The Venetian Method of double entry bookkeeping is the best practice used by most professional accountants today[39].

Double-entry bookkeeping is perhaps one of the greatest discoveries and its impact on commerce and its significance is difficult to overstate. Which came first, double-entry bookkeeping or the enterprise[40]? Was it double-entry bookkeeping and what it offered that enable the large

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[34] YouTube, *2016 Debit Credit Theory Accounting Rap Song from O'Neill High School*, https://www.youtube.com/watch?v=PHanSCcMb_I

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

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

[37] *Fool Me Once*, https://digitalfinancialreporting.blogspot.com/2023/07/fool-me-once.html

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

[39] *Accounting: Our First Communications Technology*, http://xbrl.squarespace.com/journal/2021/10/23/accounting-our-first-communications-technology.html

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

enterprise to exist; or, did the large enterprise create the need for double-entry bookkeeping?

Triple-entry accounting[41] further builds on double-entry in that triple-entry links a transaction in two double-entry ledgers and the link is publicly available for all to see certain specific aspects of a transaction. You are still able to explain the reasoning behind the entry but additionally the transaction is visible for all to see which makes it very tough to lie since others are watching. It would be illogical for the transaction to not be reflected the same in both ledgers.

2.4. Foundational Mathematical Equation for Double-Entry Accounting

The foundational basis of double-entry accounting is straightforward. Quoting David Ellerman from his paper *The Math of Double-Entry Bookkeeping: Part I (scalars)*[42]:

> "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 errors and to distinguish an error from fraud.

Of course, there are a lot of details associated with setting up and operating an accounting system appropriately, but the fundamental feature is that DEBITS must equal CREDITS and if they don't, then something is up which needs to be investigated and corrected.

2.5. Difference Between Bookkeeping and Accounting

People often use the terms "bookkeeping" and "accounting" interchangeably[43]. But bookkeeping and accounting are two different things. Here are definitions of both:

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[41] *Triple-Entry Accounting*, https://youtu.be/wWXy7wUDEoQ?si=3U9gKn9fl7AYxXsj

[42] David Ellerman, *The Math of Double-Entry Bookkeeping: Part I (scalars)*, http://www.ellerman.org/the-math-of-double-entry-bookkeeping-part-i-scalars/

[43] Accounting Basics (Brainstorming), http://xbrlsite.azurewebsites.net/2021/library/AccountingBasics.pdf

- **Bookkeeping** is a mechanical process of recording transactions. Bookkeeping is an action; it is a record keeping process.

- **Accounting** is about determining what constitutes the transactions that are then recorded per the bookkeeping process. Accounting is the language used by bookkeeping. Accounting is a communications tool. Accounting is a classification system.

Bookkeeping history is explained in the book *Double Entry: How the Merchants of Venice Created Modern Finance*[44] by Jane Gleeson-White. A search on "difference between bookkeeping and accounting" will provide you on additional details. Basically, bookkeeping relates to transactions, journals, ledgers, trial balances, chart of accounts and the mechanical process and details involved with recording transactions. Accounting relates to coming up with a proper chart of accounts, classifying transactions, converting the trial balance into a set of financial statements and getting the accounting details right.

2.6. Universal Technology of Accountability

Double entry bookkeeping is a universal technology of accountability[45] used around the world by organizations, individuals, and communities. Regardless of the size of the organization, the location in the world, the activity of the organization, or the complexity of the organization; the double entry bookkeeping model works. Double entry bookkeeping will never become obsolete because where there are people, there is fraud.

2.7. Accounting Equation

Building on the double-entry bookkeeping model is the accounting equation[46]. Assets (a debit) is always equal to the sum of Liabilities (a credit) plus Equity (a credit). This is essentially a second layer building on the first layer. The foundational semantics of double-entry accounting is the accounting equation:

"Assets = Liabilities and Equity"

The terms "assets", "liabilities", and "equity" have very specific and generally well understood meanings in accounting and business. Accounting is referred to as "the language of business". This high-level

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

[45] *Universal Technology of Accountability*, https://digitalfinancialreporting.blogspot.com/2023/02/universal-technology-for-accountability.html

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

accounting equation is broken down into two trees of information. Those two trees are the detailed items which make up a financial report, "Assets" and "Liabilities and Equity". The semantics reiterates what that foundational equation states and assigns meaning to the numbers that make up those DEBITS and CREDITS.

Empirical evidence gathered shows that there are a finite number of ways used to organize the high-level concepts that make up the three primary financial statements: balance sheet, income statement, cash flow statement. I call these different organizations reporting styles[47].

2.8. Financial Reporting Schemes

As explained by the FASB in SFAC 6[48], "Elements of financial statements are the building blocks with which financial statements are constructed—the classes of items that financial statements comprise. The items in financial statements represent in words and numbers certain entity resources, claims to those resources, and the effects of transactions and other events and circumstances that result in changes in those resources and claims."

Financial standards setters or perhaps regulators create reporting schemes. Every financial reporting scheme fundamentally adheres to the accounting equation in some form. Creators of financial reporting schemes tend to create a set of high-level financial concepts that map directly to assets, liabilities, and equity and the rule "assets = liabilities + equity".

Here is a comparison of the core set of interrelated elements defined by five different financial reporting schemes[49].

Reporting Scheme	US GAAP issued by FASB	IFRS issued by IASB	FRF for SMEs issued by AICPA	IPSAS issued by IPSASB	GAS issued by GASB
Assets	Assets	Assets	Assets	Assets; Other Resources	Assets and Deferred Inflow of Resources
Liabilities	Liabilities	Liabilities	Liabilities	Liabilities; Other Obligations	Liabilities and Deferred Outflow of Resources
Equity or Net Assets	Equity (or Net Assets)	Equity (or Net Assets)	Equity (or Net Assets)	Net Financial Position	Net Position
Comprehensive Income	Comprehensive Income	Income and Expenses	Net income	Surplus or Deficit	Change in Net Position
Investments by Owners	Investments by Owners	Contributions from Holders of Equity Claims	Investments by Owners	Ownership Contributions	Increase in Net Position (Implied)

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[47] Charles Hoffman, *Making the Case for Reporting Styles*, http://xbrlsite.azurewebsites.net/2017/library/MakingTheCaseForReportingStyles.pdf

[48] FASB, SFAC 6, Elements of Financial Statements, page 14, https://www.fasb.org/pdf/con6.pdf

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

Reporting Scheme	US GAAP issued by FASB	IFRS issued by IASB	FRF for SMEs issued by AICPA	IPSAS issued by IPSASB	GAS issued by GASB
Distributions to Owners	Distributions to Owners	Distributions to Holders of Equity Claims	Distributions to Owners	Ownership Distributions	Decrease in Net Position (Implied)
Revenues	Revenues	Income	Revenues	Revenues	Inflow of Resources
Expenses	Expenses	Expenses	Expenses	Expenses	Outflow of Resources
Gains	Gains		Gains		
Losses	Losses		Losses		

On the one hand, the unique aspects of an economic entity need to be articulated. On the other hand, investors and financial analysts need to be able to compare the financial position and financial performance of different economic entities. Standard financial reporting schemes strive to strike an appropriate balance.

2.9. Interrelated Elements of Financial Statements

Every financial reporting scheme defines a core set of interrelated elements of a financial statement that are fundamentally grounded in some form of the accounting equation. For example, the Financial Accounting Standards Board (FASB) defines these ten interrelated elements of a financial statement in SFAC 6[50]; Assets, Liabilities, Equity, Comprehensive Income, Investments by Owners, Distributions to Owners, Revenues, Expenses, Gains, Losses. Then, additional elements are defined based on that core set. As is explained next, the interrelations of these elements are intentional.

2.10. Articulation

Articulation[51] is the conscious interconnection of the primary financial statements mathematically.   This screen shot below depicts this interconnection[52]:

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[50] FASB, SFAC 6, Elements of Financial Statements, page 23.

[51] Articulation, https://digitalfinancialreporting.blogspot.com/2023/08/understanding-articulation.html

[52] PROOF Articulation, https://www.xbrlsite.com/seattlemethod/platinum/proof/PROOF_Articulation.jpg
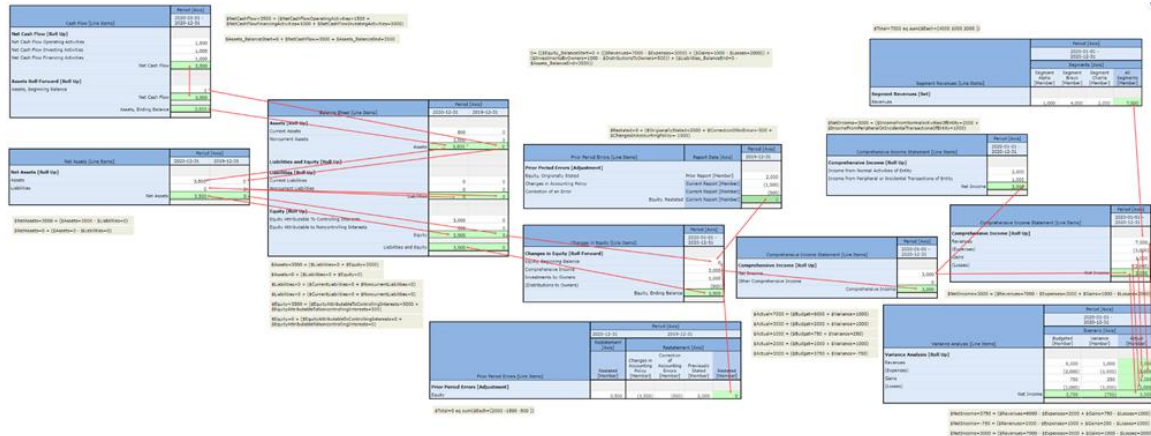
2.11. Interconnected Stocks and Flows

Articulation is the notion that the elements of a financial statement are intentionally interrelated into stocks and flows that explain the status, performance, and liquidity of an economic entity. The following graphic[53] helps one understand these interconnections:
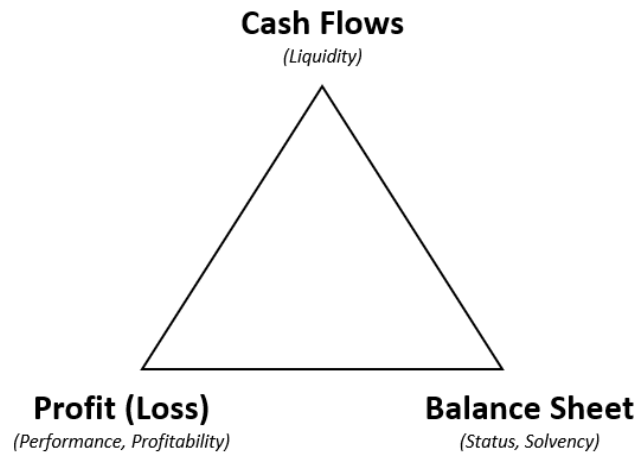
Stocks are instances of information at a specific point in time. Flows are durations of information between two points in time. Flows change the stocks.

A balance sheet provides a set of "stocks" that provide information about the status of an economic entity. An income statement provides a set of "flows" that provide information about the performance of that economic entity in terms of profit (loss). A cash flow statement provides a set of "flows" that provide information about the liquidity of that economic entity in terms of cash flows.

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[53] Inspired by a similar graphic provided by Dr. Willi Brammertz, http://www.brammertz-consulting.ch/about/about-willi-brammertz/

The interconnections will be made more tangible in a moment when we discuss the four statement model.

2.12. Transactions, Events, Circumstances, Other Phenomenon

The FASB in SFAC 6 (section 64, page 41)[54] points out that all transactions, events, circumstances, and other phenomenon that impact an economic entity can be grouped:
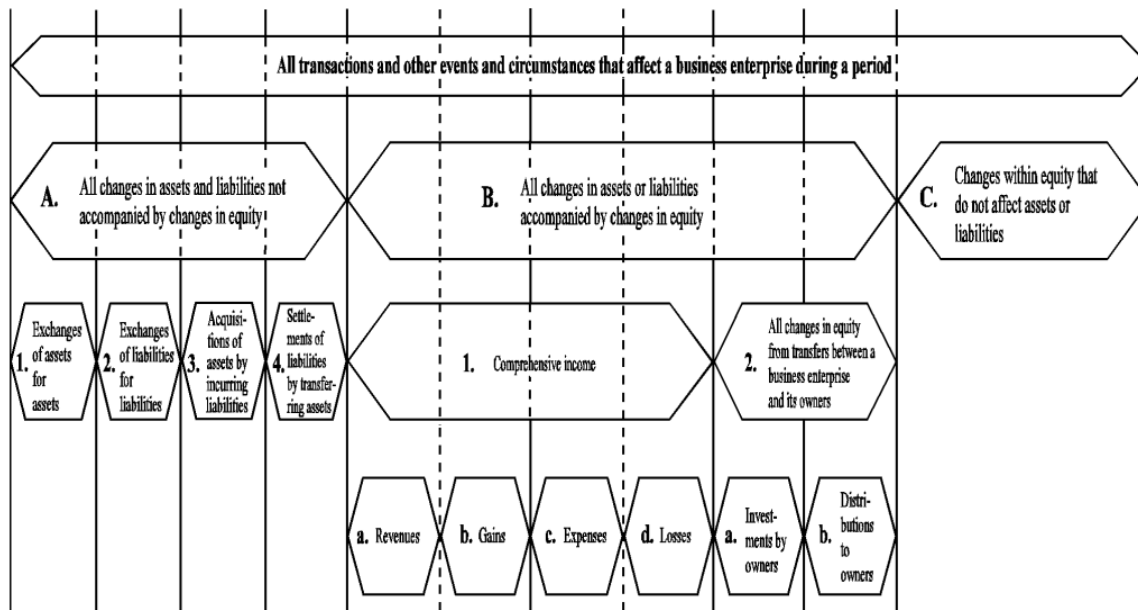
These changes can be grouped into eight primary bookkeeping or accounting entries categories:

1. Exchange of assets.
2. Exchange of liabilities.
3. Exchange asset for liability
4. Exchange liability for asset.
5. Exchange asset for income.
6. Exchange liability for expense. (special case of reserve building)
7. Moving profit (loss) into equity.
8. Moving asset or liability to equity.

While it is possible to have other combinations, those combinations are rare and potentially suspect.

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[54] FASB, SFAC 6, Elements of Financial Statements, section 64, page 41.

2.13. Obstacles to Automation

Continuous accounting, continuous reporting, artificial intelligence assisted audits, algorithmic regulation, computational professional services, automated analysis all offer unprecedented opportunities to modernize accounting processes. But there are fundamental challenges to automating accounting and reporting processes.   Here are fundamental obstacles that need to be overcome:

- **Information is entered into systems after transaction entry**: The reality of many if not most finance processes is that a significant amount of information is managed using spreadsheets and that is where context tagging and classification occur. *The fix?* Enter context tagging and classification information sooner, preferably at time of transaction entry.

- **Complex disparate systems trap information**: The reality of many if not most finance processes is many dissimilar systems making information integration complex. Often, complexity is self-inflicted such as an incorrectly set up chart of accounts or a less than adequate mapping between the chart of accounts and a report writer or audit lead schedules. *The fix?* Take the time to set up your accounting systems correctly.

- **Missing metadata**: Far too often information necessary to flow data through a system is entered into the system at the end of a process instead of at the beginning of a process. This missing metadata makes it impossible to automate processes. *The fix?* Establish standard metadata, enter that metadata as early in the process as possible, enable information to flow through the process where possible.

- **Missing information**: Commonly, information necessary for a system to be automated is not available to the system and therefore information is supplemented by manually created spreadsheets. *The fix?* Bring more and more tasks and processes into core systems and where possible avoid supplementing information using spreadsheets.

- **Overly manual process control mechanisms**: Process control mechanisms today tend to be overworked accounting professionals that have to manually control process output quality within systems that push far too much work to the end of the process. This manual approach is expensive, not reliable enough letting errors slip through the systems, and cause more important work to be delayed or simply left undone. *The fix?* Human-

machine collaboration. Augment manual processes with automated processes and let machines help overworked humans get work done. Leverage Lean Six Sigma[55] philosophies and techniques.

- **Communications issues**: The typical professional accountant does not really grasp the possibilities that technology offers to improve processes accurately. Computer scientists do not tend to understand important nuances of accounting, reporting, auditing, and analysis and therefore cannot build systems precisely or set priorities effectively. Most accountants focus on getting work done allocating little to no effort towards process improvement. *The fix?* It will take far less time for a professional accountant to learn what is necessary to communicate effectively with computer scientists than it would for a computer scientist to understand the important subtleties and nuances of accounting, reporting, auditing, and analysis. Take the time to improve your skills. If you don't want to make the investment, then hire a good consultant that has.

A properly set up chart of accounts, accounts properly assigned account "types", use of roll forward grouping codes, a properly set up report writer, and entering information into accounting systems rather than spreadsheets can enable the possibility of automation. Properly setting up an accounting system will enable significant changes in accounting processes to occur[56].

2.14. Objective of Financial Reporting

The following problem description or business use case was inspired by a similar sort of description by Harry S. Delugach, Associate Professor of Computer Science, in a presentation, *Common Logic Standards Development*, (page 7). Fundamentally, a financial statement serves this purpose:

> Two economic entities, A and B, each have information about their financial position, financial performance, and liquidity. 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

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

[56] *Turning Accounting On its Ear (Brainstorming)*,
https://digitalfinancialreporting.blogspot.com/2023/02/turning-accounting-on-its-ear.html

(economic entity A, economic entity B, investor) are using a common set of basic logical principles (facts, statements, deductive reasoning, etc.), common financial reporting standard terms and associations between terms (terms, associations, structures, assertions for a reporting scheme US GAAP, IFRS, IPSAS, etc.), and a common world view so they should be able to communicate this information fully, so that any inferences which, say, the investor draws from economic entity A's information should also be derivable by economic entity A itself using common basic logical principles, common financial reporting standards (terms, associations, structures, rules), and common world view; and vice versa; and similarly for the investor and economic entity B.

This problem/use case has been effectively solved for hundreds of years via the use of paper-based and human readable general-purpose financial statements.

Financial reports can be interrogated systematically and logically.

2.15. Things that can Go Wrong

Do the bookkeeping transactions and the accounting used to create a financial report reflect a "true and fair" story and provide accurate information about the financial position, financial performance, and liquidity of an economic entity? What exactly can go wrong?

There are many different things that can go wrong including measurement or valuation issues, timing issues, and such. But things that can go wrong can be grouped into the following categories:

- **Unintended errors** (a.k.a. an unintended mistake)
  - Simple errors
  - Complex errors (a.k.a. multiple simple errors)
- **Intended criminal errors** (a.k.a. fraud)
- **Judgment errors** (a.k.a. applying accounting rules inappropriately or in ways that are not permitted)

Things that have gone wrong could be detected by internal review processes or by independent third-party review or audit processes.

2.16. Financial Reports are Not Forms

General purpose financial statements are essentially "complex messages with variability". As explained by the FASB in SFAC 6,

variability is an intentional, inherent characteristic of a financial statement. For example, per SFAC 6, page 47, paragraph 77[57]:

> "Examples of intermediate components in business enterprises are gross margin, income from continuing operations before taxes, income from continuing operations, and operating income. Those intermediate components are, in effect, subtotals of comprehensive income and often of one another in the sense that they can be combined with each other or with the basic components to obtain other intermediate measures of comprehensive income."

That statement describes the "intermediate components" that contribute to the variability of a financial report.

A financial report is essentially a graph as defined by graph theory[58]. A graph is a mathematical structure used to model pairwise relations between objects. Graphs don't really exist in the real world, but they are used to describe real world objects to things like computer software.

It would be appropriate to call a financial report a "knowledge graph" and an XBRL-based financial statement is a machine-readable knowledge graph[59]. Financial report knowledge graphs can be interrogated systematically and logically using machine-based processes.

A "tree" is a special type of graph. So, for simplicity's sake let's use the term "tree". And so, imagine a financial report as a "tree" of information. Here is a tree:

And here is a "forest" of financial reports (i.e. a set of trees, for example the SEC EDGAR system might be considered a "forest" of financial reports:

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[57] Ibid.

[58] Wikipedia, *Network Theory*, https://en.wikipedia.org/wiki/Network_theory

[59] *Financial Report Knowledge Graphs*,
http://xbrlsite.azurewebsites.net/2021/Library/FinancialReportKnowledgeGraphs.pdf

But really, the forest above is not a good representation of US GAAP or IFRS forest of financial reports. The forest above assumes that all the "trees" are the same, which they are not because of the inherent variability of a financial report, the different intermediate subtotals as previously described. And so, a "forest" of US GAAP or IFRS financial reports might better be represented by something more like this:


Due to the inherent variability of financial reports, they are not all the same. Yes, financial reports have similarities and they have

patterns. But financial reports are not, and should not, be forms like the first forest.

But you can find patterns in the forest that is full of trees, the trees can be put into "sets" that have similarities. For example, those sets of financial reports when organized might look something like this:
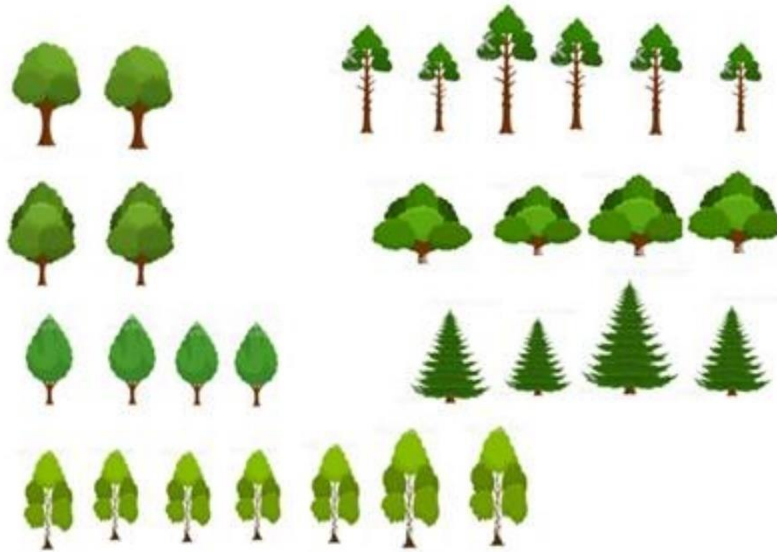
One might be tempted to call the forest seven different types of "forms" because unlike the one pattern in the first forest, we have seven patterns and therefore seven different types of forms. But this would not be accurate.

2.17. Understanding Intermediate Components

To understand the notion of intermediate components, consider the income statement. SFAC 6 clearly defines the components of comprehensive income to be[60]:

- Revenues
- Gains
- Expenses
- Losses

Those four components total to comprehensive income.

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[60] ibid, page 42, paragraph 65 B 1.

Further, if you read the definitions of the four components of comprehensive income the definitions of those four terms refer to the notions of "normal activities" and "peripheral activities"

- Income from Normal Activities of Entity
- Income from Peripheral or Incidental Transactions of Entity

Those two components likewise total to comprehensive income.

Reading the definitions of those four components of comprehensive income again, it is clear that "Revenues" and "Expenses" might not necessarily total to the component "Income from Normal Activities of Entity"; nor is it the case that "Gains" and "Losses" would total to "Income from Peripheral or Incidental Transactions of Entity".

It is likewise true that the typical financial report never reports their income statement using either of the above to breakdowns of comprehensive income. Income statement line items tend to be along the lines of the following components:

- Revenues (meaning revenues from normal activities or "operating" revenues)
- Cost of Revenues (meaning direct operating expenses)
- Gross Profit (Loss) (an intermediate subtotal)
- Operating expenses (meaning indirect operating expenses if the line item Cost of Revenues is reported)
- Other Operating Income (meaning operating gains that don't belong in the line item Revenues)
- Operating Income (Loss) (meaning the portion of comprehensive income relating to normal activities of the entity)
- Nonoperating Expenses (Income) (meaning peripheral or incidental expenses, gains, or losses)
- Income from Continuing Operations Before Taxes (an intermediate subtotal)
- Income Tax Expense (Benefit) (meaning taxes or benefits from normal or peripheral activities)
- Income from Continuing Operations After Taxes (an intermediate subtotal)
- Income (Loss) from Discontinued Operations (meaning a portion of income from normal activities that, however, have been discontinued)

- Net Income (Loss) (an intermediate subtotal)

- Net Income (Loss) Attributable to Parent (the portion of net income attributable to controlling interests)

- Net Income (Loss) Attributable to Noncontrolling Interests (the portion of net income attributable to noncontrolling interests)

- Other Comprehensive Income (meaning components that are specifically defined to be part of comprehensive income other than all other previous components)

- Comprehensive Income (defined by SFAC 6)

Now, this is only a portion of the intermediate components and subtotals that might exist on the income statements of most industries that take into considerations important ideas of "direct" versus "indirect" expenses; "operating" and "nonoperating"; "continuing" and "discontinued" operations; and other such important distinctions. Other industries such as banking have completely different line items and subtotals that might be used.

Professional accountants understand these important distinctions and explaining the specifics of these distinctions are beyond the scope of this document. Further, there are nuances and subtleties that need to be considered when determining what line items and subtotals should be reported.   These line items and subtotals are based, in part, on professional judgement and even personal preference sometimes but always need to be justifiable. Further, the logic of the specific line items and subtotals is both knowable and should make accounting sense.

2.18. Variability of Intermediate Components

Every financial report has inherent variability that is the result of explicitly allowing intermediate components of a financial report (i.e. subtotals) to be combined in appropriate but perhaps different ways depending on the needs of the reporting economic entity. Again, this is explained by the FASB in detail within SFAC 6[61].

There are a multitude of other patterns within financial reports that can be leveraged. For example, some financial reporting schemes require that each of the four primary financial statements be present within a set of financial statements in some form: balance sheet, income statement, statement of changes in equity, statement of cash flows. Disclosure notes such as the basis of reporting and nature of

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[61] ibid, page 47, paragraph 77.

the economic entity providing the financial report. These additional patterns which tend to be unique per financial reporting scheme are beyond the scope of this basic explanation of the logical conceptualization of a financial report.

A financial **reporting scheme**[62] is a formal specification for how financial reports are to be created and the underlying accounting rules and is usually created by a standards setter or regulator. For example, US GAAP, IFRS, and IPSAS are all financial reporting schemes. Financial reports are not forms. Financial reporting schemes allow for a certain amount of flexibility and variability when reporting certain specific disclosures or subtotals contained within a disclosure.

2.19. Comparability Including Consistency

Per SFAS 8[63] issued by the FASB, page 19, QC23:

> "Comparability is not uniformity. For information to be comparable, like things must look alike and different things must look different. Comparability of financial information is not enhanced by making unlike things look alike any more than it is enhanced by making like things look different."

A form is uniformity. As stated, financial statements are not forms. And while financial statements are not forms, they are likewise not random either.

It is important to understand what the FASB means by "comparability (including consistency)". That is explained in SFAS 8[64]. Here is the pertinent section of that document. This is well stated, very clear, and every word is worth reading:

- **QC20**. Users' decisions involve choosing between alternatives, for example, selling or holding an investment, or investing in one reporting entity or another. Consequently, information about a reporting entity is more useful if it can be compared with similar information about other entities and with similar information about the same entity for another period or another date.

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[62] Reporting Scheme, http://xbrlsite.azurewebsites.net/2018/Library/ReportingSchemes-2018-12-30.pdf

[63] FASB, *Statement of Financial Accounting Concepts No. 8*, page 19, http://www.fasb.org/cs/BlobServer?blobcol=urldata&blobtable=MungoBlobs&blobkey=id&blobwhere=1175822892635&blobheader=application/pdf

[64] FASB, *Statement of Financial Accounting Concepts No. 8*, page 19, http://www.fasb.org/cs/BlobServer?blobcol=urldata&blobtable=MungoBlobs&blobkey=id&blobwhere=1175822892635&blobheader=application/pdf

- **QC21**. Comparability is the qualitative characteristic that enables users to identify and understand similarities in, and differences among, items. Unlike the other qualitative characteristics, comparability does not relate to a single item. A comparison requires at least two items.

- **QC22**. Consistency, although related to comparability, is not the same. Consistency refers to the use of the same methods for the same items, either from period to period within a reporting entity or in a single period across entities. Comparability is the goal; consistency helps to achieve that goal.

- **QC23**. Comparability is not uniformity. For information to be comparable, like things must look alike and different things must look different. Comparability of financial information is not enhanced by making unlike things look alike any more than it is enhanced by making like things look different.

- **QC24**. Some degree of comparability is likely to be attained by satisfying the fundamental qualitative characteristics. A faithful representation of a relevant economic phenomenon should naturally possess some degree of comparability with a faithful representation of a similar relevant economic phenomenon by another reporting entity.

- **QC25**. Although a single economic phenomenon can be faithfully represented in multiple ways, permitting alternative accounting methods for the same economic phenomenon diminishes comparability.

US GAAP is an excellent financial reporting scheme because it strikes a good balance between the ability to compare and the ability to accurately report the financial condition and financial position of an economic entity. When trying to implement "comparisons" in software, it is very important to understand the goal of comparability the financial reporting scheme enables.

2.20. *Conceptual Framework*

The financial accounting conceptual framework created by the FASB contributes to this clear, consistent, logically coherent, and unambiguous terminology and principles by providing a disciplined framework[65] which can be used to think about financial accounting. A

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[65] Per FASB Special Report, *The Framework of Financial Accounting Concepts and Standards* (1998)

discussion of the conceptual framework in a FASB special report states in part the objectives of such a conceptual framework:

- Providing a set of common premises as a basis for discussion

- Provide precise terminology

- Helping to ask the right questions

- Limiting areas of judgment and discretion and excluding from consideration potential solutions that are in conflict with it

- Imposing intellectual discipline on what traditionally has been a subjective and ad hoc reasoning process

However, given the idiosyncratic tendencies of humans, interpretations which reflect the arbitrary peculiarities of individuals can sometimes slip in or mistakes can be made when expressing such terminology. Further, parts of our understanding of financial reporting can be incorrect and can evolve and improve and may even simply change over time.

2.21. Ledgers

Accountants have a special name for the spreadsheets, or tables, that these farmers invented. Accountants call these *ledgers*[66]. A ledger is simply a place where you record information such as transactions. There are a number of different types of ledgers that accountants use. General ledgers[67] tend to be double-entry and capture numeric information. Special ledgers, or subsidiary ledgers, are also generally double-entry and are basically special purpose ledgers for recording specific classes of transactions. For example, a sales ledger is used to record sales transactions of an economic entity and a purchases ledger is used to record purchases of an economic entity.

2.22. Journals

A ledger and a journal are not the same thing but are sometimes confused. Journals are the original lists of transactions. Ledgers summarize transactions, generally by account.
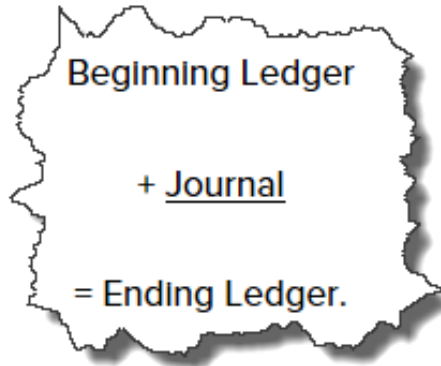
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[66] Wikipedia, Ledger, https://en.wikipedia.org/wiki/Ledger

[67] Wikipedia, General Ledger, https://en.wikipedia.org/wiki/General_ledger

2.23. Ledgers and Journals, Stocks and Flows

Another important piece of double-entry accounting is explained well in David Ellerman's article, *The Math of Double-Entry Bookkeeping: Part II (vectors)*, is ledgers and journals[68].

This is the relationship between a ledger and a journal:

Beginning Ledger

+ Journal

= Ending Ledger.

Ledgers summarized balances. For example, the general ledger summarizes account balances. Journals record the transactions which make up the changes between ledger balances. Other terms used for the relationship shown above are "roll forward" or "movements" or "stocks and flows". All three of these terms basically explain the following equation:

"Beginning balance + Additions - Subtractions = Ending balance"

Balance sheet accounts are stocks. Roll forwards of the beginning and ending balances of balance sheet accounts are flows. The income statement is a flow of net income (loss). The cash flow statement is a roll forward of the net change in cash and cash equivalents. The statement of changes in equity is a roll forward of equity accounts.

Many transactions, events, circumstances, and other phenomenon are recorded as transactions in a journal, make their way to a ledger, and then end up in the primary financial statements or within disclosures which detail the line items of the primary financial statements. Much of this information is part of the two trees which make up the roll ups of "Assets" and "Liabilities and Equity". However, there are other trees that can make up the complete "forest" of a financial report.

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[68] David Ellerman, *The Math of Double-Entry Bookkeeping: Part II (vectors)*, http://www.ellerman.org/the-math-of-double-entry-bookkeeping-part-ii-vectors/

2.24. Chart of Accounts

A chart of accounts is simply a listing of the account names that an economic entity uses to record transactions in its journals and ledgers. An economic entity tailors its chart of accounts to meet the specific unique needs of the economic entity.

Examples of account names that might be in a chart of accounts might be:

- Cash in bank
- Petty cash
- Other cash and cash equivalents
- Trade accounts receivable
- Finished goods inventory
- Work-in-progress inventory
- Raw materials inventory
- Land
- Buildings
- Equipment
- Trade accounts payable
- Long-term debt
- Retained earnings
- Sales revenue
- Depreciation and amortization
- Income tax expense

However, although an economic entity uses a unique chart of accounts internally, when information is reported that information is grouped following some financial reporting scheme.

2.25. Account Types

Accounting systems generally allow for the assignment of a "type" to each account so that accounts can be processed correctly. However, these types tend to be too general, incomplete, and many times informal in nature.

2.26. Roll Forward Grouping Codes

The notion of a roll forward grouping code is informally implemented by Workday informally using the notion of a "work tag"[69]. Someone else

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[69] Workday, *Tales of the Cloud: The Story of Worktags*, https://blog.workday.com/en-us/2012/tales-of-the-cloud-the-story-of-worktags.html

refers to the same thing as "transaction verbs"[70]. The notion of roll forward grouping codes will be discussed in detail in later sections of this document.

2.27. Four Statement Model

As previously mentioned, every financial reporting scheme has a characteristic that is referred to as "articulation". Articulation is the notion that the elements of a financial statement are interrelated and therefore depend on one another and so the four core financial statements; the balance sheet, the income statement, the statement of changes in equity and the cash flow statement are all mathematically interrelated to one another. Articulation is explained very methodically by the FASB in SFAC 6[71]. The graphic below shows the interrelated nature, the articulation, of the core four financial statements:

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70 GitHub, Lodgeit Labs, https://github.com/lodgeit-labs/accounts-assessor

71 ibid, page 21 – 22, "Interrelation of Elements-Articulation"

2.28. Forests, Trees, Branches, and Leaves

I explained graphs, forests, trees, branches, and leaves in my document *Accounting Process Automation using XBRL*[72].

A **tree**[73] is a special type of graph. A tree is what is called an undirected graph because the items in a tree are connected by exactly one path. This is important to understand because it means that trees are safer than other types of graphs which can contain cycles which generally need to be avoided because they can cause problems. For example, one type of cycle is an infinite loop.

A **forest** is a disjointed union of trees. Trees have **branches**. Trees have **leaves**.

A chart of accounts will not have an account or ledger for either "Assets" or "Liabilities and Equity". "Assets" and "Liabilities and Equity" are branches.

For example:

- *Assets*
  - *Current assets*
    - **Cash and cash equivalents**
      - Cash in bank
      - Petty cash
      - Other cash and cash equivalents
    - **Receivables**
      - Trade accounts receivable
    - **Inventories**
      - Finished goods inventory
      - Work-in-progress inventory
      - Raw materials inventory
  - *Noncurrent assets*
    - **Property, plant and equipment**
      - Land
      - Buildings
      - Equipment
    - **Long-term investments**
      - Equity securities

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[72] Charles Hoffman, *Accounting Process Automation Using XBRL*, page 5, http://xbrlsite.azurewebsites.net/2018/Library/AccountingProcessAutomationUsingXBRL.pdf

[73] Wikipedia, *Tree (Graph Theory)*, https://en.wikipedia.org/wiki/Tree_(graph_theory)

- Debt securities

The items above in bold italics are branches in the tree of assets. "Assets" is the root branch. "Current assets" and "Noncurrent assets" are always branches, you never post transactions to those, they are not accounts and they don't have ledgers. Depending upon how a chart of accounts is set up something could be a branch or it could be a leaf. For example, in the example above, "Cash and cash equivalents" is likely a branch with three leaves for the accounts to which transactions are posted.

2.29. Reporting Styles

How the "branches" are organized within the "tree" of information into which the "leaves" from the chart of accounts are put is referred to as a reporting style. US GAAP has a set of reporting styles[74]. Similarly, IFRS has a set of reporting styles[75]. The same sort of pattern exists for every financial reporting scheme.

2.30. Record to Report

Wikipedia describes record to report as follows: "Record to report or R2R is a Finance and Accounting (F&A) management process which involves collecting, processing and delivering relevant, timely and accurate information used for providing strategic, financial and operational feedback to understand how a business is performing.[76]"

Another description of record to report is provided as follows[77]:

"Record to Report (R2R) is a Finance and Accounting (F&A) management process which involves collecting, processing and delivering relevant, timely and accurate information. It provides strategic, financial and operational feedback on how a business is performing. Stakeholders read the feedback and gain insights into whether an organization is performing successfully or not, and if their expectations have been met." The same author describes best practices in record to report[78].

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[74] US GAAP Reporting Styles, http://www.xbrlsite.com/2018/10K/US-GAAP-Reporting-Styles.pdf

[75] IFRS Reporting Styles, http://www.xbrlsite.com/2018/IFRS/IFRS-Reporting-Styles.pdf

[76] Wikipedia, *Record to Report*, https://en.wikipedia.org/wiki/Record_to_report

[77] Senthil Kumaran, Operations Manager - Finance and Accounting, Invensis Technologies, *What is Record to Report (R2R)*, https://www.invensis.net/blog/finance-and-accounting/what-is-record-to-report/

[78] Senthil Kumaran, Operations Manager - Finance and Accounting, Invensis Technologies, *6 Best Practices for Record-to-Report Process*, https://www.invensis.net/blog/finance-and-accounting/6-best-practices-record-report-process/

The essence of what I call enhanced record to report can be explained graphically as follows:
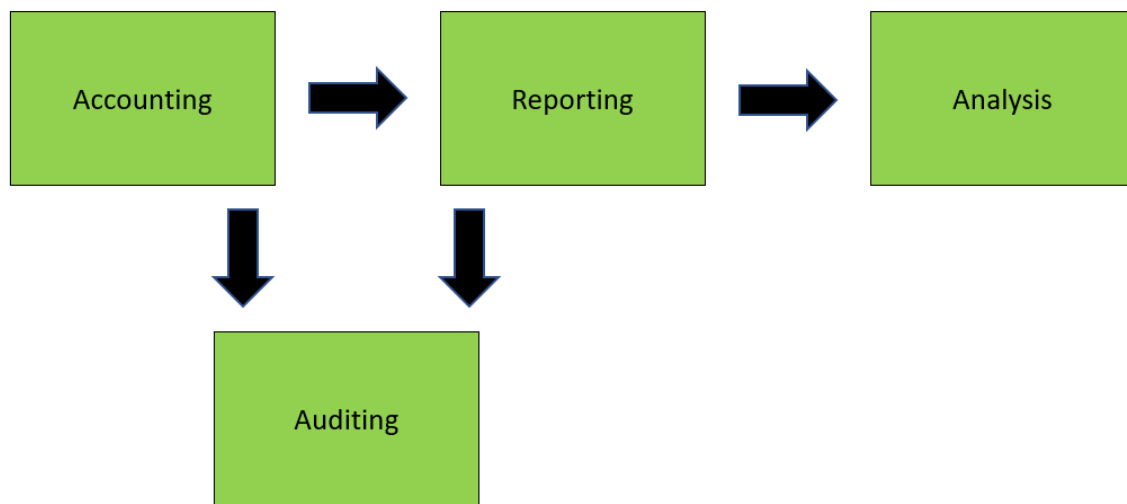
- **Accounting**: Accounting information is captured in journals and ultimately posted to ledgers. Special journals may be used to feed the general ledger for specific accounting subsystems.

- **Reporting**: Accounting information is summarized and a specific generally accepted financial reporting scheme is used to report economic entity information to regulators and other appropriate parties. A special purpose financial reporting scheme might also be used sometimes.

- **Auditing**: At times, independent third-party verification is required. When required, an independent public accountant verifies that a financial report is a true and fair representation of the financial position and financial performance of an economic entity.

- **Analysis**: Regulators, investors, analysts, and other such interested parties use reported information to evaluate an economic entity. Period comparisons are often created to evaluate the condition and performance of one economic entity over a period of time. Entity comparisons[79] are often created to compare and contrast one economic entity with one or more other economic entities. Financial ratios are often computed based on reported information. Financial models, such as an unlevered

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[79] Charles Hoffman, CPA, *Reporting Style Examples*, http://www.xbrlsite.com/2016/fac/v3/Examples/Index.html

discounted cash flow model[80], might be created to evaluate an economic entity.

The Knowledge Graph Cookbook: Recipes that Work[81], points out that the basic rule is that context information such as tagging and classification of information should take place as soon as possible after content has been created. It is better to add information during financial transaction entry than when a financial report is being created.

Again, this is a high-level overview of the very basics of a record to report process. In the real world, economic entities have to deal with complexities such as multiple currencies, consolidating hundreds of subsidiaries which might use different accounting systems, and other such realities.

2.31. Complexity

The following graphic shows the processes and tasks involved in the creation of general purpose or special purpose financial report:
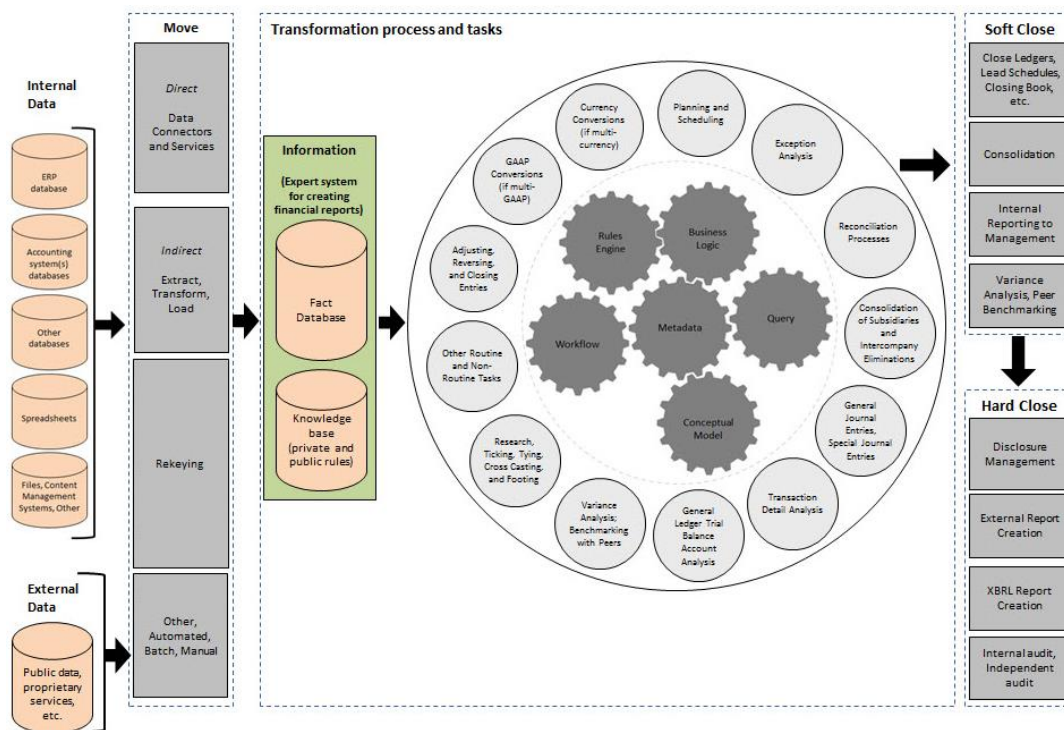
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[80] Charles Hoffman, CPA, *Representing Unlevered Discounted Cash Flow Model Using XBRL*, http://xbrl.squarespace.com/journal/2018/9/4/representing-unlevered-discounted-cash-flow-model-using-xbrl.html

[81] Andreas Blumauer and Helmut Nagy, The Knowledge Graph Cookbook: Recipes that Work, page 56, https://www.poolparty.biz/wp-content/uploads/2020/04/the-knowledge-graph-cookbook.pdf

Complexity enters this system in many ways including multiple currencies, multiple subsidiaries, multiple accounting information systems, multiple business activities, etc.

2.32. Cost of Quality

The 1-10-100 Rule is related to what's called "the cost of quality." Essentially, the rule states that prevention is less costly than correction which is less costly than failure. Saying this another way; it makes more sense to invest $1 in *prevention*, than to spend $10 on *correction*. That in turn makes more sense than to incur the cost of a $100 *failure*[82]. This 1-10-100 rule is depicted graphically as follows[83]:

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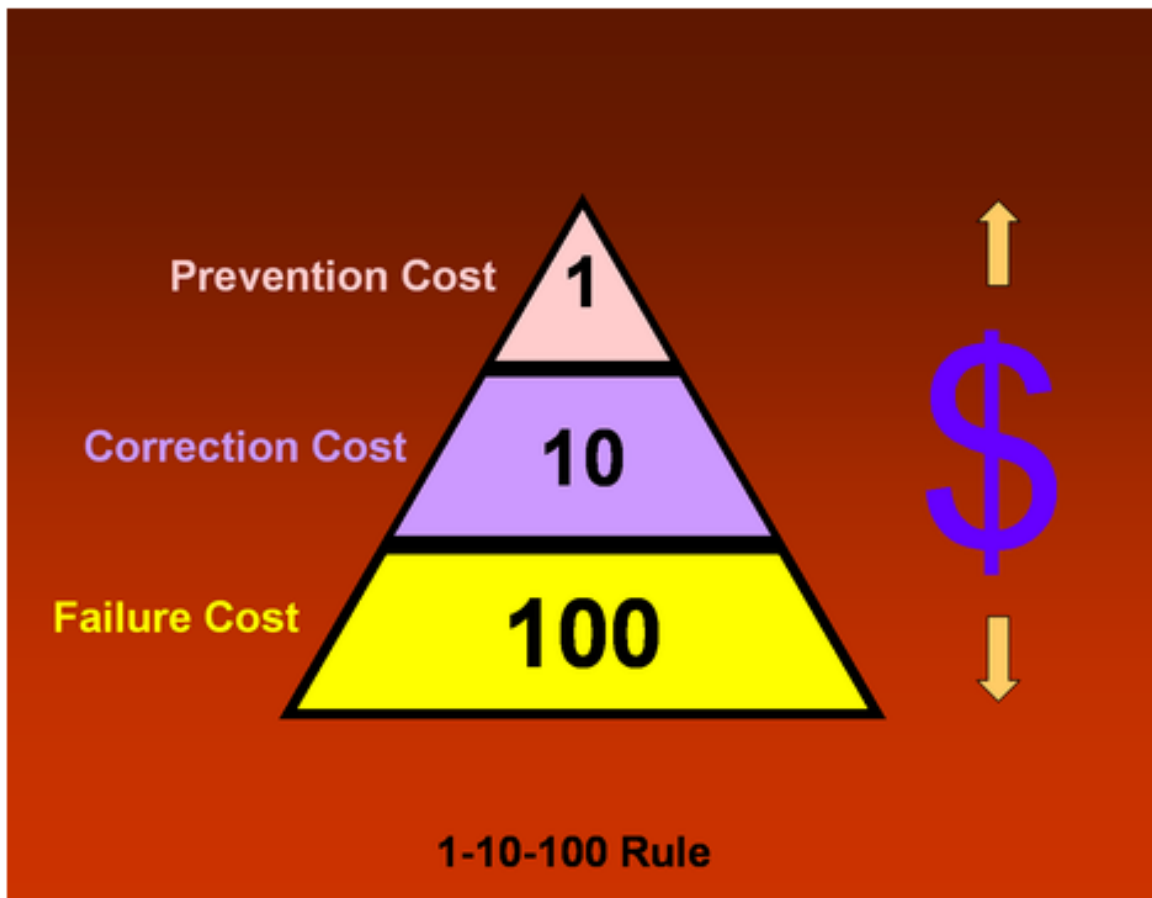
[82] Michael Canic, *The Cost of Quality: The 1-10-100 Rule*,
https://www.makingstrategyhappen.com/the-cost-of-quality-the-1-10-100-rule/

[83] Total Quality Management, *What is 1-10-100 Rule?*,
https://totalqualitymanagement.wordpress.com/2009/02/25/what-is-1-10-100-rule/

2.33. Defining quality

There are many different ways to define or think about quality. Engineer and statistician W. Edwards Deming[84] defined quality as "predictability," and called variance "the enemy of quality." To achieve an intended outcome, Deming thought it was important to plan for common-cause variation, which can be predicted, and special-cause variation, which cannot be predicted.

Harold F. Dodge, one of the principal architects of the science of statistical quality control said, "You cannot inspect quality into a product." In other words, once the inspection takes place, it's too late. Rather, data from the quality inspection needs to be utilized to continually improve the process.

Businessman Philip B. Crosby, who developed the concept of Zero Defects while working as senior quality engineer at aircraft manufacturer The Martin Company, defined quality as "a conformance to requirements." He warned against the high cost of nonconformance and said that the desired performance standard of zero defects could only be achieved through the proper management system.

Management consultant Joseph Juran, who focused on management training and the human element of quality control for a variety of businesses, stated that quality is "a fitness for use."

2.34. Controlling Quality

Lean Six Sigma[85] is a discipline that combines the problem-solving methodologies and quality enhancement techniques of Six Sigma[86] with the process improvement tools and efficiency concepts of Lean Manufacturing[87]. Born in the manufacturing sector, Lean Six Sigma[88] works to produce products and services in a way that meets consumer demand without creating wasted time, money and resources.

Specifically, Lean is 'the purposeful elimination of wasteful activities.' It focuses on making process throughout your company faster, which

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[84] YouTube.com, *A Theory of a System for Educators and Managers*, https://www.youtube.com/watch?v=2MJ3lGJ4OFo

[85] Wikipedia, *Lean Six Sigma*, https://en.wikipedia.org/wiki/Lean_Six_Sigma

[86] Wikipedia, *Six Sigma*, https://en.wikipedia.org/wiki/Six_Sigma

[87] Wikipedia, *Lean Manufacturing*, https://en.wikipedia.org/wiki/Lean_manufacturing

[88] Charles Hoffman, CPA and Rene van Egmond, *Comprehensive Introduction to Lean Six Sigma*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part01_Chapter02.72_LeanSixSigma.pdf

effects production over a period of time. Six Sigma works to develop a measurable process that is nearly flawless in terms of defects, while improving quality and removing as much variation as possible from the system.

Manual approaches, automated approaches, or a combination of both manual and automated approaches can be used to control quality.

2.35. Best Practice

A **best practice** is a method or technique that has been generally accepted as superior to any alternatives because it produces results that are superior to those achieved by other means or because it has become a standard way of doing things, e.g., a standard way of complying with legal or ethical requirements.

2.36. Representation Theory

Representation theory[89] is a way of taking complicated objects and "representing" them with simpler objects. As explained by Kevin Hartnett in his article, *The 'Useless' Perspective That Transformed Mathematics[90],* "The complicated objects are often collections of mathematical objects — like numbers or symmetries — that stand in a particular structured relationship with each other. These collections are called groups. The simpler objects are arrays of numbers called matrices, the core element of linear algebra. While groups are abstract and often difficult to get a handle on, matrices and linear algebra are elementary."

A representation of the simpler objects that make up the more complicated financial report can be both mathematically and logically so that both computers and humans can understand the representations.

2.37. Financial Report Models

As we have pointed out, financial reports are knowledge graphs. Those financial report knowledge graphs have an explainable model. *Atomic Design Theory*[91] can be used to understand and describe that financial report model. The "organisms" that make of a financial report model

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[89] Wikipedia, *Representation Theory*, https://en.wikipedia.org/wiki/Representation_theory

[90] Quantamagazine, Kevin Harnett, *The 'Useless' Perspective That Transformed Mathematics*, https://www.quantamagazine.org/the-useless-perspective-that-transformed-mathematics-20200609/

[91] Atoms, Molecules, Organisms, and Designing Systems, https://digitalfinancialreporting.blogspot.com/2025/01/atoms-molecules-organisms-and-designing.html

and report information can be used to construct software that make the financial report model and report information easy for business professionals to make use of.

2.38. Puzzle Pieces of Financial Reporting[92]

Financial information "behaves" differently from non-financial information in know, specific ways. The logical artifacts need to be understood and considered when digitizing financial reporting. Digital financial reporting can leverage the behaviors of financial information. The following is a summary of the puzzle pieces of financial reporting that need to be considered when digitizing financial reporting[93]:

Non-financial information	Financial Information (e.g. part of financial reporting scheme)			
Rules of Logic, Mathematics, Set theory, Categorization, Mereology, Model theory, Systems theory Certain rules are prescribed to both financial information and non-financial information; standards setters have no control over these rules that are prescribed to them				
Set Things that go together for some reason	**Double Entry Bookkeeping Model** DEBITS = CREDITS, two synchronized ledgers for detecting errors and distinguishing unintentional errors from intentional errors (a.k.a. FRAUD)	**Report Model** Digital representation which describes a specific disclosures provided within a report; follows logical patterns of information for "roll up" or "roll forward" or "set"	**Conceptual Framework** Conceptual framework is used to help created good standards for a financial reporting scheme. Issue is that conceptual framework is not also a practical tool for understanding how to make use of the standards of a financial reporting scheme	
Roll Up Aggregation of a set of STOCKS or a set of FLOWS; cannot intermingle stocks and flows, would be illogical.	**Accounting Equation** Some version of accounting equation; "Assets = Liabilities + Equity" or "Assets - Liabilities = Net Assets"; there are other definitions	**Reporting Style** A reporting style is a group of choices made by an economic entity per some set of permitted alternatives using judgment, skill, and experience of a professional accountant, choices of how an industry sector reports, etc.	**Standards** Standards of a financial reporting scheme are written in books; but they really need to be organized within a component content management system (CCMS) so using the information in the standards is more flexible	
Roll Forward Reconciliation of the value of a STOCK at one point in time to that same STOCK at some other point in time per some set of FLOWS.	**Set of Elements of Financial Statements Defined (Types, Subtypes, Parts)** Some high level set of elements of financial statements (FAC) defined within boundaries of double entry bookkeeping model and accounting equation; for example US GAAP defines: Assets, Liabilities, Equity, Comprehensive Income, Investments by Owners, Distributions to Owners, Revenues, Expenses, Gains, Losses; Types, subtypes, "wider" or "narrower", parts, wholes, and other such organizations are possible	**Fundamental Accounting Concepts (FAC)** Fundamental Accounting Concepts continuity cross checks of high level concepts of a report specific to some reporting style used by some economic entity creating a report	**Interpretations of Standards and Instructions** GAAP guides and other such interpretations of or instructions for using accounting standards and creating financial reports are created by many different sources and tend to be more practical and useful tools; can be different interpretations	
Error Correction (a.k.a. Adjustment) Reconciliation a fact reported at one point in time (originally stated fact) with a fact reported at another point in time (restated fact).			**Novel Practices (.8%)** Novel practices tend to be unique to an economic entity and the patterns of agreement tend to be fewer	**Judgement** Judgment involves something where there are known alternatives and professional skills and experience are used to pick between those alternatives
Difference (a.k.a. Variance) Difference between facts per one reporting scenario (say actual) with some other reporting scenario (say budgeted) with a difference between the two eporting scenarios	**Articulation** Set of primary financial statements are intentionally mathematically interrelated and interconnected; assists with the detection of errors	**Types** Type-subtype, class-subclass, general-special, wider-narrower, whole-part, has-part, instant-inflow, instant-outflow, instant-contra, or other categorization of fundamental accounting concepts, line items of those concepts, disaggregations or aggregations of concepts, etc.	**Emergent Practices (1.2%)** Emergent practices tend to be more complicated than good practices, but there are patterns of agreement	
Arithmetic Any arbitrary mathematical rule that is asserted between numeric facts				**Ambiguity** Ambiguity relates to contradictions in standards, unintended different interpretations of accounting standards, incomplete standards
Dimensional Aggregation Logically equivalent to a roll up except that the aggregation or roll up is across a set of member of a dimension	**Intermediate Components** The high level set of financial statement elements can be subtotaled or totaled in different ways by different industries or economic entities; provides flexibility. The intermediate components have patterns. For example, "Gross Profit (Loss)" is an intermediate subtotal.	**Disclosure Mechanics** Logic of mechanical rules followed by individual disclosures in the form patterns followed by specific disclosures; for example, a roll up pattern always has a total and that total is always represented by XXXX concept within some specific disclosure.	**Good Practices (18%)** Good practices tend to be obvious but tend to be a bit more complex requiring expertise (skills, experience)	
Text Block Prose represented as one fact	**Categorization of Transactions** Fundamentally, accounting relates to the categorization of information from business events into transactions that impact specific accounts; provides consistency and comparability. This categorization has patterns.	**Disclosure Checklist** When disclosures are required to be provided within a report; always, when specific line item is provided, when some other disclosure is provided, when some sort of business event has occurred, etc.	**Best Practices (Obvious) (80%)** Best practices are obvious and generally agreed to practices	**Skills and Experience** Poor judgement or inappropriate use of principles might be used to overcome ambiguity if someone lacks the skills and/or experience to reach good conclusions

2.39. Digitizing Financial Reporting

A green field project[94] is a project that does not have the constraints of prior work. Imagine what financial accounting, reporting, auditing, and analysis might look like if they were invented and designed today. What if financial reporting schemes were not written in books, but rather

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[92] *Puzzle Pieces of Digital Financial Reporting*, https://digitalfinancialreporting.blogspot.com/2023/11/puzzle-pieces-of-digital-financial.html

[93] *Puzzle Pieces of Digital Financial Reporting*, https://xbrlsite.azurewebsites.net/2023/Library/PuzzlePieces.jpg

[94] Wikipedia, *Green Field Project*, https://en.wikipedia.org/wiki/Greenfield_project

created using an ontology-like thing[95]. What if those ontology-like things generated the books that contain conceptual frameworks, standards, interpretations of the standards, instructions for creating financial reports. What if the skills and experience of accountants was more consistent and good practices and best practices were well understood. What if the ambiguity of financial reporting schemes were reduced or even eliminated altogether. What if there was some set of technologies that could be used to create logical systems[96] that worked reliably and did not break? What if good software was created that did its job and was easy for business professionals such as accountants found the software easy to use? What if accountants and software engineers understood the difference between "strings" and "things"?

Here are the moving pieces of the puzzle[97]:
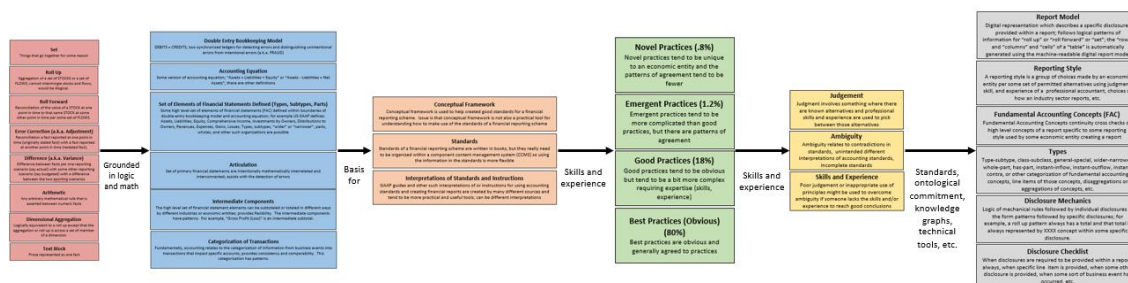
If you had a "green field" and could reinvent financial reporting; would you want to use Microsoft Word and Excel spreadsheets to create financial reports? Would you want to look at the process of creating disclosures that go into such reports as individual "art projects" or would you prefer that the disclosures were more similar to Legos and building a report was putting Lego blocks together, perhaps leveraging software tools for that process? Would you want to be bothered with having to figure out that you made a math error; or would you prefer that a software application would detect such errors and let you fix them; or even better, prevent you from making the error in the first place? Would you want a global standard knowledge graph of accounting rules and software that could provide functionality that looked like magic to

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[95] *Describing Financial Reporting Rules Using Ontology-like Thing*, https://digitalfinancialreporting.blogspot.com/2023/11/describing-financial-reporting-using.html

[96] *Logical Systems for Professional Accountants*, https://digitalfinancialreporting.blogspot.com/2023/09/logical-systems-for-business.html

[97] *Puzzle Pieces of Digital Financial Reporting*, https://digitalfinancialreporting.blogspot.com/2023/11/puzzle-pieces-of-digital-financial.html

accountants[98]? Would you want explainable and reliable artificial intelligence to augment your accounting skills, making you a better accountant similar to how a calculator makes you better at doing math?

2.40. Forward Looking Information

Some criticize conventional accounting saying that information provided by such systems is backwards-looking and not useful in managing a business. While these conventional systems provide a reliable record of past financial performance and current financial status, those systems tend to not provide adequate insights necessary for future decision making such as strategic planning. Further, some question the relevance of this information to investors. Others argue that conventional accounting systems do not adequately communicate how a business creates value.

When information technology professionals and business systems analysts first implemented computer-based accounting systems in the 1950s, they essentially digitized the manual tasks and processes performed by accountants at that time. This included only parts of Pacioli's *Summa*[99]. Other parts of Pacioli's Venetian Method of double-entry bookkeeping summarized in the *Summa* were simply left out. The reason for this was that these information technology professionals and business systems analysts implementing computerized accounting took advice from accountants who had never read the *Summa* and only operated those manually implemented systems because human 'computers' were the only option available at that time. Given the limitations of these human 'computers' only a sub-optimal set of the Venetian Method was used during this manual era of accounting and now the computer era of accounting is sub-optimal as a result.

If someone had taken the time to revisit the *Summa*, they would have discovered the Ricordance[100], recognized its value, and perhaps implemented that mechanism.

Essentially, the Ricordance transforms the currently historical-oriented accounting process into what Pacioli had originally envisioned, which indeed involved future-oriented information.

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[98] SAP, *Knowledge Graphs: A Dream of a Knowledge Network*, https://news.sap.com/2023/04/knowledge-graphs-dream-of-knowledge-network/
[99] Wikipedia, *Summa de Arithmetica*, https://en.wikipedia.org/wiki/Summa_de_arithmetica
[100] The Accounting Historian's Journal, *Pacioli's forgotten book: The Merchant's Ricordanze*, https://egrove.olemiss.edu/aah_journal/vol39/iss2/3/

Business management encompasses the handling of all aspects of financial and business contracts associated with that business. It involves the inception, the life cycle, and the management of both financial and business contracts. The Ricordance proves beneficial in managing these events in relation to time, as it aids in organizing all this information on a timeline.

Utilizing the Ricordance allows for not only backwards-looking retrospective accounting but also forward-looking prospective analysis. This is made possible by the information provided by the Ricordance about future financial and business contracts, and the impact of these resources and obligations on a business.

2.41. Declarative Accounting

Traditional accounting systems are imperative in nature. Effectively, what this means that you tell the accounting system what to do step-by-step.

But what if an accounting system were declarative in nature? Declarative accounting is a way of setting up accounting systems where you focus on what you want the system to do, rather than how the accounting system should do the work.

You can understand the difference between imperative and declarative by, say, thinking of how a self-driving car might work. There are perhaps two approaches to giving instructions to a self-driving car to, say, get to the airport:

- Using an imperative approach you're telling the car "Turn right at the next light, then go straight for two miles, then turn left..." You're giving step-by-step instructions to get from where you are to the airport.

- Using a declarative approach you're telling the car "Take me to the airport." The car figures out the best route, handles the turns, and gets you there.

In declarative accounting, you define the rules and relationships between different aspects of your accounting information (like assets, liabilities, income, and expenses). The system then uses those rules, which are represented in machine readable form, to automatically assure compliance with the rules, generate reports, perform calculations, and ensure accuracy.

Here's a simple example: Instead of manually entering debits and credits for every transaction, you might define a rule such as,

"Whenever a sale is recorded, increase revenue and increase accounts receivable."

The system then automatically applies this rule whenever a sale happens, without you having to manually input the accounting entries for this category of common business event, a "sale".

Declarative accounting has some significant benefits over imperative accounting including:

- Enables automation which reduces manual work and the associated risk of human error when work is performed by humans.

- Declarative accounting systems are smarter so those using the system can have less accounting skills and experience.

- Flexibility in terms of adapting to changes in accounting standards or business needs throughout all your processes.

- Ensures that accounting rules are applied consistently across the organization.

- Speeds up accounting processes and frees up time for accountants to perform higher value add activities such as analysis and decision-making.

In essence, declarative accounting is about building smarter accounting systems that can handle more of the work automatically, allowing accountants to focus on higher-level tasks.

The idea of declarative accounting is not new. The 1981 paper, Declarative and Procedural Features of a CODASYL Accounting System[101], mentions declarative accounting.

Digital distributed ledger technology such as blockchain has the potential to enable fully declarative accounting systems by providing a shared, immutable ledger and using smart contracts to automate accounting processes. Declarative rules can be published for specific industries, specific company accounting policies, etc. Declarative accounting systems have interesting audit ramifications in terms of setting up internal controls.

Keep in mind that the degree of "declarativeness" can vary significantly between different declarative accounting systems. Some may offer more

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[101] William E. McCarthy and Graham Gal, *Declarative and Procedural Features of a CODASYL Accounting System*, https://www.researchgate.net/publication/221270140_Declarative_and_Procedural_Features_of_a_CODASYL_Accounting_System

flexibility and control over defining rules, while others may have more pre-defined functionality. These are choices you need to make.

Choosing a declarative accounting system often depends on the specific needs and technical expertise of the organization. Plain text accounting tools may be suitable for individuals or small businesses with technical skills, while larger organizations may prefer the more comprehensive features of ERP systems.

3. Explanation of a Logical Theory in Simple Terms

In order to understand a logical theory, we must first explain the terms we will be using to describe that logical theory. This section provides that explanation in simple terms that is approachable to business professionals.

3.1. System

A system[102] is a cohesive conglomeration of interrelated and interdependent parts that is either natural or man-made.

3.2. Patterns

All systems exhibit patterns. A pattern[103] is any form of correlation between the states of elements within a system. The opposite of pattern is randomness.

3.3. Logic

Logic is thinking according to a set of consistent and coherence rules.

3.4. Theory

A system can be explained by a theory. A logical theory is an abstract conceptualization[104] of specific details of some domain. The logical theory provides a way of thinking about a domain by means of deductive reasoning to derive logical consequences of the theory.

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[102] Wikipedia, *Systems Theory*, https://en.wikipedia.org/wiki/Systems_theory

[103] YouTube.com, *The Science of Patterns*, https://www.youtube.com/watch?v=kh6KMW8J3RQ

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

A **logical theory** enables a community of stakeholders trying to achieve a specific goal or objective or a range of goals/objectives to agree on important statements used for capturing meaning or representing a shared understanding of and knowledge in some universe of discourse.

A logical theory is made up of a set of *models*, *structures*, *terms*, *associations*, *rules*, and *facts*. In very simple terms,

- **Logical theory**: A *logical theory* is a set of models that are consistent with and permissible per that logical theory. A logical theory can be used to describe a logical conceptualization.

- **Model**: A logical *model*[105] is a set of logical structures that are consistent with and permissible interpretations of that logical model.

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

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

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

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

  - **Rules**: Rules are logical statements that describe what tend to be IF…THEN…ELSE types of relationships such as "IF the economic entity is a not-for-profit THEN net assets = assets - liabilities; ELSE assets = liabilities + equity".

  - **Facts**: Facts are logical statements about the numbers and words that are provided by an economic entity within a business report. For example, the financial report, a type of business report, might state "assets for the consolidated legal entity Microsoft as of June 20, 2017 was

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

> $241,086,000,000 expressed in US dollars and rounded to the nearest millions of dollars.

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

3.5. *Proper Functioning Logical System*

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

A logical theory can have high to low **precision** and high to low **coverage**. *Precision* is a measure of how precisely the information within a logical theory has been represented as contrast to reality of the logical system for the area of knowledge. *Coverage* is a measure of how completely information in a logical theory has been represented relative to the reality of the logical system for an area of knowledge.

When a logical system is consistent and it has high precision and high coverage the logical system can be considered a properly functioning logical system. When a system is working right, it creates a virtuous cycle[106].

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

Define terms, associations, structures, rules, models

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

Virtuous Cycle

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

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

3.6. Spectrum for Knowledge Representation and Reasoning Capabilities

The following graphic shows the relationship between knowledge representation capabilities and reasoning capabilities of a machine-based system:

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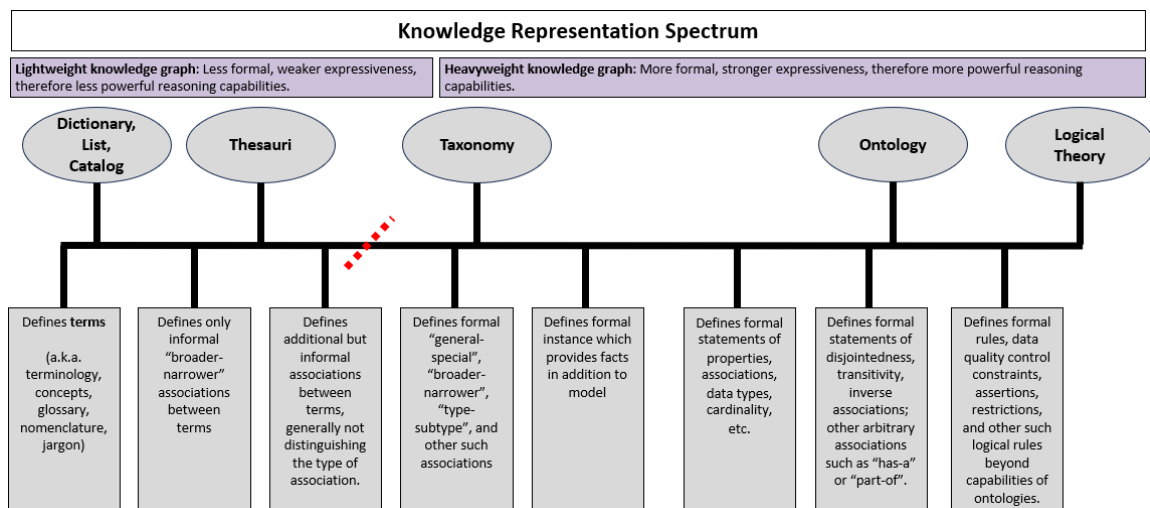
3.7.   Logical Theory Describing Financial Report[107]

Several years ago Rene van Egmond and I summarized our thoughts about the business logic of a financial report and define a conceptual model of such reports in the document *Financial Report Semantics and Dynamics Theory*[108]. Over a period of years since that document was first created, I have created various logical conceptualizations of a financial report based on XBRL-based financial reports that have been submitted to the Securities and Exchange Commission (SEC) using the US GAAP and IFRS financial reporting schemes.

While US GAAP XBRL-based reports of about 6,000 public companies have been the primary focus for about five years[109], IFRS reports of about 406 foreign issuers have also been tested[110].

The initial logical conceptualization and conceptual model has been combined into what I call the *Logical Theory Describing Financial Report*[111].

That logical theory has been rigorously and methodically tested[112]. The logical theory is the basis for a forthcoming OMG Standard Business Report Model (SBRM)[113]. OMG is stripping off all financial reporting related artifacts and creating a business report model.

Finally, I have taken all of this information and created a robust representation of the US not-for-profit financial reporting scheme and several reports to prototype this logical theory[114].

The machine-readable syntax is pure global standard XBRL.

All of this has been tested using multiple interoperable software implementations. I have created a report, taxonomy, and all the business rules necessary to provide robust verification to make sure the

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[107]

[108] Charles Hoffman and Rene van Egmond, *Financial Report Semantics and Dynamics Theory*, http://xbrlsite.azurewebsites.net/2016/Library/Theory-2017-06-26.pdf

[109] US GAAP Test Data - 2017 10-Ks, http://xbrl.squarespace.com/journal/2018/7/28/us-gaap-test-data-2017-10-ks.html

[110] Updated List of IFRS Filings, http://xbrl.squarespace.com/journal/2018/7/14/updated-list-of-ifrs-filings.html

[111] Charles Hoffman, CPA, *Logical Theory Describing Financial Report*, http://www.xbrlsite.com/2020/Theory/Home.html

[112] Charles Hoffman, CPA, *Mastering XBRL-based Digital Financial Reporting*, http://xbrlsite.azurewebsites.net/2020/master/

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

[114] Charles Hoffman, CPA, Not-for-Profit Financial Reporting Scheme, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/nfp/documentation/Index.html

report is created correctly[115]. That example works as expected and proves these ideas in the Pesseract working proof of concept[116] and in commercial software that is made available in XBRL Cloud's Evidence Package[117] which is part of their Clean Score product.

Both the Pesseract and XBRL Cloud software has contributed to significant improvements in the high-level fundamental accounting concept relations of XBRL-based reports that are submitted to the U.S. SEC[118]. To a lesser extent, disclosure mechanics quality has improved and quality related to the automated reporting checklist has shown improvement.

4.   Distilling the Essence of Accounting

In its simplest form, an accounting and reporting system has three distinct parts: inputs, processing, and outputs.
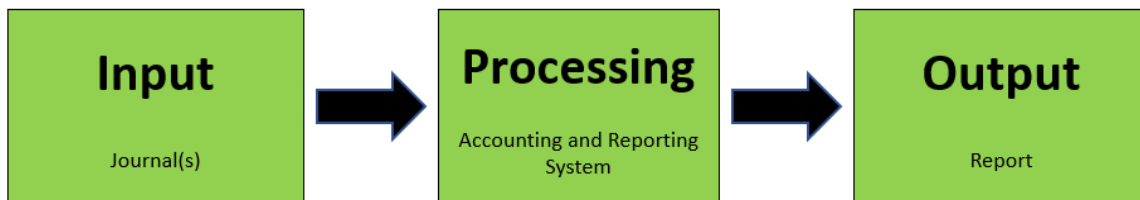
Everything else is details.

Mathematics Magazine published an article written by David Ellerman, *The Mathematics of Double Entry Bookkeeping*[119], where Ellerman points out that double entry accounting is based on well-known mathematics construction from undergraduate algebra. But Ellerman laments, "Mathematics and accounting truly seem to live in disjoint universes with no trespassing between them."

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[115] You can download the ZIP file here, http://xbrlsite.azurewebsites.net/2018/Pesseract/DynamicRules_AllFilesLocal.zip

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

[117] XBRL Cloud, Clean Score, https://www.xbrlcloud.com/cleanscore.html

[118] Quarterly XBRL-based Public Company Financial Report Quality Measurement (Mar 2018), http://xbrl.squarespace.com/journal/2018/4/1/quarterly-xbrl-based-public-company-financial-report-quality.html

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

This fundamental mathematical nature of double entry accounting offers leverage when creating software. To a computer scientist, accounting is essentially a graph[120]. Accounts are nodes; transactions are edges.

Information relating to transactions, events, circumstances and other economic phenomenon related to an economic entity are entered into journals. Financial reports provide information in the form of words and numbers about the status and performance of that economic entity.

One approach to instantiating such an accounting information system is using paper *journal*, having a human *process* the information in the journals, turning the journal entries into a *report*. An example of such a system is this 19th century German ledger[121]:
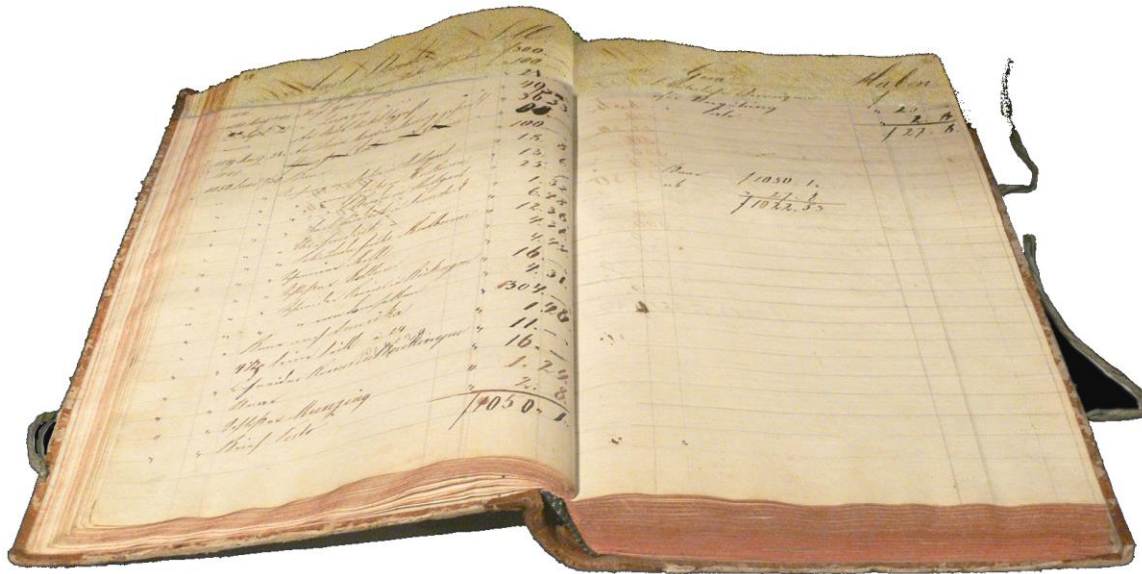
Another approach is to instantiating such an accounting information system is using a computer readable journal, have a computer software application process the journals, turning the machine-readable journal entries into a report. An example of such a system is hledger[122]:

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[120] Martin Kleppmann, *Accounting for Computer Scientists*, http://martin.kleppmann.com/2011/03/07/accounting-for-computer-scientists.html

[121] Wikipedia, *Accounting Information System*, https://en.wikipedia.org/wiki/Accounting_information_system

[122] hledger.org, hledger, https://hledger.org/

```
; $HOME/.hledger.journal (or $LEDGER_FILE)

2020-01-01 opening balances
    assets:checking          $1234
    equity

2020-03-15 client payment
    assets:checking          $2000
    income:consulting

2020-03-20 Sprouts
    expenses:food:groceries  $100
    assets:cash               $40
    assets:checking
```

```
$ hledger bs
Balance Sheet 2020-03-20

                || 2020-03-20
============++============
 Assets      ||
------------++------------
 assets      ||      $3134
  cash       ||        $40
  checking   ||      $3094
------------++------------
             ||      $3134
============++============
 Liabilities ||
------------++------------
------------++------------
             ||
============++============
 Net:        ||      $3134

$ hledger is -M
Income Statement 2020-01-01-2020-03-20

                         || Jan  Feb    Mar
========================++================
 Revenues                ||
------------------------++----------------
 income:consulting       ||   0    0  $2000
------------------------++----------------
                         ||   0    0  $2000
========================++================
 Expenses                ||
------------------------++----------------
 expenses:food:groceries ||   0    0   $100
------------------------++----------------
                         ||   0    0   $100
========================++================
 Net:                    ||   0    0  $1900
```

hledger is a port/branch of another similar computer software application called Ledger[123]. Both hledger and Ledger are part of the plain text accounting movement[124].

I will use hledger and Ledger to help explain the essence of accounting. Several weeks ago, I created an accounting process automation and record to report demonstration[125]. That demonstration was explained in this video, Seeing XBRL Work[126]. In that demonstration, I showed a set of accounting transactions going from the input process (journal) to the output process (report). The processing was achieved using a Microsoft Access Database application that I created and several XBRL tools to verify the XBRL technical syntax and the accounting and reporting logic of the report.

To that prior demonstration I am adding an accounting system to verify that the information in the journal is correct as contrast to me manually

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[123] Ledger, https://www.ledger-cli.org/index.html

[124] Charles Hoffman, CPA, Plain Text Accounting, http://xbrl.squarespace.com/journal/2020/5/5/plain-text-accounting.html

[125] Accounting Process Automation, http://xbrlsite.azurewebsites.net/2020/master/automation/index.html

[126] YouTube.com, Seeing XBRL Work, https://youtu.be/xWOvwUyMZ28

verifying the journal entries. Further, I am going to explain complexities and show how those complexities fit into this basic accounting system.

4.1. Facts

Facts are statements about the numbers and words that are provided by an economic entity within a financial report. For example, the financial report might state "assets for the consolidated legal entity Microsoft as of June 20, 2017 was $241,086,000,000 expressed in US dollars and rounded to the nearest millions of dollars."

Words and numbers are used to convey information about the status and performance of an economic entity.

Accountants creating financial reports provide both quantitative information and qualitative information to convey the financial status and performance of an economic entity.

Quantitative information includes actual numbers to disclose an amount or to show a change. For example, "net income for the year was $1,000,000" is quantitative information.

Qualitative information includes providing information in other ways such as using relative terms. For example, disclosing an entity's objective for holding or issuing derivative instruments, background information necessary for understanding those instruments, strategies used to meet those objectives, and information helpful in understanding derivative activity is qualitative information.

4.2. Journal

Facts related to transactions, events, circumstances, and other economic phenomenon pertaining to an economic entity are recorded in journals.

In my prior accounting process automation example, I provided a journal represented using the XBRL Global Ledger technical syntax[127].

Those same transactions were also represented using XBRL Dimensions technical syntax[128]. For this implementation I used typed dimensions.

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[127] Accounting Process Automation, *XBRL Global Ledger Format*,
http://xbrlsite.azurewebsites.net/2020/master/automation/xbrl-gl-JournalEntries-Instance.xml

[128] Accounting Process Automation, *XBRL dimensions technical syntax*,
http://xbrlsite.azurewebsites.net/2020/master/automation/xbrl-typedMembers-JournalEntries-Instance.xml

To those first two examples, I added the same journal entries using the plain text accounting journal format[129].

Further, to better document the entries I added a PDF of a printout of the details of the journal entries[130] and a screen shot of the database table which contains the journal entries itself[131].

What is interesting is that you can then run the journal entries through hledger which summarizes the transactions into the form of a basic balance sheet, income statement, and cash flow statement.

Here you see my first attempt at generating a balance sheet, income statement, and cash flow statement: (I don't have all of these correct yet; have not done the closing entries)

```
C:\Programs\hledger>hledger balancesheetequity
Balance Sheet With Equity 2020-01-01

                               || 2020-01-01
===============================++============
 Assets                        ||
-------------------------------++------------
 Assets                        ||     $24000
  tb_CashAndCashEquivalents    ||      $5000
  tb_Inventories               ||      $1000
  tb_PropertyPlantAndEquipment ||     $11000
  tb_Receivables               ||      $7000
-------------------------------++------------
                               ||     $24000
===============================++============
 Liabilities                   ||
-------------------------------++------------
 Liabilities                   ||     $12000
  tb_AccountsPayable           ||      $1000
  tb_LongtermDebt              ||     $11000
-------------------------------++------------
                               ||     $12000
===============================++============
 Equity                        ||
-------------------------------++------------
 Equity                        ||      $6000
  tb_RetainedEarnings          ||      $4000
  tb_RetainedEarnings $-2000   ||      $2000
-------------------------------++------------
                               ||      $6000
===============================++============
 Net:                          ||      $6000
```

---

129 Accounting Process Automation, Plain Text Accounting Journal Format, http://xbrlsite.azurewebsites.net/2020/master/automation/TrialBalance.dat.txt

130 Accounting Process Automation, *Human Readable PDF of journal entries*, http://xbrlsite.azurewebsites.net/2020/master/automation/rptGeneralJournalByEntry.pdf

131 Accounting Process Automation, *Human Readable JPEG of the database table containing the journal entries*, http://xbrlsite.azurewebsites.net/2020/master/automation/JournalEntriesInDatabase.jpg

```
C:\Programs\hledger>hledger is
Income Statement 2019-12-31-2020-01-01

                                 || 2019-12-31-2020-01-01
=================================++======================
 Revenues                        ||
---------------------------------++----------------------
 Revenue:tb_Sales                ||                 $4000
---------------------------------++----------------------
                                 ||                 $4000
=================================++======================
 Expenses                        ||
---------------------------------++----------------------
 Expense:tb_CostsOfSales         ||                 $2000
---------------------------------++----------------------
                                 ||                 $2000
=================================++======================
 Net:                            ||                 $2000
```

```
C:\Programs\hledger>hledger cf
Cashflow Statement 2019-12-31-2020-01-01

                                     || 2019-12-31-2020-01-01
=====================================++======================
 Cash flows                          ||
-------------------------------------++----------------------
 Assets:tb_CashAndCashEquivalents    ||                $10000
 Assets:tb_Inventories               ||                 $3000
 Assets:tb_PropertyPlantAndEquipment ||                 $6000
-------------------------------------++----------------------
                                     ||                $19000
```

4.3. Accounts

Journal entries relate to the economic entity being accounted for, some calendar period, and an account from the chart of accounts.

Both hledger and Ledger let you put in whatever accounts you want. You can add accounts on the fly. I was able to use XBRL element names as the account names.

What would be great is if you could constrain what accounts are used by specifying an XBRL taxonomy[132]. (Here is a human readable version[133]. Here is the master version in Excel[134].) For example, here is a not-for-profit chart of accounts that I created.

---

[132] Unified Chart of Accounts, XBRL, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/nfp/ucoa/ucoa.xsd

[133] Unified Chart of Accounts, Human readable, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/nfp/ucoa/ucoa_ModelStructure.html

[134] Unified Chart of Accounts, Master Excel version, https://netsuiteorg.atlassian.net/wiki/spaces/PB/pages/108729619/Unified+Chart+of+Accounts+UCOA

Line	Label	Object Class	Period Type	Balance	Report ElementName
1	1110 - Unified Chart of Accounts	Network			http://www.xbrlsite.com/ucoa/role/UnifiedChartOfAccounts
2	Assets	Concept (Monetary)	As Of	Debit	nfp:Assets
3	Cash and Cash Equivalents	Concept (Monetary)	As Of	Debit	nfp:CashAndCashEquivalents
4	Cash in bank-operating	Concept (Monetary)	As Of	Debit	ucoa:CashInBankOperating
5	Cash in bank-payroll	Concept (Monetary)	As Of	Debit	ucoa:CashInBankPayroll
6	Petty cash	Concept (Monetary)	As Of	Debit	ucoa:PettyCash
7	Savings and short-term investments	Concept (Monetary)	As Of	Debit	ucoa:SavingsAndShortTermInvestments
8	Receivables	Concept (Monetary)	As Of	Debit	nfp:Receivables
9	Accounts receivable	Concept (Monetary)	As Of	Debit	ucoa:AccountsReceivable
10	Doubtful accounts allowance	Concept (Monetary)	As Of	Credit	ucoa:DoubtfulAccountsAllowance
11	Contributions receivable	Concept (Monetary)	As Of	Debit	ucoa:ContributionsReceivable
12	Pledges receivable	Concept (Monetary)	As Of	Debit	ucoa:PledgesReceivable
13	Doubtful pledges allowance	Concept (Monetary)	As Of	Credit	ucoa:DoubtfulPledgesAllowance
14	Discounts - long-term pledges	Concept (Monetary)	As Of	Credit	ucoa:DiscountsLongTermPledges
15	Grants receivable	Concept (Monetary)	As Of	Debit	ucoa:GrantsReceivable
16	Discounts - long-term grants	Concept (Monetary)	As Of	Credit	ucoa:DiscountsLongTermGrants
17	Other receivables	Concept (Monetary)	As Of	Debit	ucoa:OtherReceivables
18	Employee and trustee receivables	Concept (Monetary)	As Of	Debit	ucoa:EmployeeAndTrusteeReceivables
19	Notes/loans receivable	Concept (Monetary)	As Of	Debit	ucoa:NotesLoansReceivable
20	Doubtful notes/loans allowance	Concept (Monetary)	As Of	Credit	ucoa:DoubtfulNotesLoansAllowance
21	Inventories	Concept (Monetary)	As Of	Debit	nfp:Inventories
22	Inventories for sale	Concept (Monetary)	As Of	Debit	ucoa:InventoriesForSale
23	Inventories for...	Concept (Monetary)	As Of	Debit	ucoa:Inventories...

If there was a way to specify which chart of accounts must be used and the reporting taxonomy plus reporting style used.

4.4. Trial Balance

A trial balance is simply a total of all journal entries (transactions) summarized by chart of accounts account. The sum of all transactions will always be zero:

Trial Balance [Roll Up]	Period [Axis]	
	2020-12-31	2019-12-31
Trial Balance [Roll Up]		
Cash and Cash Equivalents	4,000.00	3,000.00
Receivables	2,000.00	1,000.00
Inventories	1,000.00	1,000.00
Property, Plant and Equipment	6,000.00	1,000.00
Accounts Payable	(1,000.00)	(1,000.00)
Long-term Debt	(6,000.00)	(1,000.00)
Retained Earnings	(6,000.00)	(4,000.00)
Check Sum	.00	.00

4.5. Real versus Nominal (Temporary) Accounts

There are two types of accounts in a chart of accounts: **real** (or permanent) and **nominal** (or temporary).

Real account balances are not closed at the end of an accounting year; they begin each year with the ending balance of the prior year. Balance sheet accounts are real accounts.

Nominal account balances are closed at the end of an accounting year; they begin each year with a zero balance. Income statement accounts are nominal accounts.

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4.6. Roll Forward of Real Accounts

A trial balance provides a summary of transactions by account. After a set of books is closed, every balance sheet account (each real account) has a set of transactions that flow through that account. Two accounts are of particular note.

All the transactions that flow through the balance sheet account "Cash and Cash Equivalents" form the items that will appear on the cash flow statement if the direct method is used. For example:

Cash and Cash Equivalents [Roll Forward]	Period [Axis]
	2020-01-01 - 2020-12-31
Cash and Cash Equivalents [Roll Forward]	
Cash and Cash Equivalents, Beginning Balance	3,000.00
Collection of Receivables	3,000.00
Payment of Accounts Payable	(2,000.00)
Additional Long-term Borrowings 2	6,000.00
Repayment of Long-term Borrowings 2	(1,000.00)
Capital Additions of Property, Plant and Equipment 2	(5,000.00)
Cash and Cash Equivalents, Ending Balance	4,000.00

Each item in the roll forward above would be grouped on the cash flow statement using the direct method as either cash flows from operating, investing, or financing activities. The beginning and ending cash and cash equivalents balance ties the beginning balance sheet to the ending balance sheet of an accounting period.

Further, all the transactions that flow through the balance sheet account "Retained Earnings" form the items that will appear on the statement of changes in equity. For example,

Retained Earnings [Roll Forward]	Period [Axis]
	2020-01-01 - 2020-12-31
Retained Earnings [Roll Forward]	
Retained Earnings, Beginning Balance	4,000.00
Net Income (Loss)	2,000.00
Retained Earnings, Ending Balance	6,000.00

All the transactions that flow through the item "Net Income (Loss)" is the sum of all the transactions of the nominal accounts. The line item "Net Income (Loss)" ties the beginning and ending statement of changes in equity to both the balance sheet and to the income statement.

This forms the four statement model framework.

While a roll forward is not generally reported for each and every balance sheet account in a set of external financial statements; it is the case that every balance sheet account does have a roll forward of transactions which can be grouped into important financial information. For example, accounts receivable:

Receivables [Roll Forward]	Period [Axis]
	2020-01-01 - 2020-12-31
Receivables [Roll Forward]	
Receivables, Beginning Balance	1,000.00
Sales 2	4,000.00
Collection of Receivables 2	(3,000.00)
Additions to Allowance for Bad Debts	.00
Bad Debts Written Off	.00
Receivables, Ending Balance	2,000.00

Long term debt:

Long-term Debt [Roll Forward]	Period [Axis]
	2020-01-01 - 2020-12-31
Long-term Debt [Roll Forward]	
Long-term Debt, Beginning Balance	1,000.00
Additional Long-term Borrowings	6,000.00
Repayment of Long-term Borrowings	(1,000.00)
Long-term Debt, Ending Balance	6,000.00

Finally, if you take all of the roll forward groupings of all the real accounts after the accounts have been closed for an accounting period; the total of those balance sheet real account roll forward groupings would be zero just like the general ledger trial balance:

Changes Summary [Roll Up]	Period [Axis]
	2020-01-01 - 2020-12-31
Changes Summary [Roll Up]	
Collection of Receivables	3,000.00
Payment of Accounts Payable	(2,000.00)
Additional Long-term Borrowings 2	6,000.00
Repayment of Long-term Borrowings 2	(1,000.00)
Capital Additions of Property, Plant and Equipment 2	(5,000.00)
Sales 2	4,000.00
Collection of Receivables 2	(3,000.00)
Additions to Allowance for Bad Debts	.00
Bad Debts Written Off	.00
Purchases of Inventory for Sale	2,000.00
Costs of Sales 2	(2,000.00)
Inventory Written Off	.00
Capital Additions of Property, Plant and Equipment	5,000.00
Depreciation and Amortization 2	.00
Property, Plant and Equipment Written Off	.00
Purchases of Inventory for Sale 2	(2,000.00)
Payment of Accounts Payable 2	2,000.00
Additional Long-term Borrowings	(6,000.00)
Repayment of Long-term Borrowings	1,000.00
Net Income (Loss)	(2,000.00)
Check Sum Changes	.00

Many accountants tend to not manage this information effectively and end up having to create this information at the end of an accounting cycle. However, if this information were entered at the point of transaction entry, then a proper cash flow statement and statement of changes in equity can be generated along with a balance sheet and income statement.
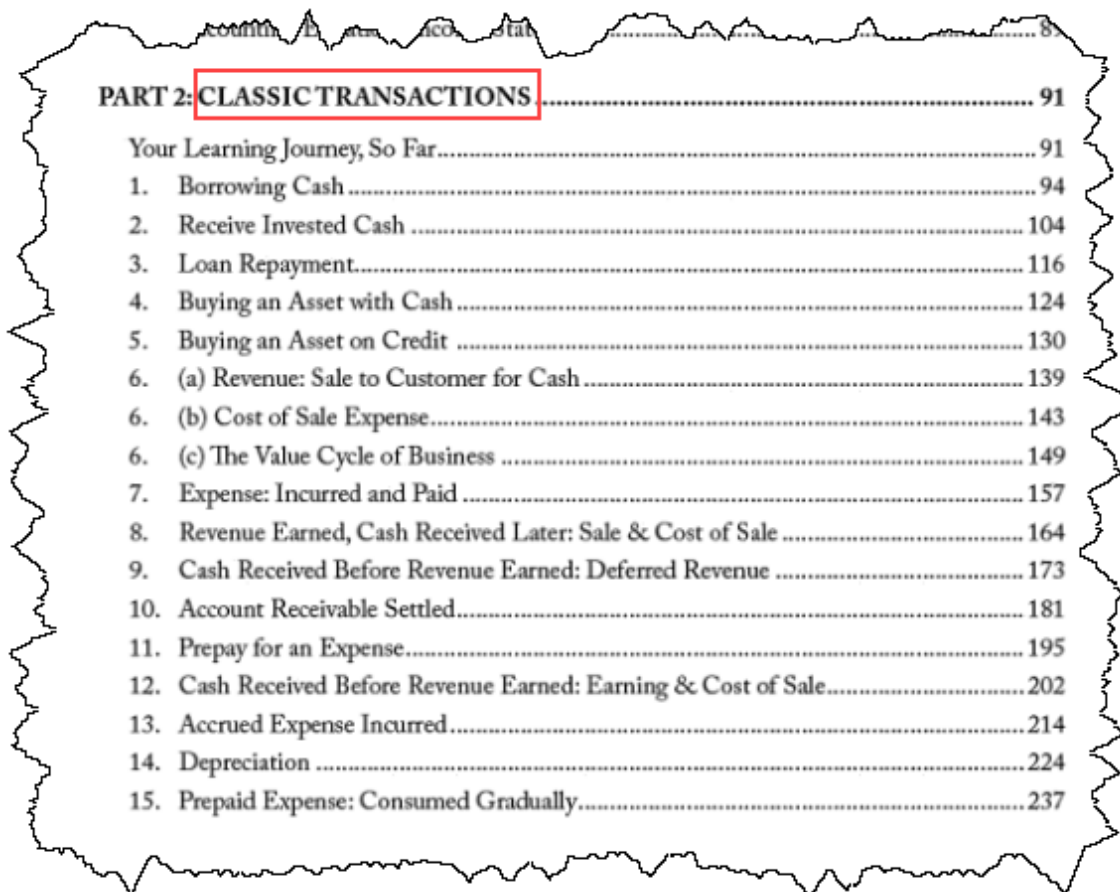
4.7. Canonical Chart of Accounts

Over 40 years of experience with accountants and accounting information systems has demonstrated that the average accountant has a hard time setting up a chart of accounts properly in an accounting system. Imagine if accounting systems provided industry specific chart

of accounts, or a canonical chart of accounts, for specific industries that could then be modified by accountants to meet the individual needs of specific reporting economic entities. Saying this another way; it is very rare that the person that operates an accounting system also has the skills necessary to set up that accounting system efficiently. Using canonical charts of accounts could solve this problem.

4.8. Categories of Transactions

The roll forward of real accounts described in the last section help you recognize that there are patterns of transactions[135]. The Joy of Accounting provides a list of these transaction patterns which they refer to as classic transactions[136]:

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[135] Classic Transactions and Canonical Representations of Business Events, https://digitalfinancialreporting.blogspot.com/2023/01/classic-transactions-and-canonical.html

[136] Peter Frampton & Mark Robilliard, *The Joy of Accounting*, https://www.amazon.com/Joy-Accounting-Game-Changing-Approach-Makes/dp/1735312924/

In reality though, it is better to see that the patterns are in the nature of the business events[137] for which transactions are posted into an accounting system. Another approach to seeing the patterns of transactions is in the economic events described by the Resource-Event-Agent (REA) conceptual model[138].

4.9. Business Event Templates

A template is simply a reusable data or information structure. Imagine an accounting system that has templates for each classical type of business event and that template could be used to generate a transaction.

4.10. Report Writer

Essentially, an XBRL taxonomy can be viewed somewhat as report writer metadata. The XBRL taxonomy specifies the high-level concepts that constitute a financial report and how those high-level concepts are organized (i.e. a reporting style) within the set of financial statements. The XBRL taxonomy also specifies the mathematical computations of the report.

The "leaves" or the items within the chart of account roll up to the "branches" which make up the subtotals and totals of a report. So, for example, on the actual report you see the line items "Cash and Cash Equivalents" and "Accounts Receivable" and "Inventories" as contrast to the more detailed items which are contained within the chart of accounts. Perhaps some other internal report shows both the higher level intermediate totals/subtotals and the chart of account items that make up those intermediate totals/subtotals.

Roll up:

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[137] *Business Events Drive Transactions*,
http://xbrl.squarespace.com/journal/2022/1/12/business-events-drive-accounting.html

[138] Understanding the Resource-Event-Agent (REA) Conceptual Model,
http://xbrl.squarespace.com/journal/2016/9/27/understanding-the-resource-event-agent-rea-conceptual-model.html

Balance Sheet [Abstract]	Period [Axis]	
	2018-12-31	2017-12-31
Balance Sheet [Abstract]		
Assets [Roll Up]		
Current Assets [Roll Up]		
Cash and Cash Equivalents	4,000	3,000
Accounts Receivable	2,000	1,000
Inventories	1,000	1,000
Current Assets	7,000	5,000
Noncurrent Assets [Roll Up]		
Property, Plant, and Equpment, Net	6,000	1,000
Noncurrent Assets	6,000	1,000
Assets	13,000	6,000

XBRL calculation relations rule:

Label	Rendered	Reported	Calculated	Balance	Decimals	Message
Assets [Roll Up]						
Current Assets [Roll Up]						
Cash and Cash Equivalents	4,000 +	4,000	4,000	DR	INF	
Accounts Receivable	2,000 +	2,000	2,000	DR	INF	
Inventories	1,000 +	1,000	1,000	DR	INF	
Current Assets	7,000 +	7,000	7,000	DR	INF	OK
Noncurrent Assets [Roll Up]						
Property, Plant, and Equpment, Net	6,000 +	6,000	6,000	DR	INF	
Noncurrent Assets	6,000 +	6,000	6,000	DR	INF	OK
Assets	13,000	13,000	13,000	DR	INF	OK

The basic equation for a roll up is "A + B + n = Total", where some value A plus some value B plus n other values = the roll up total.

Roll forward:

Changes in ledger balances or the "flows" between a stock at two points in time or the equation "Beginning balance + changes = Ending Balance" is represented in the form of what accountants commonly refer to as a "roll forward" or "movements analysis". For example, the following is a basic roll forward:

Long-term Debt [Roll Forward]	Period [Axis]
	2020-01-01 - 2020-12-31
Long-term Debt [Roll Forward]	
Long-term Debt, Beginning Balance	1,000.00
Additional Long-term Borrowings	6,000.00
Repayment of Long-term Borrowings	(1,000.00)
Long-term Debt, Ending Balance	6,000.00

Adjustment:

Adjustments to a ledger balance to correct an error, the equation "Originally stated balance + Adjustments = Restated Balance". For example, the following is a basic adjustment:

Component: (Network and Table)	
Network	FA - Statement - **Changes in Equity, Prior Period Adjustments**
Table	Statement of Changes in Equity, Prior Period Adjustments [Table]

Reporting Entity [Axis]	1234567890 http://regulator.gov/id
Legal Entity [Axis]	Consolidated Entity [Member]
Reporting Scenario [Axis]	Actual [Member]
Unit [Axis]	USD

Statement of Changes in Equity, Prior Priod Adjustments [Li...	Report Date [Axis]	Period [Axis]
		2010-01-01/2010-12-31
Retained Earnings (Accumulated Losses), Prior Period Adjustments [Adjustment]		
Retained Earnings (Accumulated Losses), Originally Stated	Reported as of February 22, 2010 [Member]	2,000
Retained Earnings (Accumulated Losses), Prior Period Errors	Reported as of March 18, 2011 [Member]	500 [1]
Retained Earnings (Accumulated Losses), Changes in Accounting Policies	Reported as of March 18, 2011 [Member]	(1,500) [1]
Retained Earnings (Accumulated Losses), Restated	Reported as of March 18, 2011 [Member]	1,000

Again, this shows the mathematical relations more clearly:

Label	Rendered Value	Op	Reported Value	Calculated Value	Balance	Result	Name
Statement of Changes in Equity, Prior Priod Adjustments [Line Items]							gaap:StatementChangesInEquityPriorPriodAdjustmentsLineItems
Retained Earnings (Accumulated Losses), Prior Period Adjustments [Adjustment]							gaap:RetainedEarningsAccumulatedLossesPriorPeriodAdjustmentsAdjustment
Retained Earnings (Accumulated Losses), Originally Stated	2,000	+	2,000		Credit		gaap:RetainedEarningsAccumulatedLosses
Retained Earnings (Accumulated Losses), Prior Period Errors	500	+	500		Credit		gaap:RetainedEarningsAccumulatedLossesPriorPeriodErrors
Retained Earnings (Accumulated Losses), Changes in Accounting	(1,500)	+	-1,500		Credit		gaap:RetainedEarningsAccumulatedLossesChangesInAccountingPolicies
Retained Earnings (Accumulated Losses), Restated	1,000	+	1,000	1,000	Credit	Verified	gaap:RetainedEarningsAccumulatedLosses

4.11. Metadata

Metadata[139] is simply data that provides information about other data. A chart of accounts is used to distinguish transactions that go through one account, say "Receivables", with those that go through some other account, say "Inventories". Commonly, more detail is necessary and so mechanisms exist to, say, distinguish one category of transactions related to "inventories" from another.

Different accounting systems have different mechanisms for categorizing transactions: subaccounts, additional database fields, tags, dimensions.   Further, accounting systems might provide multiple mechanisms from which an accountant can choose and different accountants might make different choices. But essentially, logically the same thing is going on regardless of the means used to arrive at the fundamental objective: categorizing transactions.

XBRL also has a mechanism for distinguishing information details called XBRL Dimensions[140].

hledger and Ledger likewise have mechanisms for categorizing transactions.   For example, hledger has the following mechanisms: code, description, comment, tag[141]. For example:

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[139] Wikipedia, *Metadata*, https://en.wikipedia.org/wiki/Metadata

[140] XBRL International, XBRL Dimensions 1.0, http://www.xbrl.org/specification/dimensions/rec-2012-01-25/dimensions-rec-2006-09-18+corrected-errata-2012-01-25-clean.html

[141] hledger, *Tags Tutorial*, https://hledger.org/tags-tutorial.html

Fundamentally, what is going on logically is that accounting information tends to be multidimensional[142]. When you work with transactions you can work at different levels of granularity.   The lowest level of granularity is typically at the accounting transaction itself. The highest level of granularity are classifications that you might find on the primary financial statements. Then, you could have multiple levels in between.

Different types of transactions have different information that might be important. For example, a job costing system needs to track each job and a fixed assets management system tracks information about individual assets. Each accounting subsystem has information that is unique to that subsystem.

But what is common to all accounting subsystems is that it is sometimes critically important to track additional details.   Call the piece of information you add a "subaccount" or "dimension" or "tag" or "field" or whatever you might come up with for a name. But fundamentally, what is going on is that transactions are being provided with different information and different subsystems need different information.

4.12. Disclosures

Facts that flow from the double-entry accounting system to a report are not the only facts provided within a report such as an external financial report.   A report also contains policies, disclosure notes, and other information that does not come from the double-entry accounting system. Commonly, that information is managed using spreadsheets, databases, and other approaches.

We described the notion of a fact ledger in the document *Introduction to the Fact Ledger*[143].

A fact ledger is a ledger in that it is used to record information. A fact ledger could be double-entry such as a general journal or a fact ledger can be single-entry and contain information that does not go through the double-entry accounting system.

The information that a fact ledger is used to record is facts. In my particular case I am interested in recording facts related to a financial report. But a fact ledger could be used to record a single fact, some set or sets of facts, or an entire database of information such as the complete set of all public company financial reports that have been

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[142] YouTube.com, *Introduction to the Multidimensional Model for Professional Accountants*, https://youtu.be/A5AAruLUud4

[143] Charles Hoffman, CPA, and Andrew Noble, PNA, BBus, *Introduction to the Fact Ledger*, http://xbrlsite.azurewebsites.net/2018/Library/IntroductionToTheFactLedger.pdf

submitted to a regulator such as the Securities and Exchange Commission (SEC) and placed into their EDGAR system[144]. Many different fact ledgers might be used in the process of creating a financial report.

A fact ledger is simply a standardized approach to managing the facts that make up financial report. An XBRL instance is an instantiation of a fact ledger using global standard syntax. But a collection of XBRL instances can also be a fact ledger.

Policies tend to be made up of mostly words which are not posted to a journal. Likewise, some disclosure notes likewise do not run through double-entry journals. But these policies and notes can be stored within a single-entry fact ledger. Disclosures[145], templates[146] that can be used to create disclosures, exemplars[147] or examples from other reports of the same sort of disclosure are all similar to small, machine-readable fact ledgers.

4.13. Provenance

Being able to trace back to the origin of information and understand the chain of custody or who has access and could therefore manipulate information provides the possibility of establishing an audit trail.

4.14. Auditing

Auditors independently verify facts provided within a financial report.

The purpose of an audit is to provide an independent third-party opinion as to whether reported information about the financial condition and financial performance of an economic entity is being represented fairly by the information provided in a financial report, in all material respects. The audit is about the **independent third-party opinion** as to the fairness of that information. Financial reporting managers still need to represent information in their financial reports that reflects the true and fair status and performance of an economic entity. They may not be independent of the economic entity, but the steps used in many cases by a reporting manager and an auditor are the same.

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144 XBRL Cloud, *EDGAR Dashboard*, https://edgardashboard.xbrlcloud.com/edgar-dashboard/

145 US GAAP Disclosures, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/us-gaap/documentation/Disclosures.html

146 US GAAP Templates, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/us-gaap/documentation/Templates.html

147 US GAAP Examples, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/us-gaap/documentation/Examples.html

External financial reporting managers need to create true and fair representations of their financial information. The team that works with the external financial reporting manager needs to make sure the financial report is true and fair. Internal auditors that work for a company to make sure the external financial reporting manager is doing their job correctly need to make sure the information is true and fair. Finally, the CFO that signs off on the report needs to make sure the financial report information is true and fair.

The point here is that there are lots of people who care that the information contained in a financial report is represented appropriately, not just auditors. Many of the tasks and procedures auditors use are the same tasks and procedures that an external financial reporting manager should be using. Sure, some are different. But fundamentally, the objective is to make sure information is true and fair.

The *COSO Enterprise Risk Management Framework*[148] is a way of thinking about risk and internal accounting controls within an organization.
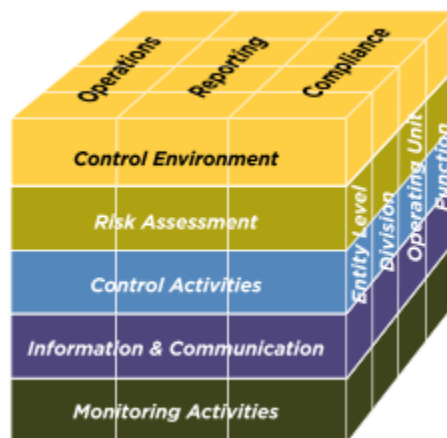
4.15. Financial Analysis

Financial reports are created to provide information about the financial position and financial performance of regulators, investors, financial analysts, and other interested parties. Management of an economic entity is also interested in this information for the purposes of managing the economic entity. The level of detail might be different depending if

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[148] COSO Enterprise Risk Management Framework, http://xbrl.squarespace.com/journal/2021/4/13/coso-enterprise-risk-management-framework.html

a financial report is created for someone internal and someone external to the reporting economic entity.

Economic entities can use whatever organization they might choose for financial information that is consumed within that organization. However, when financial information is reported external to an economic entity and that report is required to be prepared using some specific financial reporting scheme then the rules of that financial reporting scheme must be applied to the external financial reports. External financial information can also be used for internal purposes but generally internal information is generally more detailed in nature.

Financial analysts and others create ratios[149] that are used to evaluate the information provided by an economy entity. An example of a few ratios include: working capital, debt to equity ratio, return on assets, return on equity, return on sales. Financial analysts created financial models such as the unlevered discounted cash flow model[150].

In summary, accountants need to:

- **Validate** that all information is accurate and properly classified
- **Analyze** that information to gain insights into what has happened, why it happened, what can be done to do things better next time
- **Simulate** different possible scenarios, looking into the future to figure out the best course of action

4.16. Financial Benchmarking

Economic entities and auditors tend to benchmark reported financial information against that economic entity's peers in order to search for reporting errors and to better understand reported financial information and financial trends. Because only summarized information tends to be available for peers, benchmarking tends to be at the financial report line item level.

4.17. Variance Analysis

Economic entities and auditors tend to analyze reported financial information against prior financial information for that economic entity to search for possible reporting errors and to better understand reported

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[149] Ciaran Walsh, *Key Management Ratios*, https://www.amazon.com/Key-Management-Ratios-Financial-Times/dp/0273719092

[150] Charles Hoffman, CPA, *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

financial information and financial trends. Because all of this information is internal, variance analysis could be performed down to any level of detail.

In addition to variance from actual reported accounts, variance from budget(s) and/or any forecast(s) might also be performed if budgets and forecasts exist for an economic entity.

4.18. Digital Distributed Ledger

Explaining digital distributed ledgers in any detail is beyond the scope of this document; I would refer you to *Comprehensive Introduction to Digital Distributed Ledgers*[151]. There are a lot of details that still need to be worked out but digital distributed ledgers appear promising. That said, we do want to introduce the idea.

A digital distributed ledger[152] is an indestructible and un-editable decentralized computer record, or ledger. A digital distributed ledger provides a full and complete history of transactions in that ledger. Ledgers can be as public and open or private and limited as the use case demands. Ledgers can be permissioned or permission-less in determining who can add new transactions. Different approaches can be used to determine how new transactions are authorized (proof-of-stake, proof-of-work, consensus, identity mechanisms) before they can add new information to the ledger. Ledgers can be interlinked with one or more other ledgers.

The following is a summary of the characteristics of a digital distributed ledger:

- No hackers can corrupt information because there is no centralized version; there are many versions and they all must agree
- Immutable (unchangeable, secure, set in stone)
- No centralized administrator/authority owns the system
- Entries into ledger are "notarized" (similar to idea of notary public)
- Public or private; permissioned or permission-less
- Machine readable
- Stand alone or interlinked with other ledgers

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[151] Charles Hoffman, CPA, *Comprehensive Introduction to Digital Distributed Ledgers*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part01_Chapter02.71_DistributedLedgers.pdf

[152] Wikipedia, *Distributed Ledger*, https://en.wikipedia.org/wiki/Distributed_ledger

The following is a prototype digital distributed ledger created so that you can get the feel of such ledgers[153]:

This[154] is a second digital distributed ledger example.

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[153] Digital Distributed Ledger Prototype,
http://xbrlsite.azurewebsites.net/2020/master/automation/digital-ledger/blocks/0xcbece514be3449fbbe9677fbd69cd1be58f41de2df3844fb84a64acf6b1726f9.html

[154] Second digital distributed ledger prototype, http://xbrlsite-app.azurewebsites.net/io/certification/0x000e499240f14b8b98978dc65c66aa8a441d063f106c41c88efd262dffb5404d.html

Certification (Prototype)

Blockchain block hash: (click to navigate to block)

0x000e499240f14b8b98978dc65c66aa8a441d063f106c41c88efd262dffb5404d

Entity:

MATERIALISE NV

Identifier: (http://www.sec.gov/cik)

0001091223

AccessionNumber:

0001193125-18-178695

XBRL instance:

http://www.sec.gov/Archives/edgar/data/1091223/000119312518178695/mtls-20171231.xml

SEC Filing Page:

http://www.sec.gov/Archives/edgar/data/1091223000119312518178695/0001193125-18-178695-index.htm

Reporting style:

IFRS-BSC-ISFUNC6-SCI1-CF1

Sector:

Business Services

Date verified, accepted, certified and digitally locked:

2018-05-30

4.19. Financial Report

The final product or output of the tasks and processes is a financial report. Information from that financial report came from an accounting information system. That report might be audited. That report might be analyzed.

The intent of this section is to explain that financial reports created using this process could look precisely like financial statements created today. Those reports, however, would be created in new ways.

As I understand it, today about 85% of external financial reports created are created using word processors and spreadsheets that have no knowledge of financial reporting. Because these applications have no knowledge of financial reporting, the burden is on the creator of the financial report, the operator of the word processing documents and spreadsheets, to understand financial reporting rules.

It is my view that some of the boring, mundane and mindless tasks involved in the creation of external financial reports can be delegated to automated machine-based processes.

The following is an example of one possible target so that you can get a feel for the quality of the financial reports that I am referring to[155]:

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[155] Inline XBRL report example, http://xbrlsite.azurewebsites.net/2020/master/tb/instance-PixelPerfect.html

Balance Sheet

ABC Company, Inc.

(See accompanying notes to the financial statements.)

(in US Dollars)	As of December 31, 2018	As of December 31, 2017
ASSETS		
Current Assets:		
Cash and cash equivalents	$4,000	$3,000
Receivables	2,000	1,000
Inventories	1,000	1,000
Current assets	7,000	5,000
Noncurrent Assets:		
Property, plant, and equipment	6,000	1,000
Noncurrent assets	6,000	1,000
Assets	$13,000	$6,000
LIABILITIES AND EQUITY		
LIABILITIES		
Current liabilities:		
Accounts payable	$1,000	$1,000
Current liabilities	1,000	1,000
Noncurrent liabilities:		
Long-term debt	6,000	1,000
Noncurrent liabilities	6,000	1,000
Liabilities	7,000	2,000
EQUITY		
Retained earnings	6,000	4,000
Equity	6,000	4,000
Liabilities and equity	$13,000	$6,000

Essentially, pixel perfect external financial reports could be created to the extent of the features of HTML 5 and CSS 3 for document publishing. Such a report could be supplemented by something like an Inline XBRL viewer software application[156].

Other rendering alternatives are available that provide far less work but the presentation formats are not pixel perfect. Specific details of a

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[156] Inline XBRL report with embedded viewer,
http://xbrlsite.azurewebsites.net/2020/master/tb/instance-PixelPerfectWithViewer.html

report can be communicated precisely[157]. Entire HTML-based applications can be created for interacting with a financial report; for example[158],

Statement of Financial Postion, Classified [Line Items]	Period [Axis]	
	2020-12-31	2019-12-31
Assets [Roll Up]		
Current Assets [Roll Up]		
Cash and Cash Equivalents	25,843	29,843
Short-term Investments	17,855	17,440
Receivables	4,833	5,750
Inventories	18,751	12,144
Prepaid Expenses	1,284	1,743
Other Current Assets	3,467	2,588
Current Assets	72,033	69,508
Noncurrent Assets [Roll Up]		
Investments, Noncurrent	84,839	84,839
Property, Plant and Equipment	190,745	189,176
Other Noncurrent Assets	29,803	34,509
Noncurrent Assets	305,387	308,524
Assets	377,420	378,032

While all of these reports are readable by humans, each is also machine readable[159]. In fact, the autogenerated HTML-based reports are generated dynamically using the machine-readable XBRL-based report plus supporting XBRL taxonomies.

Taking all this a step further, machine-readable reports can be interacted with using software applications[160]. These sorts of software applications are a lot like pivot tables with all sorts of robust functionality[161].

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[157] HTML-based autogenerated representation of financial report, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/nfp/reference-implementation/evidence-package/contents/RenderingSummary.html

[158] Auto-generated financial report, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/nfp/reference-implementation/evidence-package/

[159] Machine-readable raw XBRL instance, http://xbrlsite.azurewebsites.net/2020/reporting-scheme/nfp/reference-implementation/instance.xml

[160] Pesseract working proof of concept, http://pesseract.azurewebsites.net

[161] Self guided tour of XBRL-based financial report, http://xbrlsite.azurewebsites.net/2019/Tour

However, there are some issues related to some autogenerated financial reports. HTML 5 and CSS 3 currently do not support page layout document oriented flow control[162]. As such, it can be challenging to get a report that works well on the web to also act well as a printed document.

Document Information Typing Architecture[163] (DITA) is a step closer to better layout when page flow is desired. Another option is a word processor document format such as DocBook[164]. DITA is different than DocBook[165]. Another alternative is XSL-FO which does basic page flow but does have limitations; but it is free and can be used to generate a PDF document.

HTML and CSS are suitable and sufficient for browser-oriented rendering of information. To overcome those limitations, the W3C created the Extensible Stylesheet Language Formatting Objects (XSL-FO) to define a collection of pagination semantics for print-oriented rendering.

Exactly which of these alternatives to use for printed financial reports is up in the air. If you don't care about page flow, such as with Inline XBRL documents that are not intended to be printed, then XHTML + XBRL (i.e. Inline XBRL) could work just fine. If you want pixel-perfect rendering, commercial publishing alternatives exist but they tend to be somewhat expensive.

Serializing financial reports to OpenDocument[166] or Microsoft Word is very doable. Even better, outputting to multiple different rendering formats would also be a very good thing.

Are "pretty" financial reports necessary? Sometimes likely yes, other times perhaps not.

4.20. Repeatable Method

I have published a number of documents trying to show and explain the process of creating a financial report. This is a summary of information from those documents and what I was trying to achieve with the

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162 Quark, The Ugly Duckling No More: Using Page Layout Software to Format DITA Outputs, https://blog.quark.com/2016/10/ugly-duckling-no-using-page-layout-software-format-dita-outputs/

163 Wikipedia, *Document Information Typing Architecture*, https://en.wikipedia.org/wiki/Darwin_Information_Typing_Architecture

164 DocBook.org, What is DocBook?, https://docbook.org/whatis

165 DocBook versus DITA Comparison, https://www.oxygenxml.com/events/2018/DITA_OT_DAY/Radu-Coravu_docbook-vs-dita.pdf

166 Wikipedia, *OpenDocument*, https://en.wikipedia.org/wiki/OpenDocument

document. Right now, I can say that I do have a method for creating high-quality XBRL-based digital financial reports. I cannot say that I have adequately documented this best practices-based method yet.

What I am trying to show in the document *General Ledger Trial Balance to External Financial Report*[167], is a basic example of taking the information from a general journal to a general ledger and then ultimately to a financial report using XBRL. The beginning of the process is the accounting system which summarized the information, the end of the process is a human readable and machine readable financial report.

What I was trying to show in the document *INTELLIGENT DIGITAL FINANCIAL REPORTING – PART 4: EXAMPLES AND SAMPLES – COMPREHENSIVE EXAMPLE*[168], is a much more complex financial report which was created using the same techniques as the basic example. Not that this document has several "forests" or disjoint unions of trees meaning that not all the information in this financial report is run through the general ledger trial balance.

What I am trying to show in the blog post *Representing Unlevered Discounted Cash Flow Model Using XBRL*[169], is both how information from a financial report is used by financial analysts to analyze economic entities reporting information and that such models can be created using techniques similar to how the financial reports themselves are created.

What I am trying to show in the document *Introducing the Fact Ledger*[170], is that intermediate documents or ledgers can be used to summarize information that is used within this process.

What I am trying to show in the document *Blueprint for Creating Zero-Defect XBRL-based Digital Financial Reports*[171]; is how business rules can be used to automate many of the tasks related to moving information from one step to another, verifying that information is

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[167] Charles Hoffman, CPA, *General Ledger Trial Balance to External Financial Report*, http://xbrlsite.azurewebsites.net/2018/RoboticFinance/TrialBalanceToReport.pdf

[168] Charles Hoffman, CPA and Rene van Egmond, *INTELLIGENT DIGITAL FINANCIAL REPORTING – PART 4: EXAMPLES AND SAMPLES – COMPREHENSIVE EXAMPLE*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part04_Chapter07.5_ComprehensiveExample.pdf

[169] Charles Hoffman, *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

[170] Charles Hoffman and Andrew Noble, *Introducing the Fact Ledger*, http://xbrlsite.azurewebsites.net/2018/Library/IntroductionToTheFactLedger.pdf

[171] Charles Hoffman, *Blueprint for Creating Zero-Defect XBRL-based Digital Financial Reports*, http://xbrlsite.azurewebsites.net/2017/Library/BlueprintForZeroDefectDigitalFinancialReports.pdf

correct and otherwise of high quality so that these processes can be reliable.

What we are trying to show in the document *Putting the Expertise into an XBRL-based Knowledge Based System for Creating Financial Reports*[172], are general ideas related to how patterns can be leveraged when creating software that is useful in creating XBRL-based financial reports.

Finally, what I tried to show in the document *Guide to Building an Expert System for Creating Financial Reports*[173], are specific techniques we used to create Pesseract[174] which is a working proof of concept which we used to prototype and test the ideas in this document.   The application can be downloaded and used to better understand these ideas.

My next step is to turn all of this information into a documented method that is easy to understand.

4.21. Ecosystem

Imagine an ecosystem that is as elegant as an iPhone for accounting, reporting, auditing, and analysis.   Imagine if standard technical syntaxes existed and you could convert bidirectionally from one syntax back to some other syntax. Imagine if the logic of accounting, reporting, auditing, and analysis was agreed to by the members of the supply chain.   Software vendors and other stakeholders could plug into this digital ecosystem and add value.   Imagine if standard output formats were agreed to.   Imagine something like this:
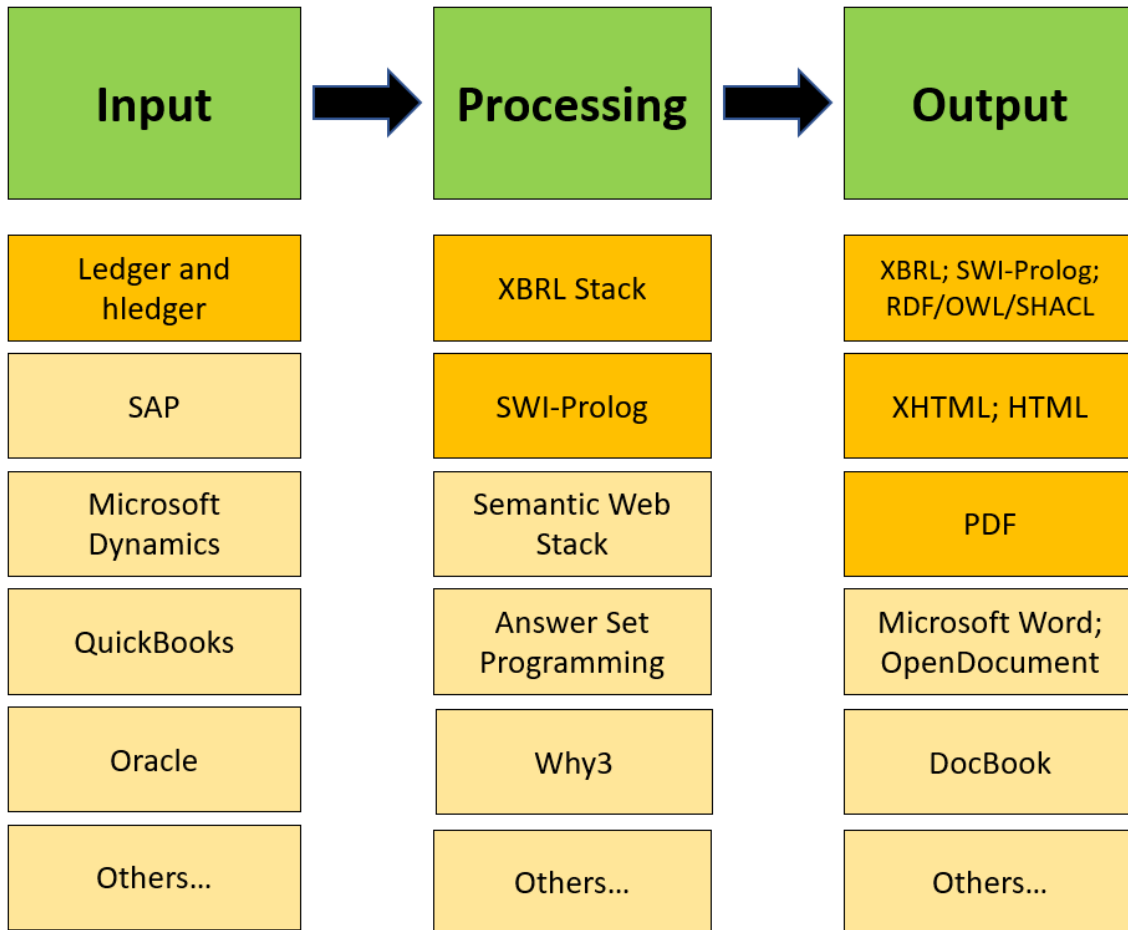
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[172] Charles Hoffman and Hamed Mousavi, *Putting the Expertise into an XBRL-based Knowledge*
Based System for Creating Financial Reports,
http://pesseract.azurewebsites.net/PuttingTheExpertiseIntoKnowledgeBasedSystem.pdf

[173] Charles Hoffman, *Guide to Building an Expert System for Creating Financial Reports*,
http://xbrlsite.azurewebsites.net/2018/Library/GuideToBuildingAnExpertSystemForCreatingFinancialReports.pdf

[174] Pesseract, http://pesseract.azurewebsites.net/

Input		Processing		Output
Ledger and hledger		XBRL Stack		XBRL; SWI-Prolog; RDF/OWL/SHACL
SAP		SWI-Prolog		XHTML; HTML
Microsoft Dynamics		Semantic Web Stack		PDF
QuickBooks		Answer Set Programming		Microsoft Word; OpenDocument
Oracle		Why3		DocBook
Others…		Others…		Others…

Imagine if ISO and OMG standards were leveraged similar to how the ISO standard shipping container, the Universal Product Code is leveraged in retail, or MPEG formats for movies.

Youtube.com does not support just one single technical format, it supports all of the follow following formats: MOV, MPEG4, AVI, WMV, MPEG PS, FLV, 3GPP and WebM.

Multiple technical formats are a reality.

This ecosystem already exists to a degree. The darker orange color exists and works today. The lighter color orange does not yet work. Piece-by-piece, this will ultimately be put together.

4.22. Triple entry accounting system

The idea of triple entry accounting was first introduced by Yuji Ijiri in 1989 in his book *Momentum Accounting & Triple-Entry Bookkeeping*[175]. In 2005, cryptographer Ian Grigg provided a more well-known example of a triple-entry accounting system, in a paper, *Triple Entry Accounting*[176]. Some are saying that triple-entry accounting is the most important invention of the last 500 years[177].

With triple entry accounting, both parties to a transaction would complete a transaction and simultaneously record information about that transaction in a shared ledger such as a digital distributed ledger. Once that happens, it's necessary to ensure that that information about that transaction can't be changed.

4.23. Universal Technology for Accountability

Double entry bookkeeping is a universal technology used around the world by organizations, individuals, and communities. Regardless of the size of the organization, the location in the world, the activity of the organization, or the complexity of the organization; the double entry bookkeeping model works. Double entry bookkeeping will never become obsolete. Formally documented by Luca Pacioli in 1494 and referred to as the Venetian Method, double entry bookkeeping is a global standard.

Accounting using the double entry bookkeeping method is about documentation and accountability using a proven, professional approach that detects errors and differentiates an unintentional error from an intentional error (i.e. fraud). Without accountability civilization cannot advance. Accountability advances civilization, economics, enterprises, environmental stewardship, personal property, governmental stewardship, etc.

Accounting is one of the most important technologies invented in the history of human civilization and has been around about 7,000 years. Accounting was invented before writing and before the invention of

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[175] Yuji Ijiri, *Momentum Accounting & Triple-Entry Bookkeeping*, American Accounting Association, https://www.goodreads.com/book/show/15067963-momentum-accounting-triple-entry-bookkeeping

[176] Ian Grigg, *Triple Entry Accounting*, http://iang.org/papers/triple_entry.html

[177] Daniel Jeffries, *Why Everyone Missed the Most Important Invention in the Last 500 Years*, https://hackernoon.com/why-everyone-missed-the-most-important-invention-in-the-last-500-years-c90b0151c169

numbers. The global multinational organization simply could not exist without double entry bookkeeping and accounting.

The simple concepts that are used to build financial accounting and financial reporting yield an elegant result.

Orthodox is defined as conforming to what is generally or traditionally accepted as right or true; established and approved. Topology is the way in which constituent parts are logically interrelated or arranged. Orthodox topologies or logical schemas of financial reports that summarize some set of accounting transactions that result from some set of business events of an economic entity can be differentiated from the unorthodox given a clear and complete set of rules.

This universal technology for accountability[178] is grounded, even ingrained, in medieval traditions. Yet this universal technology for accountability is going to be impacted by structured information, artificial intelligence, digital distributed ledgers, and other such technologies. And they should be. Those same technologies that are causing the ever-increasing volume and complexity of information that is overwhelming us is also the solution to the information overload that is being experienced.

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[178] *Universal Technology for Accountability*,
https://digitalfinancialreporting.blogspot.com/2023/02/universal-technology-for-accountability.html