

Introduction: Staying Ahead of the Emergent Risk

THE AI TECHNOLOGICAL REVOLUTION is sweeping through the globe. Audit is no exception. The world of audit is about to change. With not just *automation*, but *intelligent automation*, the future of traditional, mostly manual, audit is being redesigned. IAA, or intelligent audit automation, is the next generation of audit services that encapsulates new audit business models, new audit professionals, new types of tools and techniques, new standards, and new ways of looking at knowledge creation. Welcome to the bold and new world of intelligent automation.

As your guide on this journey, my goal will be to first introduce to you the era of intelligent automation. It is important for you to recognize that intelligent automation is not just a phase or a temporary detour or even the next step in the evolution of the digital technology. It is an era of its own. Together we will walk through this amazing entrance that will lead us into a completely new age for humankind. The era of nonhuman intelligent workforce. Once past that point, we will then pick up some tools of the trade so we can develop a perspective about the nuts and bolts needed to function in these revolutionary times. These nuts and bolts – essentially our toolkits – will help us proceed to the next level of audit automation. The toolkits are general, so even if you are not an auditor

trying to learn about how to automate audit, they will come in handy. Equipped with the toolkits, we will enter the realm of total audit automation.

As I walk you through this amazingly new and exciting world, I recognize that you are a businessperson who wants to learn about Intelligent Audit Automation. That is why my goal will not be to turn you into a data science expert or a machine learning guru, but instead to turn you into a visionary practitioner who can lead, guide, develop, and manage organizational transformations that can take a firm from today's AIS (accounting information systems) – centric capabilities to a totally and comprehensively automated audit organization. My goal is to equip you with the knowledge that will allow you to lead a legacy audit firm or audit department and turn it into one of the world's most advanced and automated firms. I do recognize that you may feel awkward or uncomfortable with the words "total automation of the audit organization" – mostly because that statement somehow comes with a billboard that says: "Humans not needed." That is not the case. If anything, as you will see in this book, there will be tremendous need for humans – but it will be in a little different capacity than we are used to. Do not worry, as we will address those issues also.

What IAA will do is not to eliminate human work, but instead eliminate human weaknesses that make human work prone to mistakes, errors, biases, and misconduct. It will create a more perfect human work product.

Like you, I am also concerned about the audit profession. If we take an inventory of where we stand, it is highly troubling. With rising criticism, scandals, audit failures, and growing anxiety among both practitioners and clients, the profession's future seems uncertain. When combined with slow-moving nepotistic knowledge creation, declining audit quality, and lack of innovation, we are confronted with the loss of the profession's credibility. No wonder regulators and governments are losing their patience. All these unfavorable conditions have placed the profession in disarray.

As we think about upgrading and improving the profession, we know that it will require a two-pronged approach that will include improving audit quality while reducing the cost of audit. IAA is the natural answer to accomplish that goal. Whether we want to eliminate the problems and challenges of audit, or we want to automate the audit process, our gateway to the future of audit is artificial intelligence (AI). This book is all you will need to develop a comprehensive understanding and strategy of audit automation with AI.



KILLER ROBOTS AND AUDIT

Pick up any general article on artificial intelligence and it likely begins with some anxiety-inducing sentence like “The mention of the words artificial intelligence brings to mind images of killer robots and autonomous drones flying over our heads” – and the next sentence is usually designed to reduce our anxiety and is something like “Don’t worry, even though AI is here, there is nothing killer about it.”

Unlike other authors who, at this point, will tell you to relax, and declare that all those sci-fi scenarios are the works of Hollywood’s imagination, I will tell you the opposite. I will inform you that it is true that both killer robots and autonomous drones are now part of our world. In fact, even though many people will state that the technology is “not there yet,” I will say the reverse. Looking at how rapidly the technology has developed in AI, nothing seems impossible or too far-fetched at this point. This applies to killer robots, and it applies to the field of audit. We can hope that the human civilization will use AI responsibly and not for destructive purposes. One of those extremely responsible and valuable uses of AI is in audit.

Audit is the foundation over which the entire global economy rests. Breaches or cracks in the foundation can easily crash the global economy. Therefore, it is incumbent upon us to protect the global economy by improving the audit quality and doing so with the best technology available to us.

If you are a businessperson, a professional auditor, internal auditor, or member of a finance organization, you will naturally want to learn about artificial intelligence. When you start exploring, it is likely that you will not get your answers from the IT department, or from general books on IT technologies, or from the highly confusing articles on machine learning and AI. It feels like you need a PhD in mathematics to read even a simple article on machine learning. I teach executives like you, and I know the problems they encounter when trying to understand AI.

The overwhelming complexity, when combined with its novelty, makes the field unapproachable. And that is where many businesspeople lose interest or stop caring about the great opportunities that await those who dare to pursue. But in this book things will be different. I will guide you through the complexities of the AI field in a manner that any businessperson will be able to follow the most relevant and important areas of the field. I want to equip you with only those things that will impact your audit transformation and save you from details that are unnecessary for a businessperson to know. If you find that some

parts of the artificial intelligence field interest you more than others, you can then pursue other avenues to learn more or get trained in those areas.

Despite its business orientation, this book is not a pie-in-the-sky, wishful, futuristic, motivational book about artificial intelligence. Those feel-good types of books fail to acknowledge on-the-ground constraints and realities of technology. They also don't serve the needs of the practitioners who want applied knowledge and who want to learn things they can apply right away in their business. I wanted to give you a toolkit that you can deploy the next day in your business.

You are also not seeking a textbook or a book that feels like a furniture assembly manual. Those narrated manuals of the deployed capabilities dwell in the land of suffocating and hopeless pragmatism, and they often inhibit innovation.

This book presents a comprehensive and systematic approach to audit automation with artificial intelligence. In many cases I use existing, applied, and documented knowledge, but in other cases I give a bold but practical vision of the possible.

A pragmatic *vision* is always challenging. It lays out the path, it shows the destination, and it clarifies the roadmap. But to achieve the destination one must move, struggle, and strive. This book will be your guide to practical intelligent automation in audit. It is highly unlikely that any company in the world will today have all that is included in this book. But it is highly likely that companies around the world will be experimenting with parts of what is covered in the book.

Most new technologies and innovations are adopted without considering their own future evolutionary paths, much less how they will evolve and transform business. In such scenarios, companies adopt technology as if their business models are independent of technology, and as if technology is merely an enabler of their business models. In today's world this thinking can be detrimental. It constrains vision and the ability to grasp the full potential of technology. For example, almost every retailer in America adopted technology and rode the "digital" hype wave, but many major retailers (Macy's, Nordstrom, Sears, and others) could not compete with Amazon. For Amazon, technology was not an enabler; it was the primary business model. For others it was an enabler to their business strategy and model but not the core strategy itself.

One can argue that the reason the traditional retailers are struggling is because their business models are brick-and-mortar based. The response to that misunderstanding is that one should look at Walmart. Walmart can be considered as a company from the old brick-and-mortar times, but the firm

always built itself around technology. Technology was not just an enabler to the strategy; it was at the core of the Walmart's business strategy – and Walmart is competing effectively. Thus, “brick-and-mortar” has nothing to do with being properly automated or digital; it is the strategic orientation and mindset that distinguish companies from being modern or outdated. That is another reason why bringing in the world's top consulting firms will not help you to become automated. As we will learn in this book, it will greatly depend upon your own leadership, people, strategy, and vision that will determine if you will thrive or barely survive in the new era. The winners build their entire companies around AI.

Similarly, when we think about audit, we need to pay attention to building the entire audit function and service around technology. In that regard, we need to part with the twentieth-century mindset that technology enables audit and adopt the modern outlook of building the audit function around artificial intelligence. This book shows how to do that.

BUILDING THE AUDIT FUNCTION AROUND AI

The world of audit is complex, broad, regulated, highly procedural, and standards-driven. Given that each audit situation can be unique, and that the business world is always evolving, it is natural for auditors to consider technology as an enabler. Traditionally, the audit technology has focused on audit management automation and not on intelligent audit automation. When we change the goal from enablement to building a company around AI, we need to understand what it means for the audit service delivery mechanism and how that will change the business model of audit firms.

In general, we know that the modern business is a fast-changing system. As AI enters the business world and becomes more pervasive, it is bound to impact audit in multiple ways. Regardless of the industry, intelligent automation is not only automating processes; it is also enabling companies and government agencies to become more intelligent and innovative. For example, the pharmaceutical industry is not only automating its core business processes with artificial intelligence but also implementing AI to discover new molecules. This means that “automation + intelligence” becomes the new competitive advantage.

With intelligent automation as the new competitive advantage, the adoption of intelligent technologies becomes a natural *survive and thrive* mechanism and, hence, will lead to rapid adoption of the AI technologies across the board.

As the example of the retail industry in the previous section shows, just because we are automating doesn't mean we are realizing full business value or establishing competitive advantage. Our business models and designs need to reflect the winning models and strategies. That comes by gaining a more thorough and holistic understanding of our environment.

Additionally, the accelerated introduction of the AI technologies in the business universe will have major ramifications for audit:

- It will introduce new types of emergent risks for which audit firms are not prepared.
- It will force audit firms to rethink their service delivery systems.
- It will require audit firms to stay a step ahead of the emergent risk versus always playing catchup.

Audit firms will have to become proactive innovators such that they can *always stay ahead of the emergent risk*.

STAYING AHEAD OF THE EMERGENT RISK

As we enter the AI era, let us establish some ground rules for the audit profession. One of these reminders is borrowed from the field of cybernetic systems. It is known as The First Law of Cybernetics and is derived from William Ross Ashby's Law of Requisite Variety. The law in its crude form (mostly due to my interpretation and use here) implies that the degree of control of a system is directly proportional to the information available about the system.

In order to monitor a system, particularly if we are approaching audit as a comprehensive verification, control, and monitoring system, we need to have control and feedback systems that are more intelligent than the system they are trying to monitor. Ashby presents the idea of requisite variety (Ashby, 1958). In this case he uses the word "variety" to signify diversity of information. To control a system, we need information about the system that is equal to or greater than the information available in the system. Again, in an analogous, but useful, manner we will interpret this law for audit as demanding that the information and intelligence of the entity responsible for auditing an organization should be at least as much as the entity being audited.

This is one area where audit has struggled. Audit has always played catchup. Audit has always been in a reactive mode and not a proactive mode. Scandal after scandal, and failure after failure, audit has functioned as a

follower and never a leader of best practices. Being proactive means that audit must stay ahead of the emergent risk.

To appreciate the concept of staying ahead of the emergent risk versus chasing it, we can make the preliminary assumption that the audit function will innovate with the general speed of innovation in business. Since audit is also a business, any innovation that happens in general in the business world will sooner or later be adopted by the audit profession. Audit innovation will not happen in a vacuum. Along with many other areas of business, the entire accounting function is also getting automated and that means the impact of business and accounting automation will require a parallel innovation path in audit. Let us give this type of adoption a name: General Adoption. General Adoption of technology happens when firms adopt technology at the average pace and rate at which the business world adopts technology.

As shown in Figure 1.1, if clients are adopting intelligent automation, audit firms will also adopt intelligent automation for their core processes and would focus on the automation of the existing workflows, processes, and methods.

But for a profession that brings accountability and transparency to other systems, it must have greater intelligence horsepower than the entities it is analyzing. After all, the introduction of intelligent automation in the business universe will not only increase business complexity, but also give rise to new types of risks. The audit literature seems to be obsessed with Enron and Enron-type disasters but ignores the more systemic and catastrophic shocks to the global economy.

Take the example of the Great Recession of 2007–2009. The rapid introduction of an interlinked global economy enabled the financial (and business) world to introduce complex financial products, and package and sell risk in creative ways. That created a complex system with high systemic risk, which

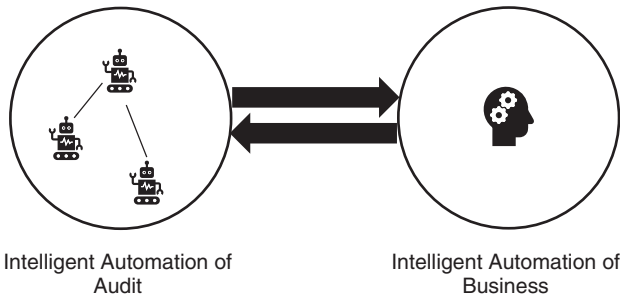


FIGURE 1.1 Bidirectional Impact

exhibited domino-effect collapse characteristics and emergent dynamics. When an adverse event happened, the intensity and power unleashed was so enormous that the entire global economy collapsed. The shock was alarming, but not as much as the fact that the whole world – including the Federal Reserve bank – was in a state of complete obliviousness and denial. That catastrophic event was also a failure of audit at a consolidated level. Clearly, risk outpaced the ability of the audit firms to comprehend it. The Great Recession was a testament to the fact that the public audit profession must have greater intelligence horsepower than the entities it audits. Since the ability of the audit profession to stay ahead of the risk is paramount to its efficacy, to be truly effective audit firms need to have more advanced innovation and technology than their clients.

Since the AI revolution's impact are widespread and global, the audit response to the challenge posed by AI-related innovations needs to be proactive and comprehensive. Let us consider some examples of when AI has negatively impacted the economy or institutions:

- Gone are the days when humans made trading decisions, as the majority of trading these days is algorithmic trading. We have observed flash crashes in financial markets, where markets lose significant value within minutes. Some studies have attributed the increase in systemic risk and flash crashes to the rise of algorithmic trading and have shown the value of ex ante regulatory intervention as more beneficial (Paulin et al., 2019). Consider the question from an audit perspective: how to value assets when in the new world the market collapse can happen so suddenly?
- We observed the intervention of foreign bots in US elections in 2016. Similar approaches have been applied to destabilize products and services by companies. This implies that a type of engineered risk can take shape that can suddenly impact the value of a business. Should auditors account for that risk?
- The modern business is now composed of both human and digital workers. A system driven by the interaction between millions of digital and thousands of human workers can exhibit emergent forms of risks. For instance, some researchers attribute the Boeing 737 crash to AI (Pasztor and Tangel, 2019). Can a similar catastrophic failure risk arise in a business?

This brings us to the next level of intelligent automation that will be needed from audit firms. Let us give this a name and call it Superior Adoption.

Superior Adoption implies that given the nature of the business, some businesses must adopt technology at a higher pace and rate (and capability level) than other businesses (or adversaries). One example of this mindset is seen in national security adoption of technology. At all times, the national security technology capability, pace, and rate should be greater than the adversaries or catastrophic scenarios can unfold. This mission-critical approach implies that the system that is designed to monitor other systems must display a higher level of intelligence than those it is monitoring. Applying that to the audit profession, innovation will need to be far more robust and much stronger than it has been in the past.

As the rise of AI changes business, that change will demand increasingly greater change from the audit profession. This means that if the audit function wants to stay effective and relevant, its innovation needs to be constant, powerful, and impactful. Audit can no longer be the lagging profession that is playing catch-up to clients. It will have to adopt the proactive mission-critical mindset to innovation.

Despite the need to be at the forefront of modernization, we observe that innovation in audit has been sporadic, disconnected, and rudimentary. We observe that while large audit firms have made announcements that they are investing in audit automation, we have not seen any major strategies, designs, or implementations to show that. Except for press releases and cheap marketing videos, the real automation is rare and, when it does happen, it is focused on audit management automation and not audit automation. We observe the hype but nothing truly concrete behind the glamour.

In fact, if anything, we have observed a decline in audit quality, increasing audit failure rates, and more problems. The rate of innovation is once again exceeding the ability of the audit firms to adapt. It is only a matter of time before another major economic disaster happens.



THE MUCH-NEEDED EVOLUTION OF THE AUDIT FIRM

Based upon the great transformation taking place in the economy, both the core structure of the audit firm and the business model will change. The new mission for the audit firm is to perform intelligent automation-led quality audits efficiently. Technically, it is possible to have a totally automated audit firm with zero employees. Obviously, from a pragmatic perspective, we don't expect that to happen anytime soon; however, structural changes in the audit service delivery model are inevitable. As the AI revolution moves forward, traditional audit

firms will get a wide spectrum of opportunities to add greater value to their clients. Some of those opportunities are as follows:

- **Technology Provider:** Audittech firms will have the opportunity to develop, design, and install AI agents to help clients achieve better internal control and improve greater visibility to increase the understanding of inherent risks. These systems will be put in place for the internal use of the client firm and not for external use.
- **Audit as a Service:** Audit firms can now deploy AI agents that perform continuous audit and track new developments in a client's business. These agents will be visible to the audit firm.
- **Audit the Auditor:** Audit firms will acquire much better understanding of their audit teams and match the right people with clients.
- **Audit the Agents:** As agents become more pervasive, governance of audit agents will become an important issue. Audit firms will need the ability to audit the agents used by the clients.
- **Assess the Maturity:** Audit firms will be able to help clients determine their maturity in terms of being able to audit their intelligent and non-intelligent digital workforce.
- **Niche Players:** We will observe a sharp rise of audit-tech firms focused on niche areas of audit and these firms will sell their services to other audit firms.

THE CLAUSTROPHOBIC MINI UNIVERSE OF AUDIT

Besides the audit firms, the audit universe includes professional societies (like AICPA), standards organizations (like FASB), regulators (e.g., PCAOB), academics, and tech firms.

The traditional relationship structure between the large audit firms, academics, and professional societies has been somewhat strange. The symbiotic nature of the relationship, which often focused upon maximizing each entity's profitability, constrained true innovation and development. It also reduced transparency and accountability. Thus, we observed a closed network, akin to a private club, of insiders that includes professional societies in tight configurations with large legacy audit firms, a small number of audit technology suppliers, and a concentrated group of scholars from a few universities. This nepotistic relationship map correlates with the ongoing decline in audit quality and innovation.

In the old model, professional societies functioned as the mouthpieces and extended marketing arms of large firms. The large audit firms had tremendous power over the entire industry and dissent was quickly reprimanded. In some ways, professional societies were indirectly run by large firms.

The emergence of the Public Company Accounting Oversight Board (PCAOB) challenged that symbiotic structure and has exposed many vulnerabilities in the system. In the new world, independence and transparency are being considered as important virtues.

Among other things, the AI revolution will also expose such nepotistic relationships and open the profession to be far more accommodating to external parties. We can also expect a large number of automation firms entering the profession, as we will observe a huge surge in audit-tech.

THE PROBLEMS WITH TODAY'S APPROACH

While plentiful, the research in audit automation seems both directionless and sporadic. It is concentrated in the hands of a few researchers. While some attempts have been made to bring a broader perspective together, such efforts lack strategic orientation or a synthesized modular structure that forms an intelligent automation audit platform. Despite its concentration, the research has produced some powerful and revolutionary ideas – many of which are discussed in this book. There are 10 fundamental problems why a comprehensive and clear strategic approach to automated audit has not materialized:

1. The application of intelligent automation in audit, for the most part, has been done in response to specific use cases and not as a strategic enterprise adoption. When projects are implemented as specific use cases, they are often done in silos, launched on an experimentation basis, and designed without consideration for scalability and the evolution of technology.
2. Research, and appropriately so, developed in various small areas of audit. All of that research has moved the field forward; however, there is a need to bring the entire research together to formulate an enterprise-based intelligent automation audit concept.
3. The audit technology has evolved from multiple directions. Besides the standard IT systems, expert systems were used in audit. Later, process mining and RPA technologies were used. Simultaneously, the research also developed in machine learning. There is a need to tie together a technology vision that encapsulates the combined functioning of these technologies.

4. Intelligent automation is relatively new. Some of the new approaches in artificial intelligence, especially in the areas of machine learning, are recent. These approaches have not been fully integrated in the design and engineering of audit systems.
5. While due to the rise of AI, there has been significant investment in the finance technology sector, the broad fintech sector has focused more on market-centric technologies (e.g., investment and portfolio management) and not on audit.
6. The arrival of intelligent automation is the launch of a new era in computing. Even though this change is real, it creates a hype wave. When the hype wave takes effect, vendors tend to create significant confusion by repositioning their existing solutions to appear as part of the new revolution. Sometimes they achieve that by adding one or two simple features in their products, at other times not even that. This creates confusion, as it inhibits the real innovation in the market from being showcased.
7. Audit firms are making announcements about audit automation, displaying vision videos and conceptual plans – but having all that is one thing, and having a working product and a service another. No firm is offering a fully automated audit and even those that are claiming that they do automated audit seem to be at an early conceptual stage.
8. Data-centric technical platforms are not like digital technologies. They are not deterministic, and their design and engineering require a different approach. In certain cases, it is not easy to know if the system will achieve its goals or not. Unlike programming-based IT systems where you know that if the code is written the system will work, in machine learning there is no guarantee. This means we cannot have intelligent systems that are akin to the configurable IT systems (e.g., CRM, ERP) that we are used to. A lot depends on the data we have to help machines learn.
9. Unlike in regular software development and deployment where we can get away with a team of narrow skillsets, in intelligent automation we need people with many skills. A typical team may include people with business experience, data science, cognitive architecture, process mining, RPA, IT, cognitive science, governance, etc. Knowing how to assemble and deploy that team is critical.
10. Systemic and disciplined development for cognitive skills requires organizational and leadership commitment. The audit profession seems to be in the short-term mindset where leadership is more concerned about extinguishing fires than thinking about how to figure that fires don't happen in the first place.



ENABLING NEW THINKING IN AUDIT

Time has come to end the age of stymied innovation and launch a new era in audit. This is the era of end-to-end intelligent automation of the audit function. To understand how to make that happen, we will need to start by first understanding our own behaviors and mindsets about audit. For this discussion, we are approaching business as a system and audit as a feedback and control mechanism for business. There are five concepts we need to be aware of:

1. **Bounded Rationality:** We approach systems from a rational angle and try to understand specific actions and their consequences without the backdrop of human behavior. As Herbert Simon pointed out in his concept of bounded rationality, our decision-making capacity is limited by the information we have, our processing capacity, and time (Simon, 2000). We need to be aware of these three constraints in audits. How can machines help improve one or more of these three constraints?
2. **Behavior Matters:** Audit is more than just a numerical exercise or marking the checklist or filling out questionnaires. Well-trained auditors understand the importance of behavior analysis. For example, professional skepticism is a behavioral attribute. When combined with numerical audit, behavioral audit can do wonders in helping improve the audit quality. Recognizing and understanding behavioral patterns is key to a successful audit. In what areas can machines help us develop better behavioral analysis capabilities?
3. **Nonlinear Relationships:** We often approach audit with the mindset that we are looking at a linear system with a causal chain of interdependencies. For instance, we may think of a business as a chain of capabilities and processes. The modern reality is that business has become far more complex and is based upon a network of relationships. This nonlinear system has inherent complexities that cannot be ignored in audit. Viewing it from a Newtonian cause-and-effect manner can be counterproductive. We must approach it as complex adaptive system and learn how to adapt to the system's changes. Can machines help us understand the changes and the required adaptations?
4. **Our Sense of Control:** We tend to view the world of the auditee as composed of negative feedback loops. In negative feedback loops, the feedback received by the system is expected to reduce the fluctuations in the output. It promotes the system to move toward equilibrium. We operate

with a belief that the system is self-adjusting, and the feedback loop (e.g., financial statements) we deploy in companies will help the system become more stable. The opposite to that is the positive feedback loop, where feedback leads to greater instability. In many cases, the way we provide feedback tends to act as a positive feedback loop and instead of making the system more stable, it brings greater instability. For instance, providing indirect or casual feedback to a client about the suspicion of fraud may encourage the auditee to do even more coverup. Can machines help us deploy negative feedback loops such that the system (auditee's business) stays stable?

5. **Our Sense of Time:** An audit needs to perform at the speed of decision-making in enterprises. Slow and unactionable information is useless in today's world. Business needs dynamic and instantaneous intelligence to thwart and manage risks. This means we need to track the mapping between the business goals and the environment and be aware of the changes taking in both. Can machines help us perform at the speed of decisions?

As we start viewing our world and responsibilities differently, we can recognize the role played by machines in helping us improve the quality of audit.

REINVENTING THE LEGACY FIRM

The American Institute of Artificial Intelligence (AIAI) has developed the most comprehensive standards for intelligent automation in audit. In this book, I will cover the standards and design/engineering concepts offered by AIAI.

To understand the AIAI intelligent automation model, it is important to first comprehend the essential properties of the Intelligent Audit Automation (IAA).

- **Interconnected Automation:** Interconnected automation implies that IAA is not a collection of independent and disconnected parts of automation. Instead, IAA is a collection of interdependent and connected agents that work in unison to achieve the audit goals.
- **End-to-End Audit Automation:** This property implies that when the parts are put together, they address all areas of audit and nothing is left unautomated. The system is designed to be a fully automated system without any human intervention in the process and its footprint is exhaustive in the sense that it automates the entire audit process.

- **Scalable:** Scalability in this regard is more than simply the ability to scale at an enterprise level; it also implies that the technology can be grown or evolved without significant changes, rework, or replacement. As such, scalability possesses two goals: (a) the ability to scale at the enterprise level; and (b) to do so without major investment, rework, and throwaway.
- **Grow with Technology:** This property is different than the previous property as it refers to the ability to add known and upcoming forms of technology to the existing technology base without major rework or value loss. In other words, the base technology design is done in a manner that it can easily adapt to the new innovations in technology.
- **Grow with Data:** This property refers to: (a) the ability to process both structured (e.g., transactional data) and unstructured (e.g., voice, video, etc.) data; and (b) the ability to change and grow the intelligent agents as the underlying data changes. The change in the underlying problem/solution could be that new data is discovered, which may provide further explanation to the existing solution via introducing new variables. For example, new features are discovered that can have a meaningful impact on the solution. New data can also imply that the underlying distributions – based upon which the entire system was developed – have changed. As underlying data changes, the ability to grow the intelligent system without rebuilding the whole thing is a core property for design and engineering of intelligent systems.
- **Multidimensional Modular:** The system is designed to be modular and multidimensional. Modular is based upon the plug-n-play concept. It is an acknowledgment that if technology or data changes to a point where major rework is needed, it can be confined to changing the parts versus changing the whole.
- **Continuous:** From an audit perspective, the intelligent system must support continuous audit. Continuous audit is defined as follows: a continuous audit is a methodology that enables independent auditors to provide written assurance on a subject matter, for which an entity's management is responsible, using a series of auditor's reports issued virtually simultaneously with, or a short period of time after, the occurrence of events underlying the subject matter (CICA/AICPA, 1999). Continuous audit, according to the AIAI, is defined as follows: Continuous Audit is a system of machines and humans that constantly and effectively monitor the health of a business entity and enable preemptive intervention to preserve and protect its value.

- **Cost Efficient:** Deploying intelligent audit capabilities must result in reducing the overall cost of the audit.
- **Total Transactional Coverage:** Instead of selecting samples, IAA is designed to scan the entire transaction population.
- **Predictive:** IAA not only identifies patterns, but also predicts patterns. It enables preemptive intervention.
- **Simulative:** IAA includes the capability to simulate and create scenarios and learn from them. It can be self-critical and learn its weaknesses from playing the role of self-critic.
- **Flexible:** It also means that the system is designed to accommodate different types of work streams. Some work streams are simple and deterministic. Others deal with greater uncertainty. Thus, the system assigns the resources (think of it as matching) with the complexity of intelligence required and thereby eliminating mismatch between resources needed and the solution. In other words, IAA will not require a sophisticated machine-learning-based solution for a job that can be handled by a simple Robotic Process Automation (RPA).
- **Adaptable:** IAA should be built with the mindset that the business processes change in today's dynamic business situation and therefore the audit automation should be adaptable. This means it must be architecturally flexible.
- **Governable:** IAA must have governance frameworks to ensure that its design and performance meet the governance best practices and ethical frameworks. Simply put, IAA must be ethical. IAA should also be safe to use. Safety implies both mental and physical safety of human users. The complexity of IAA should be manageable and not rise to the point where the entire system becomes unstable.



THE UNIVERSE OF ACCOUNTING

As we approach IAA, it cannot be done in a vacuum. It must be approached from the perspective of being a discipline that is embedded within what we at the AIAI call the wheel of modern finance.

As shown in Figure 1.2, the universe of accounting automation is defined by the nine practice areas and four capability levels (shown as rings). Each of the practice areas describes a separate functional area. Just as the rings on a tree stump tell you the age of a tree, the capability rings inform you about the relative capability levels of a firm in its total state of intelligent

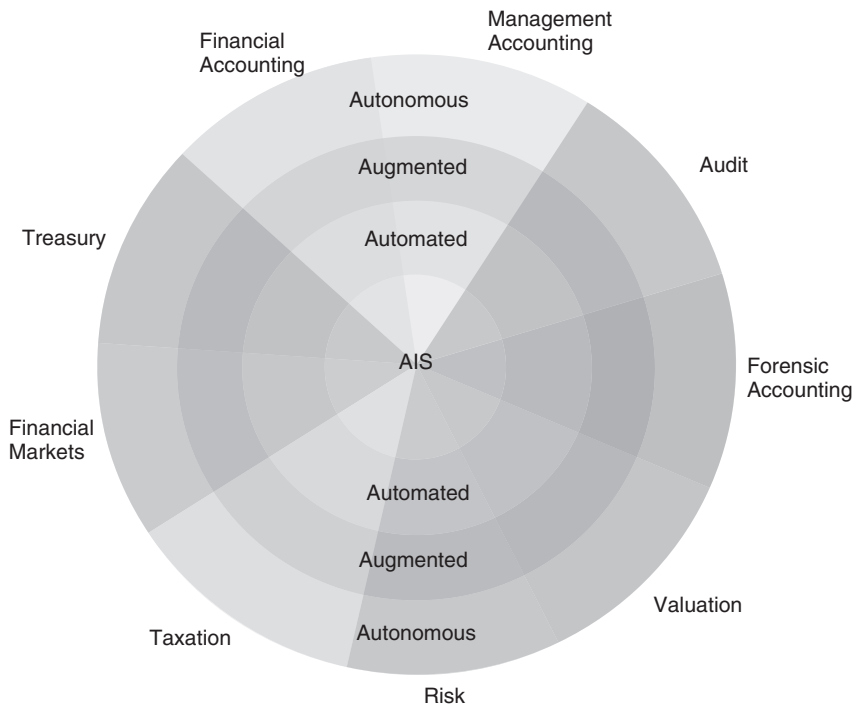


FIGURE 1.2 The Wheel of Modern Finance

finance automation. The capability levels are based upon the systematic and disciplined approach to move from the internal rings to the external bands, that is, from Transactional Automation (AIS, BA, BI), to Automation (RPA, Expert), Augmented (Machine Learning), and Autonomous (Intelligent Agents, Reinforcement Learning, Ensemble, Multiagent Systems). As intelligent automation matures, these four layers of automation will coexist in modern enterprises. This book will mostly focus on the Audit practice area. Let's look at the rings:

- **AIS:** Accounting Information Systems are systems that are used to record transactions, generate reports, and perform analysis. These systems include the typical accounting and related modules in ERP systems, the business analytics, and business intelligence systems. Most large and medium-sized companies have AIS in place. They are shown at the center because it is expected that firms will have those systems and because they are necessary to build the outer, more advanced, layers.

- **Automated:** The Automation layer is the first ring added on top of the existing AIS. This layer focuses on automating tasks that require low-level resolution of uncertainty. This is task automation where a certain work-task requiring low complexity of cognitive thinking is automated. This could be work-tasks such as matching, updating data, simple searching, or uploading files.
- **Augmented:** The Augmented layer is designed on top of the automated layer where the tasks require moderate to high complexity. These tasks can be automated but they don't result in full automation of a process. This is task automation where a certain work-task requiring complex cognitive thinking is automated. For example, automating the assessment of the culture of a firm based upon how executives communicate is augmented intelligence.
- **Autonomous:** The autonomous layer is built upon the augmented layer where the systems can independently perform entire functions or processes, with no guidance or help from humans. At this level, automated work-tasks function as a whole in an interconnected and interdependent manner and perform the entire work process autonomously. An example would be the full automation of cash audit. PricewaterhouseCoopers (PwC) has recently claimed that it now possesses the capability to perform the cash audit. The firm announced that "PwC's Cash.ai uses AI to automatically read, understand and test client documents, including reported cash balances, bank reconciliations, bank confirmation letters, foreign exchange and financial condition of the bank – in essence, the complete audit of cash" (PwC, 2019). This is an example of autonomous audit.



THE GAME PLAN

As we move through the book, I will introduce the IAA framework developed by the American Institute of Artificial Intelligence. This framework (shown in Figure 1.3) contains the following:

- Five parts of integrated audit automation
- One part of Assurance, Forensic Accounting, and Valuation Automation
- Sales and Client Management Automation
- HR, Organizational Planning and Development, and Project Management Automation
- All the capabilities that are designed to be continuous, intelligent, and automated

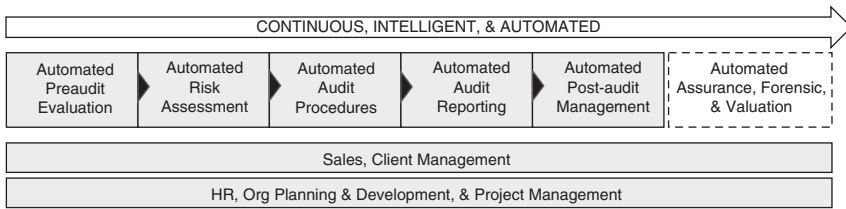


FIGURE 1.3 Intelligent Audit Automation Framework of AIAI

The book has four parts. Part One introduces business readers to the field of artificial intelligence (AI). Part Two focuses on audit features and systematically builds five areas of automated pre-audit evaluation, automated risk assessment, automated audit procedures, automated audit reporting, and automated post-audit management. Part Three focuses on automated assurance, forensic accounting, and valuation. Part Four focuses on sales and client management, organizational planning and development, and project management. It should be pointed out that organizational planning, human resources, and project management for the AI economy will be different from the regular economy.

Key Points

- Intelligent Audit Automation (IAA) is a competitive necessity for companies and audit service providers.
- IAA offers many growth- and innovation-based business opportunities for legacy firms. Legacy firms must reorganize to build their firms around AI.
- Legacy audit firms need to transition to the IAA model.
- Transitioning to IAA means automating the entire audit and making audit continuous.

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