# Getting Ready for the Digital Age of Accounting, Reporting and Auditing: a Guide for Professional Accountants

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**AICPA News Update**: "Technology has undoubtedly been the catalyst for change throughout history. But today, this change is happening faster than ever before. The world will look very different in a few years - and the accounting profession is no exception. Artificial intelligence, blockchain and other technologies are poised to reshape the accounting landscape, and we need to be ready[1]."

**Journal of Accountancy**: "Technology is poised to transform the accounting profession. Artificial intelligence, robotics, and blockchain are on the verge of automating many traditional core CPA tasks. The profession is at a critical moment, one from which it will emerge in a far different form[2]."

**Executive summary:**

- The AICPA and Journal of Accountancy are indicating that technology is poised to transform the accounting profession.
- Three primary enabling technological innovations are driving this significant change to the current accounting practices, processes, and methods: XBRL-based structured digital financial reports, knowledge-based systems and other application of artificial intelligence, and blockchain-based or hashgraph-based[3] distributed ledgers.
- Be ready. In the future, professional accountants will team with software applications. Humans augmented by machine capabilities, much like an electronic calculator enabling a human to do math quicker, will empower knowledge workers who know how to leverage the use of those machines.
- While it is difficult to precisely predict the productivity gains which will be realized, initial information is showing the productivity gains will be very, very significant.
- Professional accountants and accounting practices, procedures, and processes will need to adapt. Education and training of professional accountants also needs to adapt. Specifically, professional accountants need to understand how knowledge-based systems perform work.

[1] AICPA News Update, July 7, 2017, *AICPA News Update: Technologies are poised to reshape the accounting landscape*, http://bruegel.org/2017/04/do-we-understand-the-impact-of-artificial-intelligence-on-employment/

[2] Jeff Drew, Journal of Accountancy, *Real talk about artificial intelligence and blockchain*, July 2017, http://www.journalofaccountancy.com/issues/2017/jul/technology-roundtable-artificial-intelligence-blockchain.html

[3] *Hashgraph: An Alternative to Blockchain for Distributed Ledgers?*, http://xbrl.squarespace.com/journal/2017/10/28/hashgraph-an-alternative-to-blockchain-for-distributed-ledge.html

Current information published by the AICPA and Journal of Accountancy tell professional accountants to "be ready" because "technology is poised to transform the accounting profession" and that "the professional will emerge in a different form". But there is little information provided as to exactly how to be ready. What additional skills do professional accountants need to remain relevant?

Understanding the new paradigm that is emerging for accounting, financial reporting, and auditing from the perspective of the current paradigm will be less than satisfying. Important aspects of the new paradigm must be understood in order to adapt appropriately.

This resource provides the minimum, basic introduction to key aspects of digital financial reporting such that the average professional accountant can understand what a digital financial reporting is, how it works, and other important considerations helpful in thinking about such reports.

At the end of this document I provide specific references to fundamental additional training every professional accountant needs for the next stage in their journey into the digital age of accounting, reporting, and auditing.

## *1.1. Digital General Purpose Financial Report*

The general purpose financial report is currently getting a face lift[4]. While what goes into financial reports is not really changing, how information is conveyed by that report is changing a lot. Paper-based and even electronic versions of financial reports were not understandable by computer processes. But XBRL-based structured digital financial reports[5] are understandable by machines. Public companies have been submitting XBRL-based financial reports to the U.S. Securities and Exchange Commission for over five years now, perfecting these digital financial reports.

Most professional accountants still don't understand how to correctly convey the meaning represented by the complex logical information which makes up a financial report in the machine-readable XBRL structured format[6]. Most professional accountants still don't understand how to create the business rules that help make sure they did not make mistakes in conveying that meaning. Most professional accountants are not leveraging currently available technologies to automate things such as financial reporting and disclosure checklists. Most certified public accountants don't really understand how to audit information conveyed by an XBRL-based structured digital financial report. But all that is slowly changing.

What is going on right now, and has been going on for the past five or so years is experimentation and learning[7]. Professional accountants now have thousands of XBRL-based digital financial reports which they can look at, learn from, understand, and perfect XBRL-based digital financial reports. While not every professional accountant or financial analyst needs to be involved in this experimentation, it does offer an excellent learning opportunity.

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[4] Charles Hoffman, *Conceptual Overview of an XBRL-based Structured Digital Financial Report*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part01_Chapter02.1_ConceptualOverviewOfDigitalFinancialReporting.pdf

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

[6] Charles Hoffman, *High Quality Examples of Errors in XBRL-based Financial Reports*, http://xbrl.squarespace.com/journal/2017/4/29/high-quality-examples-of-errors-in-xbrl-based-financial-repo.html

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

## 1.2. Modernizing the Financial Report Creation Process

By all accounts, the current old-school process of creating an external financial report is an extremely inefficient process. Here is a list of how some describe that process:

- The CFA Institute calls for "...greater efficiencies within the current inefficient system" [of creating financial reports][8].
- The consultancy Gartner points out, "...average Fortune 1000 company used more than 800 spreadsheets to prepare its financial statements"[9]
- Ventana Research says, "...for larger companies, assembling the periodic external reports typically is an inefficient and error-prone process."[10]
- PriceWaterhouseCoopers points out, "...old school manual processes..." and "commonly cut and pasted, rekeyed, or manually transferred into word processing and spreadsheet applications used for report assembly and review process steps"[11]

While the process of creating an external financial report might not seem inefficient when being measured against current practices, procedures, processes, and mentalities of those thinking that the way financial reports are created is "the only way" to create such reports; and while it is hard to measure the effectiveness and efficiency of new practices, procedures, and processes because they don't yet exist; when new practices, procedures, and processes do exist the increase in productivity will be measurable and clear, and they will be substantial.

## 1.3. Human-machine Collaboration to Create Financial Reports

How do we know productivity gains will be substantial? For the past five years a software developer and I have worked to create, to the best of our knowledge, the world's first expert system for creating financial reports. We admit that the expertise offered by the system is currently fairly rudimentary but the successful working prototype of an expert system for creating financial reports is effective, it is useful, and it does prove the concept.

Contrasting our working proof of concept to what is truly possible is somewhat like comparing the first successful airplane created by Orville and Wilbur Wright, Wright Flyer, to say a Boeing 747. Yes, there is a significant amount of room for improvement. But, just like the Wright Flyer proved that sustained flight is possible; our working prototype expert system proves that artificial intelligence technology can be leveraged in the process of creating a financial report and it helped to figure out exactly how to make the technology work effectively and more efficiently that current processes.

And while the working proof of concept is commercial quality software and the software is very good; we know that we can do better. Others might even be able to do even better than what we have created. Time will reveal the best way to create expert systems for creating financial reports.

As has been said, "The best way to predict the future is to create it[12]." Yes, it can be hard to separate science-fact and science-fiction. But participating in the creation of new

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[8] CFA Institute, *DATA AND TECHNOLOGY: TRANSFORMING THE FINANCIAL INFORMATION LANDSCAPE*, June 2016, http://www.cfapubs.org/doi/pdf/10.2469/ccb.v2016.n7.1

[9] Nigel Rayner, Neil Chandler, *XBRL Will Enhance Corporate Disclosure and Corporate Performance Management*, April 23, 2008, http://unstats.un.org/unsd/nationalaccount/workshops/2008/newyork/IG22.PDF

[10] Robert Kugel, Ventana Research: Making XBRL Reporting Easy, February 13, 2009, http://businessfinancemag.com/technology/ventana-research-making-xbrl-reporting-easy

[11] Mike Willis, PriceWaterhouseCoopers, Disclosure management: Streamlining the Last Mile, March 2012, https://www.pwc.com/gx/en/xbrl/pdf/pwc-streamlining-last-mile-report.pdf

technologies or trying out new technologies before they are ready for broad commercial use does have its advantages[13].

The typical professional accountant is generally too busy working and producing to fiddle around with possible new technologies that might provide productivity improvements. But those that do lift their heads up from the daily grind of using current practices, processes, and procedures; can often see new ways that can be employed to solve those same problems that are more effective and efficient than current approaches.

While understanding the big picture is important, the devil is in the details. You need to figure out how to appropriately apply technology to your advantage.

Humans augmented by machine capabilities, much like an electronic calculator enabling a human to do math quicker, will empower professional accountants who know how to leverage the use of those machines[14].

## *1.4. Process Robotics is Disrupting Accounting and Finance*

In the video, *Finance in a Digital World and the Impact on CFOs*[15], John Steel who leads the finance transformation practice of Deloitte makes the statement:

> "Five years from now there is either no CFO or the CFO is playing a different role."

John's view is consistent with what the AICPA and Journal of Accountancy are saying which is that technology is poised to change the accounting profession[16].

In the video, John goes on to say, "Digital is having a tremendous impact and it's quite disruptive." In the video he goes over trends that are occurring. One of those trends is process robotics. John uses the term "lights out finance" meaning a finance that is completely automated. Now, we may never get to where the lights are completely out, but digital will involve automation of many existing manual processes.

A key word here is "disruptive". As pointed out by *The Innovators Dilemma*[17], there are two types of innovation: sustaining and disruptive. *Sustaining innovation* meets customer's current needs, making incremental improvements in quality and efficiency of current processes. *Disruptive innovation* is about meeting future needs of customers.

Process robotics is about automating accounting, clerical, administrative, and other such tasks using software robots. Artificial intelligence technology drives these software robots. It really is a lot like how physical robots were employed to replace humans in manufacturing processes such as the process of building cars. Software robots cannot automate all tasks but certainly there are tasks which can be automated.

We don't want to overstate what innovations such as process robotics will provide. But we likewise don't want to understate the impact either. This is not about computers taking over the world. The way it will work is that you will have humans augmented by machine capabilities, much like an electronic calculator enabling a human to do math quicker, will empower professional accountants and others who know how to leverage those machines.

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[12] BarnRaisers, attributed to both Abraham Lincoln and Peter Drucker, http://barnraisersllc.com/2013/12/12-reasons-predict-future-create/

[13] Shelly Palmer, *Automate or Die*, https://www.shellypalmer.com/2017/04/automate-or-die/

[14] Charles Hoffman, *Accounting and Auditing in the Digital Age*, http://xbrl.squarespace.com/journal/2017/6/28/accounting-and-auditing-in-the-digital-age.html

[15] SAP, *Finance in a Digital World and the Impact on CFOs*, http://events.sap.com/sapandasug/en/session/32172

[16] *AICPA News Update: Technologies are poised to reshape the accounting landscape*, http://xbrl.squarespace.com/journal/2017/7/7/aicpa-news-update-technologies-are-poised-to-reshape-the-acc.html

[17] YouTube, *The Innovator's Dilemma*, https://www.youtube.com/watch?v=yUAtIQDllo8

Underlying the process robotics will be intelligent software agents that interact with each other and with humans to get work done.

## *1.5. Audited Without Manual Interference*

The conclusion of a paper, *Imagineering Audit 4.0*, written by Jun Dai and Miklos A. Vasarhelyi and published by the *Journal of Emerging Technologies in Accounting*[18] provides a succinct and in my opinion accurate assessment of where Industry 4.0 and auditing is headed.

> "Audit 4.0 utilizes data collection equipment such as sensors, embedded computers, and software modules to collect data across the entire company and its outside entities, such as suppliers and customers, via a network in close-to-real time. Data analytics techniques are employed to build models upon these data for the purposes of monitoring product quality, identifying machine faults, saving costs, and facilitating decision making. Audit by exception is used to bring attention to major issues in a largely automated audit. The audit process strongly relies on a mirror world representation of processes and a strong analytical interlinking of not only financial but especially nonfinancial to financial linkages. Finally, the approach will substantially rebalance the concepts of lines of defense, will be applicable to many types of assurances (external, internal, specialized), and will be mainly automated."

In another paper, *DATA Act 2022: Changing Technology, Changing Culture*[19], published by Deloitte and the DATA Foundation, the authors provide a vision of what is possible to achieve by the year 2022 should *The Digital Accountability and Transparency Act of 2014*[20] be implemented effectively:

> "By 2022, if all goes well, spending information will also be automated: reported, exchanged, and *audited without manual interference*. Systems will deliver reports instantly; grantee and contractor software will communicate automatically with agency and government-wide systems."

The DATA Act is not an isolated example; it is part of a broader trend referred to as RegTech[21]. Someone, somewhere will begin employing the technologies of the *Fourth Industrial Revolution*[22]. Professional accountants and auditors will then be forced into changing. But these changes will occur and the institution of accountancy may or may not be ready. And these changes will likely occur sooner than you might realize.

The statement "audited without manual interference" implies that manual audit steps are not added value, rather the manual audit steps are unnecessary friction which should be removed from the system.

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[18] Jun Dai and Miklos A. Vasarhelyi (2016) *Imagineering Audit 4.0*. Journal of Emerging Technologies in Accounting: Spring 2016, Vol. 13, No. 1, pp. 1-15., http://aaajournals.org/doi/abs/10.2308/jeta-10494?code=aaan-site

[19] Deloitte and the DATA Foundation, *DATA Act 2022: Changing Technology, Changing Culture*, http://www.datafoundation.org/data-act-2022

[20] DIGITAL ACCOUNTABILITY AND TRANSPARENCY ACT OF 2014, https://www.congress.gov/113/plaws/publ101/PLAW-113publ101.pdf

[21] R.J. Voster BEng, *RegTech: closing the circle; Will Regulatory Technology (RegTech) digitize regulation?*, https://www.compact.nl/en/articles/regtech-closing-the-circle/

[22] Charles Hoffman, *Accounting and Auditing in the Digital Age*, http://xbrl.squarespace.com/journal/2017/6/28/accounting-and-auditing-in-the-digital-age.html

## 1.6. Be Proactive; Get Retraining, Adapt, and Prosper

A recent Journal of Accountancy Article, *Real talk about artificial intelligence and blockchain*[23], clearly indicates that change is not only inevitable, change is imminent:

> "Technology is poised to transform the accounting profession. Artificial intelligence, robotics, and blockchain are on the verge of automating many traditional core CPA tasks. The profession is at a critical moment, one from which it will emerge in a far different form."

While it has been the case that in the past it has been the tendency for most professional accountants to be reactive rather than proactive; and while it is likely the case that the majority of professional accountants and auditors will likely be reactive to this current round of technology improvements; you personally don't have be reactive.

Be proactive[24]. Based on what I can tell, in my view the transition of the accounting profession will pick up steam over the next three to five years and will be running on all cylinders by that time.

In another Journal of Accountancy article, *Accountants' role in managing AI disruption*[25], Calum Chace, an AI expert, makes the following statement, "Accountants can play a leading role in the dialogue about the future. He said accountants are trusted for their intelligence, level-headedness, and analytical abilities, and he expects that as AI's impact on the world emerges, accountants will continue to use their skills to serve the public interest."

I agree. But first, accountants need to understand AI and its probable impact.

Unfortunately, the education system used to create the next generation of accounting professionals is not outputting these new leaders with the right skills and is unlikely to change any time soon. In fact, I had one accounting student tell me that their professor told them directly that the skills they are learning in college were already obsolete. While that statement is probably not true, educators are confused as the specifics of what exactly needs to change. Educators don't understand precisely what new skills professional accountants will need.

There are ways to work around the educational system's current deficiencies. Professional accountants need to learn how computers reason. Don't fall for the "learn to code" hysteria[26].

Besides, this *Wired* article, *End of Code*[27], has the sub title "Soon we won't program computers. We'll train them like dogs." That is a very succinct and accurate statement. But I do disagree with one thing *Wired* is saying. Business professionals will train software using business rules, not code.

## 1.7. Learn About How Computers Reason

Computers reason using the rules of logic. For now, what professional accountants should do as part of their formal education is go to the philosophy department of your university and take a course in formal logic. That is the basis of computer reasoning, the rules of logic. Literacy as to the rules of logic and reasoning used by computers, which can be

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[23] Jeff Drew, *Journal of Accountancy*, July 2017, *Real talk about artificial intelligence and blockchain*, http://www.journalofaccountancy.com/issues/2017/jul/technology-roundtable-artificial-intelligence-blockchain.html

[24] Shelly Palmer, *Automate of Die*, https://www.shellypalmer.com/2017/04/automate-or-die/

[25] Ken Tysiac, *Journal of Accountancy*, October 2017, *Accountants' role in managing AI disruption*, https://www.journalofaccountancy.com/news/2017/oct/accountants-role-in-managing-artificial-intelligence-disruption-201717688.html

[26] Basel Farag, TechCrunch, *Please don't learn to code*, May 2016, https://techcrunch.com/2016/05/10/please-dont-learn-to-code/

[27] Jason Tanz, Wired*, The End of Code*, https://www.wired.com/2016/05/the-end-of-code/

taught in less than 40 hours, will help you understand the capabilities of computers and how to harness those capabilities[28].

A little harder to work around is the skill and ability to represent information and convey meaning in machine-readable form and make sure you did so correctly. I have distilled the essence of this skill into 15 succinct principles, *XBRL-base Digital Financial Reporting Principles*[29]. Principles help you think about something thoroughly and consistently. Understanding those principles will give you an idea of the skills you need to learn.

While this ability tends to be above the capabilities of most professional accountants today, the required knowledge will decrease as software functionality improves. If you think about it, software must improve. There is no way the accounting department is going to rely on the information technology department to get financial reports out. That simply will never happen.

Once you have a base of knowledge then the next step is to help software vendors understand the software you really need. If you don't have the correct understanding of what you need because you don't have the right understanding of the problems software need to solve; then you will tend to misdirect software vendors and send them down the wrong software creation path. That is what has happened for software used to create XBRL-based financial reporting by public companies. The quality of XBRL-based public company financial reports is not where it needs to be. Because of quality issues, the use of all that XBRL-based information suffers and the advantages of XBRL are harder to see[30,31].

## *1.8. Quality Digital Financial Reporting is Paramount*

One huge mistake that software vendors make is misunderstanding the quality of a financial report. Financial reports cannot contain mistakes. Period. External financial reporting managers have processes, procedures, and practices of today yield extremely high-quality output. The "high-quality" part simply cannot change. Any new technology or innovation that reduces quality will basically never be adopted by the market. What can change is the manual effort that goes into creating those high-quality financial reports. The role of technology is to enable the appropriate tasks to be automated and managed by machine-based processes which frees up humans to perform tasks that only they can perform because they are simply not automatable because they require judgement, are non-routine, or are otherwise beyond the capabilities of machine-based processes. Professional accountants understand this distinction. Information technology professionals do not understand this distinction because they do not understand financial reporting and accounting deeply enough.

The accounting profession is leading other business domains into the Digital Age[32]. It may not seem like that, but it is true. This did not start in 1999 when the American Institute of Certified Public Accountants (AICPA) started the process of creating what has become the global standard XBRL. The process started in 1929 with the creation of U.S. Generally Accepted Accounting Principles, the semantics of financial reporting. Those semantics were tuned over a period of nearly 90 years. It continued with the creation of International Financial Reporting Standards (IFRS) beginning in about 1975. Getting these financial

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[28] Charles Hoffman, *Closing the Skills Gap*, http://xbrlsite.azurewebsites.net/2018/Library/ClosingTheSkillsGap.pdf

[29] Charles Hoffman, *XBRL-based Digital Financial Reporting Principles*, http://xbrl.squarespace.com/digital-financial-reporting-pr/

[30] *Public Company Quality Continues to Improve, Trend is Good*, http://xbrl.squarespace.com/journal/2017/6/2/public-company-quality-continues-to-improve-trend-is-good.html

[31] Understanding Logical, Mechanical, and Mathematical Accounting Relations in XBRL-based Digital Financial Reports, http://xbrl.squarespace.com/journal/2016/12/15/understanding-logical-mechanical-and-mathematical-accounting.html

[32] Wikipedia, *The Information Age*, retrieved June 28, 2017, https://en.wikipedia.org/wiki/Information_Age

reporting semantics dialed in is the hard part. Representing those semantics in some technical format is easy as compared to creating the semantics in the first place.

Whether any specific government regulator such as the U.S. Securities and Exchange Commission makes this technology work appropriately or not is not really that relevant. The technology, if useful, will likely be adopted by millions of private companies because it increases productivity. Until it increases productivity, it will not be adopted broadly. The market would be foolish to adopt something that does not work appropriately.

But when the first software vendor does make this technology work, then the world of accountants and auditors will change dramatically.

## *1.9. Three Key Technologies Building on Medieval Traditions*

Accounting, which has existed for 7,000 years[33], even before the creation of formal number systems, is constantly evolving. Accounting is about to go through another significant phase in that evolution process. Professional accountants who adapt will thrive.

There are three specific new technologies that can be leveraged to significantly improve and modernize accounting and financial reporting. Those technologies will transition into the mainstream over the coming years. Those three technologies are[34]:

- XBRL-based structured **digital financial reporting**
- Knowledge-based systems and other application of **artificial intelligence** or **machine intelligence**[35]
- Blockchain-based or hashgraph-based **distributed global ledgers**

Single-entry bookkeeping[36] is how 'everyone' would do accounting. In fact, that is how accounting was done before double-entry bookkeeping was invented.

Double-entry bookkeeping[37] adds an additional important property to the 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. This then leads to an audit strategy. Double-entry bookkeeping is how professional accountants do accounting.

Double-entry bookkeeping was the invention of medieval merchants and was first documented by the Italian mathematician and Franciscan Friar Luca Pacioli[38]. Double-entry bookkeeping is one of the greatest discoveries of commerce and its significance is difficult to overstate. Which came first, double-entry bookkeeping or the enterprise[39]? Was it double-entry bookkeeping and what it offered that enable the large enterprise to exist; or did the large enterprise create the need for double-entry bookkeeping?

Accountants think differently than non-accountants, it is part of their training. Non-accountants tend to not realize this and accountants tend to forget or take this for granted. XBRL-based structured digital financial reports, knowledge-based systems and other such

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

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

[35] Shivon Zilis and James Cham, Harvard Business Review article, *The Competitive Landscape for Machine Intelligence*, https://hbr.org/2016/11/the-competitive-landscape-for-machine-intelligence

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

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

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

[39] 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

applications of artificial intelligence, and blockchain-based digital global ledgers will enhance the invention of the medieval merchants.

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

## *1.10. Professional Accountants are Knowledge Workers*

Knowledge workers such as professional accountants, whose jobs seem secure, are perhaps feeling threatened by technology. This threat by artificial intelligence and other technologies, perhaps, generates fear, uncertainty, doubt and maybe even dread within many different job categories. However, as long as professional accountants are willing and able to adapt to these changes, most professional accountants should be well-positioned to create more value than ever, augmented by machines that they understand how to work with and leverage.

The tremendous potential of the use of technologies to increase productivity in this Fourth Industrial Revolution to liberate resources offers tremendous opportunity to professional accountants faced with limited resources, more things being put on their plate, and expanding backlogs of work. It is highly-likely that new tasks for knowledge workers such as professional accountants will arise, many of which can only be performed by humans; making humans with the right skills even more valuable.

Managers can use these new technologies as a way to increase innovation among those they manage; encouraging their employees to create new ways to use liberated work hours to improve the services they provide to clients. The most forward-thinking managers will see these technologies as an opportunity to reimagine the nature of what and how professional accountants work, increasing the value they provide to their clients.

"I skate to where the puck is going to be, not where it has been." Wayne Gretzky, legendary Canadian hockey star. Don't skate to where the puck is. Understand where the puck will be and go there.

## *1.11. Automating "The Last Mile" of Disclosure Management*

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

Mike Willis, a PWC partner, wrote an article *Disclosure management: Streamlining the Last Mile*[40] which explains how software applications can enable a streamlining of current "last mile" manual financial report assembly and review processes. He points out that companies can increase net benefits by gaining a clear understanding of common areas where opportunities exist for financial reporting process enhancement. This is a summary of what a disclosure management system needs to do, per Willis:

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

- automated spreadsheet assembly;
- automated report assembly;

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

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

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

## *1.12. Internal Controls over Financial reporting*

In their document *Guide to Internal Control over Financial Reporting*[41], the Center for Audit Quality provides this fundamental definition of internal control over financial reporting (ICFR):

> "In simple terms, a public company's ICFR consists of the controls that are designed to provide reasonable assurance that the company's financial statements are reliable and prepared in accordance with GAAP."

Whether a report is paper-based information published for the consumption of humans or machine-readable information formatted for the consumption by automated computer based processes; processes, procedures, systems, and tools for creating XBRL-formatted digital financial reports must result in statements that are reliable and prepared in accordance with GAAP.

XBRL-formatted information is not part of an audit yet. Most people today are more comfortable with some sort of document such as the current HTML submissions of public companies to the XBRL or the Inline XBRL that combines the human-readable and machine-readable information into one document. What happens when only the XBRL-based information is used? Some reports are already only provided in the XBRL format to regulators.

It seems to me that it could be quite appropriate for auditors to include a point in their management representation letters for 10-K audit and 10-Q review engagements related to XBRL-formatted information. This is a very practical way for CPAs to educate their clients about XBRL, encourage their clients to get their XBRL right, and if nothing else it proves that auditors addressed this subject with their clients, that the clients are aware of SEC filing requirements and potential sanctions regarding XBRL (i.e. the XBRL is "filed" and is subject to SEC review and enforcement action if there are errors in the meaning conveyed via the XBRL formatted information), and the auditors have no responsibility for the XBRL as it is not (yet) part of an audit.

The fact is, if auditors had responsibility to attest over XBRL-formatted documents I don't think they could do a good job. Why? Auditors cannot be held responsible because auditors don't currently have the appropriate skills[42] to understand if financial information is correctly represented and conveys meaning intended of the information provided by the financial report. Further, tools are not currently up to the task of assisting external financial reporting managers, internal auditors, independent auditors, or other business professionals that need to be certain what meaning is being conveyed. Proof of this is errors in the

[41] Center for Audit Quality, *Guide to Internal Control Over Financial Reporting*, http://www.thecaq.org/sites/default/files/caq_icfr_042513.pdf

[42] Charles Hoffman and Rene van Egmond, *Comprehensive Introduction to Knowledge Engineering for Professional Accountants*, http://xbrlsite.azurewebsites.net/2016/Library/ComprehensiveIntroductionToKnowledgeEngineeringForProfessionalAccountants.pdf

reports of XBRL-based reports created by public companies[43]. However, information quality is slowly improving. Skills and tools will evolve over time and enable high-quality XBRL-based financial reports to be created, reviewed, and assured by independent third parties.

That said; it is still appropriate for external reporting managers to understand principles for creating zero-defect XBRL-based financial reports[44] and guidance published by authorities such as the AICPA[45] related to the creation of such reports. The current time is a great time to practice and gain the skills before the time comes when professional accountants and auditors will be held accountable.

## *1.13. Rules for Digitizing Financial Reports*

In an interview with *Wired* magazine[46], Barak Obama (yes, the ex-president of the United States discussing artificial intelligence) made the following statement about self-driving cars:

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

And so, how do you actually make digital financial reporting work? This example which relates to self-driving cars points out something important that accounting professionals need to consider when thinking about XBRL-based digital financial reports: who writes the rules?

Professional accountants have to understand that this is an engineering process. Professional accountants need to understand a few things about knowledge engineering[47]. Professional accountants need to understand how a problem solving logic[48] works and how the rules[49] and logic interact to make computers do their work. This will help them understand how to get computers to serve their needs. Second, you have to have a framework and theory[50] to think about digital financial reports. Without a framework and theory, all that you have to work with is the XBRL technical syntax. That will not work because that level of digital financial reporting is too technical and impossible for the average business professional or professional accountant to understand. That is why professional accountants need to learn a few new things and understand the framework and theory of a digital financial report.

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[43] *Public Company Quality Continues to Improve, 11 Quality Leaders*, http://xbrl.squarespace.com/journal/2017/4/2/public-company-quality-continues-to-improve-11-quality-leade.html

[44] *XBRL-based Digital Financial Reporting Principles*, http://xbrl.squarespace.com/digital-financial-reporting-pr/

[45] American Institute of Certified Public Accountants, 2017, *Principles and Criteria for XBRL-Formatted Information*, https://www.aicpa.org/InterestAreas/FRC/AccountingFinancialReporting/XBRL/DownloadableDocuments/aicpa-principles-and-criteria-for-xbrl-formatted-information.pdf

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

[47] Charles Hoffman and Rene van Egmond, *Comprehensive Introduction to Knowledge Engineering for Professional Accountants*, http://xbrlsite.azurewebsites.net/2016/Library/ComprehensiveIntroductionToKnowledgeEngineeringForProfessionalAccountants.pdf

[48] Charles Hoffman and Rene van Egmond, *Comprehensive Introduction to Problem Solving Logic*, http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part01_Chapter02.5_ComprehensiveIntroductionToProblemSolvingLogic.pdf

[49] Charles Hoffman and Rene van Egmond, *Comprehensive Introduction to Business Rules*http://xbrlsite.azurewebsites.net/2017/IntelligentDigitalFinancialReporting/Part01_Chapter02.4_ComprehensiveIntroductionToBusinessRules.pdf

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

## 1.14. Digitizing Financial Report Audit Schedules

In a paper *Data and Technology: Transforming the Financial Information Landscape*[51], the CFA Institute describes the currently inefficient system used to create financial reports and calls for a broader and deeper use of structured data to achieve greater efficiencies.

Further, the CFA Institute points out that the financial report audit process can be more effective and efficient if a standardized data model for commonly requested audit and other information were used. The CFA Institute points[52] to the American Institute of Certified Public Accountants (AICPA) *Audit Data Standards*[53] as a set of such standard audit schedules.

## 1.15. Broader Trend of Digital Business Reporting

A financial report is a type of business report. Digital financial reporting is part of a much broader trend which is digital business reporting. A digital business report is basically the electronic spreadsheet[54] reimagined. Add to this the technology offered by digital distributed ledgers[55]. Some people use the term triple-entry accounting[56].

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

We are in the midst of the fourth industrial revolution[57]. Here is a list of the four industrial revolutions which will help you understand where we are today:

1. Mechanization, water power, steam power.
2. Mass production, assembly line, electricity.
3. Computer and automation.
4. Cyber physical systems.

In their paper *Imagineering Audit 4.0*[58], Jun Dai and Miklos Vasarhelyi of Rutgers University provide a comprehensive and complete description of how industry will work in the future and therefore why a knowledge media such as XBRL is a critical required part of the information infrastructure for turning their vision into a reality.

Dai and Vasarhelyi describe Industry 4.0 as follows:

> "Originating in Europe and spreading to the US, Industry 4.0 emphasizes six major principles in its design and implementation: interoperability, virtualization, decentralization, real-time capability, service orientation, and modularity. The objective of Industry 4.0 is to increase the flexibility of existing value chains by

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

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

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

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

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

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

[57] Forbes, *Why Everyone Must Get Ready For The 4th Industrial Revolution*, Bernard Marr, https://www.forbes.com/sites/bernardmarr/2016/04/05/why-everyone-must-get-ready-for-4th-industrial-revolution/#64bd6673f90b

[58] Jun Dai and Miklos A. Vasarhelyi, *Imagineering Audit 4.0*. Journal of Emerging Technologies in Accounting: Spring 2016, Vol. 13, No. 1, pp. 1-15, http://aaajournals.org/doi/abs/10.2308/jeta-10494?code=aaan-site

> maximizing the transparency of inbound and outbound logistics, manufacturing, marketing, and all other business functions such as accounting, legislation, human resource, etc."

Basically, what Industry 4.0 means is that technologies will be used to dramatically improve the efficiency and effectiveness of businesses and other organizations. What does this mean? Some say[59] that it means 47% of jobs in the United States are at risk from automation.

No one knows exactly what this fourth industrial revolution will mean, but based on the other three I think the fourth will turn out just fine if you make sure your skill set is up-to-date. Information barbarians will likely not fare well. It is far better to understand digital.

But let's get back to XBRL's role in Industry 4.0. On page 16 of the paper, in the section titles "Standardization of information and data", Dai and Vasarhelyi point out the important role standards play in this new world:

> "To facilitate information exchange and analysis in Audit 4.0, regulators and standardization agencies should create suitable standards that define the formats and naming rules of commonly used data."

On page 14, the role of pre-determined business rules is pointed out:

> "In addition, business processes will be monitored against pre-determined rules to detect violations of key controls, and cross-verified via certain continuity equations."

Business rules prevent anarchy[60]. For increased efficiency and effectiveness in business processes to be realized, business information exchange will need to work correctly. For meaningful machine-based information exchange to work, you need pre-determined rules relating to technical syntax, domain semantics, and workflow. It really is that straight forward.

Further, while it might not seem to be the case because of quality issues; XBRL-based reporting by public companies to the SEC helps accountants and others figure out how to use these sorts of technologies. It is actually rather amazing that about 7,000 different companies can represent rather complex financial information and communicate that information to the SEC and get 98.96% of that information right. On average, 84.7% of companies get all of the measured information right, and a set of 8 software vendors manage to get 97% of more of their reports correct as measured by the checks that I perform.

But 98.96% is not good enough. What is good enough? Six sigma is one target manufacturing has used, that is 99.99966% of everything being correct. Is that good enough for information-based processes? Well, it is a good minimum target to shoot for currently.

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

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[59] The Guardian, Larry Elliott, *Fourth Industrial Revolution brings promise and peril for humanity*, https://www.theguardian.com/business/economics-blog/2016/jan/24/4th-industrial-revolution-brings-promise-and-peril-for-humanity-technology-davos

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

## 1.16. Framework for Understanding Digital Financial Report Mechanics

A framework is a set of principles, assumptions, ideas, concepts, values, rules, laws, agreements, and practices that establishes the way something operates. A theory is a tool for understanding, explaining, and making predictions about a system. What is conspicuously missing from the minds of most professional accountants and auditors are a framework and a theory relating to how to think about digital financial reports. The *Financial Report Semantics and Dynamics Theory*[61] is what Rene van Egmond and I created to provide this framework.

## 1.17. Vision of an XBRL-based Digital Financial Report Creation Tool

Today, I cannot show you a commercial product that works the way I imagine an expert system for creating financial reports would work. I can show you a working prototype of commercial software that proves the concept will work. But the working prototype that I helped to create is not a fully functioning tool, yet.

But I can articulate a vision and contrast how CAD/CAM and BIM software works[62]. From that, if you have an imagination you can understand the vision.

If I did had a tool for creating zero defect (sigma level 6 quality) US GAAP and/or IFRS general purpose financial reports leveraging intelligent XBRL-based structured information and I could create those reports faster than you can create financial reports today, incurring less costs than you incur today, and with a higher quality level than the financial reports that you create today; then would you buy that tool?

No magic involved; rather skillful execution, attention to detail, quality of a master craftsmen, and engineering excellence. Here is a description of the tool:

> Purpose-build for disclosure management and financial report creation, intelligent XBRL-based digital financial reporting products collect information about financial report creation projects and allow this information to be coordinated across all other representations of the project, so that every statement, policy, and disclosure is based on internally consistent and complete information from the same underling financial information database. Risk of noncompliance is minimized. Cost of compliance is minimized. Effort to comply is minimized.

Soon, I will be able to show you a tool.

## 1.18. Getting a Fundamental Understanding of How XBRL Works

The six minute video *How XBRL Works*[63] is useful to professional accountants trying to get a fundamental understanding of XBRL-based structured financial reports. Use the link in the footnote below or Google "How XBRL Works" to find this video.

## 1.19. Fundamental Additional Training Every Professional Accountant Needs

Professional accountants need to learn to think digitally. The training professional accountants get in college and early in their career needs to be supplemented slightly to

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

[62] *Intelligent XBRL-based digital financial reporting*, http://xbrl.squarespace.com/journal/2017/1/1/intelligent-xbrl-based-digital-financial-reports.html

[63] YouTube, *How XBRL Works*, retrieved July 1, 2017, https://www.youtube.com/watch?v=nATJBPOiTxM

help them understand how to do accounting and auditing in the digital age. This training is not technical.

The document ***Closing the Skills Gap: specifics as to what professional accountants need to learn to survive and thrive in the digital age of accounting, reporting, and auditing***[64] provides a concise summary of what professional accountants need to learn in about 42 pages.

As best as I can determine, the following is a summary of the additional training that is necessary. The following material is the best draft that I currently have. This information will be better synthesized, organized, and articulated in future versions; however, these are the best versions that I am currently aware of:

- **Accounting and Auditing in the Digital Age**: About 14 pages which provides additional details related to the big picture of how accounting and auditing will change over the next 10 years and why.
- **Conceptual Overview of an XBRL-based, Structured, Digital Financial Report**: About a 25 page conceptual overview of what an XBRL-based digital financial report is.
- **Digital Financial Reporting General Principles**: About 6 pages that synthesize important principles and provides a framework for thinking about XBRL-based digital financial reports and how to make them work correctly.
- **Introduction to Knowledge Engineering for Professional Accountants**: A 49 page introduction to important basic ideas related to representing knowledge in machine-readable form.
- **Comprehensive Introduction to Business Rules**: A 28 page introduction to the important role business rules play in making XBRL-based digital financial reports work correctly.
- **Comprehensive Introduction to Problem Solving Logic**: A 28 page introduction to the important notion of problem solving logic.
- **Comprehensive Introduction to Expert Systems**: A 17 page introduction to expert systems or knowledge based systems; what they are, how they work, what their capabilities are, etc.
- **Comprehensive Introduction to Intelligent Software Agents**: A 20 page introduction to intelligent software agents which use business rules and problem solving logic to perform work for professional accountants.

In the approximately 187 pages above, you will get a solid grounding in the information that you need to think about XBRL-based structured digital financial reporting correctly. Remember, this is a paradigm shift, not an incremental change. I can probably reduce the page count by 20%, about 20 pages, due to redundancy.

[64] *Closing the Skills Gap: specifics as to what professional accountants need to learn to survive and thrive in the digital age of accounting, reporting, and auditing,* http://xbrlsite.azurewebsites.net/2018/Library/ClosingTheSkillsGap.pdf