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“Let’s Have a Chat:” Applying ChatGPT and Other Large Language Models to the Practice of Forensic Accounting

Daniel Street

Bucknell University, das051@bucknell.edu

Joseph Wilck

Bucknell University, jw063@bucknell.edu

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Recommended Citation

Street, Daniel and Wilck, Joseph. "“Let’s Have a Chat:” Applying ChatGPT and Other Large Language Models to the Practice of Forensic Accounting." (2023) : 1.

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“Let’s Have a Chat”:

**Applying ChatGPT and other large language models
to the practice of forensic accounting**

Abstract

ChatGPT has captured the popular imagination because of its conversational voice, its wide scope of ‘knowledge’, and far-ranging abilities. In this paper, we use an innovative interview method to introduce CPAs to ChatGPT, its development, and the current state of its capabilities. We then draw upon our own expertise to discuss the evolution of large language models, suggest applications of large language models (LLMs) in the field of accounting, critically evaluate LLMs’ current strengths and weaknesses, and propose five principles to effectively and safely leverage LLMs in the accounting domain.

Keywords: ChatGPT, Large Language Models, Chatbots, AI

INTRODUCTION TO CHATGPT AND OTHER LARGE LANGUAGE MODELS¹

Large language models (LLMs) are tools that use artificial intelligence to read, summarize, translate, and converse in conversational language. IBM's Watson was not an LLM by today's standards because it was primarily used to search and synthesize large quantities of data; whereas, LLMs use artificial intelligence techniques to *learn* and then *create* new conversation and other artifacts.

ChatGPT is not the first LLM, but LLMs are consistently growing faster and smarter. ChatGPT marks a new age for this technology because its creator, OpenAI, has made it available for public use. Also, notably, ChatGPT has *not* been designed to focus on a single subject area. Rather, it has been trained across many areas of knowledge, and it is able to conduct general conversation, technical conversation, computer coding, etc. This paper introduces ChatGPT to the forensic accounting profession, demonstrates its capabilities, discusses its strengths and weaknesses, and provides five principles to effectively apply LLMs to the accounting domain.

This paper consists of:

- The authors' own text (denoted by Times New Roman, a serif font).
- The authors' prompts for ChatGPT (*denoted by a bold, italic, sans serif font*)
- ChatGPT's responses (*denoted by a monospaced font*)
 - Writing mistakes that the authors identified will be denoted with: **[sic]**
 - Content errors that the authors identified will be denoted with: **[error]**

¹ "ChatGPT: Optimizing Language Models for Dialogue". OpenAI, <https://openai.com/blog/chatgpt/>.

Introduction – A Conversation with ChatGPT – January 17, 2023²

What are your capabilities?

I am a large language model trained by OpenAI, and I am capable of understanding and responding to a wide range of natural language inputs. I can answer questions, generate text, and complete tasks that involve understanding and using human language. Some examples of my capabilities include:

- Answering questions: I can understand questions and provide accurate and informative answers.
- Generating text: I can generate text in a variety of styles and formats, including creative writing, news articles, and technical documents.
- Language Translation: I can translate text from one language to another.
- Language summarization: I can summarize a given text or article into a shorter version.
- Language generation: I can generate new text based on a given prompt or context.
- Language understanding: I can understand the intent and meaning behind text, and use that understanding to respond appropriately.
- Language generation with context: I can generate text that is consistent with a given context or previous text.

² “ChatGPT”. ChatGPT Jan 9 Version. Accessed on January 17, 2023. *OpenAI*, <https://chat.openai.com/chat>.

Please let me know if you have any specific task you want me to perform.

When were you developed?

I am a part of a series of models developed by OpenAI, The development of the models started in the year 2015 and continues till now, with updates and new versions being released regularly. My knowledge cutoff is 2021, which means that I have been trained on data up to 2021, and I don't have knowledge of any events that have occurred after that.

How well suited is ChatGPT to perform tasks in the accounting domain?

ChatGPT is a general-purpose language model, so it may not be specifically optimized for the accounting domain. However, it has the capability to understand and generate text in the accounting domain, but it may not be able to perform some of the more complex tasks that require deep domain-specific knowledge or expertise.

ChatGPT may be able to perform well in tasks such as:

- Generating human-like text in the accounting domain, such as financial reports or summaries.
- Answering natural language questions related to accounting, such as "What is the difference between revenue and income?"

However, it may be less well-suited to tasks such as:

- Performing complex financial calculations or analysis
- Preparing detailed financial statements or tax returns
- Tasks [sic] that require a deep understanding of accounting regulations and standards

How can I tell whether what the responses you provide are accurate? Do you know which of your responses are more vs. less likely to be accurate?

As a language model, I have been trained on a large dataset of text from the internet, which allows me to understand and respond to a wide range of natural language inputs. However, the accuracy of my responses will depend on the quality and relevance of the data in my training set, as well as the specific task and context of the question or input.

There are several ways to assess the accuracy of my responses:

- Cross-checking: You can cross-check my responses with other sources to see if the information is consistent.
- Confirming with domain experts: If the question is related to a specific domain, you can ask domain experts to confirm the accuracy of my responses.
- Evaluating the coherence of the response: The response should be coherent and consistent with the input and make logical sense.
- Using metrics: Some tasks like language translation, question answering, and text summarization have established metrics to evaluate the performance of the model.

It's also worth noting that as a language model, I don't have the ability to evaluate the accuracy of my own responses, I can only provide an answer based on the information I was trained on.

It is important to keep in mind that there may be errors or inaccuracies in my responses. It's always a good practice to cross-check any information you get from me with other sources.

The next portion of this paper does just that – we compare the accounting experts' knowledge to the responses of ChatGPT across three financial and forensic accounting contexts to demonstrate and help accountants critically assess ChatGPT's abilities. Our work complements and extends forthcoming work by Wood et al. (2023) by providing readers with illustrative ChatGPT conversation transcripts, by focusing on the forensic accounting domain, and by providing practical principles for the application of ChatGPT in forensic accounting.³

³ Wood, D. et al. (2023). The ChatGPT Artificial Intelligence Chatbot: How Well Does It Answer Accounting Assessment Questions? *Issues in Accounting Education*, forthcoming. One of that paper's authors, Daniel Street, participated in and was inspired by the work of Wood et al. to produce this paper.

A DEMONSTRATION OF CHATGPT'S ABILITIES IN FINANCIAL ACCOUNTING – FEBRUARY 2, 2023⁴

The authors developed a set of prompts for ChatGPT to examine its abilities to produce journal entries and financial statements at an intermediate level of difficulty. ChatGPT prepared elementary journal entries and financial statements correctly, but provided incorrect journal entries and financial statements for the more complex situations.

Our first exercise was to have ChatGPT prepare journal entries of intermediate difficulty related to credit sales, revenue, deferred revenue, and cash receipts. The full transcript of this conversation is provided in Online Appendix A.

Please prepare a journal entry to record the sale of 50 bicycles at \$500 each. The customers we sold the bikes to agreed to pay us within 30 days.

Journal Entry:

Date: 02/02/2023

Debit: Accounts Receivable (Asset) \$25,000

Credit: Sales Revenue (Income) \$25,000

Explanation: The company has sold 50 bicycles at \$500 each to customers, who have agreed to pay within 30 days. This results in an increase in Accounts

⁴ "ChatGPT". ChatGPT Jan 30 Version. Accessed on January 31, 2023. *OpenAI*, <https://chat.openai.com/chat>.

Receivable as the company is owed \$25,000. Additionally, this sale also results in an increase in Sales Revenue, which represents the revenue earned by the company.

Customers have now paid the cash required for 49 of the bikes. Please prepare a journal entry to record this cash receipt.

Journal Entry:

Date: 02/02/2023

Debit: Cash (Asset) \$24,500

Credit: Accounts Receivable (Asset) \$24,500

Explanation: The company has received payment for 49 bicycles that were sold to customers. This results in a decrease in Accounts Receivable as the company is owed \$1,000 less. Additionally, this payment also results in an increase in Cash, which represents the physical currency the company has on hand.

Now, please assume we sell custom helmets for \$600. Assume a customer pays a deposit of \$300 on 2/1/23 for a custom helmet to be delivered on 4/1/23. The customer will pay their remaining balance upon receipt of the helmet. Please prepare the journal entries to be recorded on 2/1/23 and 4/1/23.

Journal Entry on 2/1/2023:

Debit: Cash (Asset) \$300

Credit: Deposits from Customers (Liability) \$300

Explanation: A customer has paid a deposit of \$300 for a custom helmet to be delivered on 4/1/23. This results in an increase in Cash, which represents the physical currency the company has on hand. Additionally, this deposit also results in an increase in Deposits from Customers, which represents the amounts owed to the company by customers for goods or services to be delivered in the future.

Journal Entry on 4/1/2023:

Debit: Sales Revenue (Income) \$300

Credit: Deposits from Customers (Liability) \$300

[error]

Debit: Cost of Goods Sold (Expense) \$450

Credit: Inventory (Asset) \$450

[error]

Explanation: On 4/1/2023, the company has delivered the custom helmet to the customer and recorded the final sale of \$600. The company first credits the Deposits from Customers for the \$300 that was previously paid. [error] This results in a decrease in Deposits from Customers [error] as the customer has now received the custom helmet. The company then debits Sales Revenue for the remaining \$300, which represents the revenue earned by the company. [error] Additionally, the company records the cost of goods sold of \$450 and a decrease in Inventory to reflect the cost of the helmet that was sold.

ChatGPT correctly prepared and explained the journal entry for 2/1/2023, but made many errors in its journal entries and explanations for 4/1/23. Its journal entry should have been:

Debit: Cash	\$300
Debit: Deposits from Customers	\$300
Credit: Sales Revenue	\$600

Instead, in its first proposed journal entry, it incorrectly debited sales revenue and credited deposits from customers. This has the opposite effect than it intended as stated in its explanation. Additionally, ChatGPT never recorded the second cash receipt. Notably, in its last journal entry, ChatGPT *made up* a cost of goods sold expense amount – no mention was ever provided about the actual gross margin of this product.

Our next exercise required ChatGPT to prepare a balance sheet and statement of comprehensive income based on an adjusted, pre-closing trial balance. Most of the trial balance

items were at an elementary level of difficulty, but we did intentionally include an unrealized gain on available for sale debt securities which should be classified as part of other comprehensive income. We chose to include this OCI item to evaluate ChatGPT's abilities to recognize a key detail which should affect the structure of the financial statements (i.e., adding other comprehensive income after net income on the statement of comprehensive income, and adding accumulated other comprehensive income to the balance sheet).

The full adjusted trial balance provided to ChatGPT is shown in Online Appendix A. We input this and all following tabular data into ChatGPT in a delimited fashion. That is, each cell's content was separated from the content of the next cell with the following characters: “|”, that is, (space)(pipe)(space).

I've received the adjusted following trial balance for FICTITIOUS INC as of and for the year ended December 31, 2022. Please prepare a continuous statement of comprehensive income and a post-closing balance sheet based on this information.

ChatGPT prepared an income statement which was correct with the exception of the following errors.⁵ First, although we provided the company's name and specified the period for the results, the continuous statement of comprehensive income did not feature the company's name, nor its period of results in header lines. Second, the statement provided ended at net income, and did not include the other comprehensive income item or total comprehensive

⁵ ChatGPT's response to this prompt is available in Online Appendix A. We summarize it here for brevity.

income. That is, ChatGPT provided an *income statement* rather than a *continuous statement of comprehensive income*.

ChatGPT also prepared a balance sheet, but it contained several severe errors. First, as with its income statement, the balance sheet did not present the company's name nor its measurement date in the header. Second, its balance sheet omitted a long-term asset listed in the trial balance – a building. Third, unsurprisingly given its income statement output, the equity section omitted accumulated other comprehensive income. Fourth, and perhaps most egregiously, *its ending retained earnings did not agree to the beginning retained earnings per the trial balance plus ChatGPT's reported net income*. Instead, its retained earnings balance appears to have been “plugged” such that its total assets appeared to equal its total liabilities and owners' equity.

ChatGPT's financial statement preparation errors are particularly concerning to us. An unwitting user of ChatGPT might quickly review its financial statement output and walk through the following thought process: “The income statement starts with revenue, subtracts a series of expenses, shows each of the expected subtotals, and ends with net income. I've recalculated the statement and everything looks good.” Turning to the balance sheet, they might think: “The balance sheet features categories for assets, liabilities, and owners' equity. The assets sum to \$950, liabilities sum to \$120, and owners' equity sum to \$830. Assets equals liabilities plus owners' equity – everything looks good!” **Only with a firm knowledge of accounting principles and standards and with the exercise of substantial skepticism do ChatGPT's shortcomings in this domain come to light.**

A DEMONSTRATION OF CHATGPT’S NATURAL LANGUAGE CAPABILITIES IN THE CONTEXT OF INTERNAL CONTROLS – FEBRUARY 2, 2023⁶

A key strategy that many organizations use to reduce the likelihood of fraud is the design, implementation, and monitoring of internal controls. Many academic papers in the forensic accounting domain have been written on this subject, so the authors conducted a conversation with ChatGPT based on one such article by Kent Lachney⁷ (2022). This conversation is intended to illustrate ChatGPT’s capabilities with regard to internal controls, as well as to compare the content generated by ChatGPT to that of a deeply knowledgeable expert in the forensic accounting domain. Lachney (2022) provides a nuanced description of the current state of internal controls across a sample of protestant churches in Louisiana. Importantly, Lachney (2022) was published after ChatGPT’s knowledge cut-off in 2021, so this article will not have been part of ChatGPT’s training material.

Before asking the following questions, we provided ChatGPT with the text written by Lachney (2022) about the institutional background of these protestant churches (selected paragraphs from pages 487-489). The most relevant portions of our conversation with ChatGPT are presented here. Interested readers can find the unabridged text of this conversation in Online Appendix B.

I’d like your help thinking through internal control activities that churches should implement to prevent, or at least reduce, the risk of fraud. What are the three categories of control activities? Please describe each category and provide me with at least one example control activity for each category.

⁶ “ChatGPT”. ChatGPT Jan 30 Version. Accessed on February 2, 2023. OpenAI, <https://chat.openai.com/chat>.

⁷ Lachney, K. (2022). An Exploration of Internal Controls and Their Impact on Fraud in Protestant Churches. *Journal of Forensic and Investigative Accounting*, 14(3).

Internal control activities can be categorized into three broad categories: preventive, detective, and corrective.

1. **Preventive Control Activities:** These are designed to prevent fraud from occurring. An example of a preventive control activity is having a clear code of ethics and conduct in place and communicating it to all employees, along with regular ethics training and reminders.
2. **Detective Control Activities:** These are designed to detect any fraud that may have taken place. An example of a detective control activity is regularly performing surprise audits, or having a tip-line in place for anonymous reporting of fraud or unethical behavior.
3. **Corrective Control Activities:** These are designed to address any fraud or unethical behavior that has been detected. An example of a corrective control activity is having a clear policy in place for investigating and prosecuting any fraudulent activity, along with a process for making victims whole again.

It's important to note that the most effective internal control activities are those that are integrated and work together as a system. For example, preventive controls may reduce the need for detective controls, and detective controls can identify areas for improvement in preventive controls.

The three categories of control activities generated by ChatGPT correctly agree with those listed in Lachney 2022 (491). The example within each category of control activity differs from those in Lachney 2022, unsurprisingly, but the examples provided do indeed belong to each of their respective categories.

I have several specific questions about control activities related to human relations, cash receipts and disbursements, and purchasing. Which internal control procedures should churches implement with regard to: a) hiring personnel; b) approving processes and authorization levels; c) securing assets; and d) segregating duties among employees?

[Response omitted for brevity, see Online Appendix B]

Several elements of ChatGPT's response to this prompt agree with Lachney (2022, 491-492). However, Lachney (2022) provides *contextualized suggestions tailored to the specific institutional environment of churches* while ChatGPT provides generic suggestions that may be applicable for a wide variety of organizations, but may not suit the distinct institutional environment of a protestant church (e.g., establishing an internal audit function is likely to be impractical for a small church). Additionally, *Lachney provides readers with rich institutional knowledge and direct quotes* regarding specific churches' hiring and interviewing processes and system of cash receipts while ChatGPT does not.

Once specifically prompted to suggest internal control procedures tailored to congregational offerings, ChatGPT suggested a few appropriate controls. Other of its suggestions (conduct internal audits) may not be relevant to small churches.

Protestant churches have a distinctive method of cash receipts – the collection of congregational offerings. What internal controls over cash receipts should churches implement to mitigate the risk of misappropriation of cash offerings?

To mitigate the risk of misappropriation of cash offerings in Protestant churches, the following internal controls over cash receipts can be implemented:

1. Segregation of duties: Separate the duties of collecting, counting, and depositing offerings to reduce the risk of fraud. For example, different individuals could be responsible for each of these tasks.
2. Bank reconciliation: Reconcile the church's bank statements with its records on a regular basis to ensure that all offerings have been deposited and accounted for.
3. Secure storage: Store offerings securely, for example in a locked box or safe, until they can be deposited in a bank account.
4. Depository agreements: Establish formal deposit agreements with financial institutions to ensure proper handling of offerings.
5. Documentation: Maintain detailed records of all cash receipts and disbursements, including offerings.
6. Supervision: Provide regular supervision and review of the cash handling processes to ensure they are being followed properly.
7. Auditing: Conduct regular internal and/or external audits of the cash handling processes to verify their accuracy and identify any potential fraud.

ChatGPT possesses general knowledge, but does not readily distinguish between institutional contexts unless specifically requested to do so. Even once requested to do so, its knowledge may not be as applicable as that of a trained professional.

A DEMONSTRATION OF CHATGPT’S QUANTITATIVE ABILITIES IN FORENSIC ACCOUNTING – JANUARY 31 AND FEBRUARY 2, 2023⁸

Forensic accountants engage in analytical procedures to identify fraud risks. To examine ChatGPT’s quantitative abilities, we asked it to conduct analytical procedures as described in “An Examination of Fraud Risk at Oil and Gas Companies” (Burger, Smith, Smith, and Wood 2002, pages 76-79 and 84-85).⁹ A portion of the conversation will be presented here. Interested readers can find the unabridged text of this conversation in Online Appendix C.

First, we told ChatGPT that we would be asking it forensic accounting questions, and then we provided it with the revenue volatility information in Table 1 of Burger et al. (2022).

Burger et al. describe the results of Table 1 as follows:

From 2010 through 2014, revenue volatility in the oil and gas industry is about twice the volatility observed in other industries (based on the standard deviation of total revenues to total assets). In 2015, volatility in the oil and gas industry drops to approximately equal that in other industries, but it again increases beginning in 2018. (77)

After providing ChatGPT with Table 1, we asked it to compare oil and gas firms to other industries from 2010 to 2014, in 2015, and in 2018 and 2019.

⁸ “ChatGPT”. ChatGPT Jan 30 Version. Accessed on January 31 and February 2, 2023. *OpenAI*, <https://chat.openai.com/chat>.

⁹ Marcus Burger et al., "An Examination of Fraud Risk at Oil and Gas Companies," *Journal of Forensic and Investigative Accounting* 14, no. 1 (2022).

Referring to the previous two tables, please compare revenue volatility in the oil and gas industry to the volatility observed in other industries (based on the standard deviation of total revenues to total assets) from 2010 through 2014, in 2015, and then in 2018 and 2019.

Based on the data provided, the oil and gas industry has a higher level of revenue volatility compared to other industries from 2010 through 2014. This is indicated by the higher standard deviation of total revenues divided by total assets for the oil and gas industry compared to other industries during this period. For example, in 2014, the standard deviation for the oil and gas industry is 22,673.34, while the standard deviation for other industries is 12,082.76.

(February 2, 2023)

In its response, ChatGPT correctly compared the oil and gas industry's volatility to other industries from 2010 to 2014, but it failed to evaluate the results in 2015 and then in 2018 and 2019. In a previous version of this conversation, conducted on January 31, 2023, ChatGPT successfully completed this task when *separately prompted* to analyze 2010 to 2014, then 2015, and then in 2018 and 2019.

We then provided ChatGPT with listing of the ten largest oil and gas companies, their total revenues, and their total revenues (Table 2 of Burger et al. 2022). Burger et al. use their expertise in the field of forensic accounting as well as their specific research into the activities of oil and gas firms to state:

Closer examination of the risk management enacted by the two largest US oil and gas firms reveals the complexity and breadth of their operations... As a result of Exxon Mobil's efforts to limit risk exposure, there is an increase in the

complexity of financial reporting and, thereby, to the risk of financial statement fraud. Increased financial reporting complexity increases the potential value of internal controls, including an independent audit. (77)

By contrast, after we provided ChatGPT with the data in Table 2 and asked...

Which firm is likely to have the most complex of financial reporting and, therefore, the greatest risk of financial statement fraud?

...ChatGPT equivocated:

It is difficult to determine which firm is likely to have the most complex financial reporting and the greatest risk of financial statement fraud based solely on the information provided.

[This response was abridged for brevity]

(February 2, 2023)

Finally, we asked ChatGPT to consider Table 3 from Burger et al. Table 3 contains calculations of sales growth, leverage, and the Altman-Z score for 2018 and 2019 for the ten largest oil and gas firms. ChatGPT was able to access and compare the ten largest firms' sales growth, leverage, and Altman-Z scores to the industry average:

...I'd like you to consider three fraud risk factors: sales growth, Altman's Z-score, and leverage. Please help me examine industry averages for those three fraud factors and also calculate firm-specific factors for the top ten largest oil and gas firms to provide insight into fraud risk.

...According to the table, the top ten firms had an average sales growth of -2% and 25% in 2019 and 2018 respectively, an average leverage of 55% in 2019 and

53% in 2018, and an average Altman Z-score of 1.65 in 2019 and 1.70 in 2018. The industry average for sales growth was 8% in 2019 and 44% in 2018, leverage was 23% in 2019 and 48% in 2018, and Altman Z-score was 0.56 in 2019 and 0.52 in 2018. The results indicate that the top ten firms had a higher leverage and lower Altman Z-score compared to the overall industry average, which may suggest an increased risk for financial statement fraud.

(January 31, 2023)

(Emphasis added.) ChatGPT's response agrees closely with the interpretation of Burger et al., who write:

Indicators suggest that the top ten largest firms have below industry average sales growth, above industry average leverage, and Altman Z-scores indicating potential financial distress.

...

Oil and gas firms are at risk for fraud. (Pages 78 and 79)

This conversation indicates that ChatGPT can intelligently access, compare, and interpret specific quantitative data out of tables, at least to some extent, suggesting that it is more than just a smooth talker.

TECHNICAL EVOLUTION

ChatGPT was trained using neural networks and other artificial intelligence methods based on a variety of sources. These sources included a sampling of the internet, books, and Wikipedia.^{10, 11} Human trainers fine-tuned ChatGPT to improve its accuracy and effectiveness. Training occurred on Microsoft Azure, a cloud computing platform, and took an estimated \$5 million USD of compute time.¹² ChatGPT is continuing to be refined through supervised and reinforcement learning.^{13, 14} ChatGPT is also learning from its conversations with users. Thus, its answers to complex questions will evolve over time as it learns from user feedback.¹⁵

Microsoft has invested \$10 billion in OpenAI since 2019 (its fourth largest investment in history, only exceeded by its purchase of Activision Blizzard, LinkedIn, and Nuance)¹⁶ and has a

¹⁰ “ChatGPT: Optimizing Language Models for Dialogue”. *OpenAI*, <https://openai.com/blog/chatgpt/>.

¹¹ Brown, T., Mann, B., Ryder, N., Subbiah, M., Kaplan, J. D., Dhariwal, P., Neelakantan, A., Shyam, P., Sastry, G., & Askell, A. (2020). Language models are few-shot learners. *Advances in neural information processing systems*, 33, 1877-1901.

¹² Microsoft. (2023). Microsoft and OpenAI extend partnership. *Official Microsoft Blog*. <https://blogs.microsoft.com/blog/2023/01/23/microsoftandopenaiextendpartnership/>

¹³ Narrativa. (2022). *What is GPT-3?* Retrieved Jan 30, 2023 from <https://www.narrativa.com/what-is-gpt-3/>

¹⁴ An example of supervised learning is regression, where you have a known target and you want to predict that target using known variables. Reinforcement learning trains a model using human feedback to evaluate answers. Through a reward system, the model will continue to improve.

¹⁵ “ChatGPT: Optimizing Language Models for Dialogue”. *OpenAI*, <https://openai.com/blog/chatgpt/>.

¹⁶ Bass, Dina. (2023). Microsoft Invests \$10 Billion in ChatGPT Maker OpenAI. *Bloomberg News*. <https://www.bloomberg.com/news/articles/2023-01-23/microsoft-makes-multibillion-dollar-investment-in-opena>

profit-sharing agreement with OpenAI. In addition, through its partnership, ChatGPT capabilities are now available in the Microsoft Bing search engine.¹⁷

As a technology, ChatGPT is a product of two distinct components: its training input (“corpus”) and the models that contain and continue to refine its knowledge. If its corpus were *solely* sourced from modern accounting textbooks and regulations, then ChatGPT would be more accurate in its responses to accounting questions. However, its inputs were not specific to any one knowledge area; thus, ChatGPT’s conversational knowledge is “an inch deep and a mile wide.” Likewise, the bulk of ChatGPT’s conversations with users are not focused on accounting; thus, it is learning and being reinforced on a variety of other topics by its users.

A notable drawback for ChatGPT is that it does not know when it is wrong. However, if more credible sources are used and if credible humans are involved in the reinforcement learning process, then ChatGPT is likely to continue to improve. One way to enhance the learning process from the most credible sources is to provide a point or a badging system for more qualified contributors like the models used by Yelp, StackOverflow, and others. Such models crowdsource reinforcement learning.¹⁸

The evolution of ChatGPT will depend on its corpus, its knowledge models, and its deployment. OpenAI is currently working on developing its next corpus. The next corpus is likely to include more sources, thus ChatGPT will have the ability to provide responses across

¹⁷ Microsoft. (2023). Reinventing search with a new AI-powered Microsoft Bing and Edge, your copilot for the web. *Official Microsoft Blog*. <https://blogs.microsoft.com/blog/2023/02/07/reinventing-search-with-a-new-ai-powered-microsoft-bing-and-edge-your-copilot-for-the-web/>

¹⁸ Serban, I. V., Sankar, C., Germain, M., Zhang, S., Lin, Z., Subramanian, S., Kim, T., Pieper, M., Chandar, S., & Ke, N. R. (2017). A deep reinforcement learning chatbot. *arXiv preprint arXiv:1709.02349*.

more knowledge areas.^{19, 20} In addition to an improved corpus, the next version of GPT will likely include more parameters²¹ in its knowledge model to enable more nuanced responses to prompts. OpenAI may also license and commercialize ChatGPT to allow customers to train it on a customized corpus of domain-specific sources that have been reviewed and approved by qualified humans (i.e., subject matter experts), similar to how IBM’s Watson was designed.²²

In addition to further development of the corpus and knowledge models, OpenAI may deploy ChatGPT in a variety of ways. In February 2023, OpenAI introduced a premium plan costing \$20 per user per month that offers individual users priority access during busy times and access to alternate versions of its models.²³ OpenAI is also likely to expand its partnership with Microsoft beyond Bing to allow ChatGPT to be used in a variety of Microsoft products (e.g., Microsoft Azure, Microsoft Office, and Microsoft PowerBI). The partnership between Microsoft and OpenAI has led other organizations like Google, Facebook, and Twitter to begin or accelerate their investment in similar LLMs.

APPLICATIONS OF CHATGPT

¹⁹ Altman, S. (Jan 17, 2023). *StrictlyVC in conversation with Sam Altman (OpenAI)* [Interview]. Strictly VC. <https://www.youtube.com/watch?v=ebjkD1Om4uw&t=0s>

²⁰ This paper discusses ChatGPT based on GPT-3.5. A new version of ChatGPT (based on GPT-4) was announced in on March 14, 2023 (<https://openai.com/research/gpt-4>), but its performance and characteristics have not yet been investigated in detail. While a comparison of GPT-3.5 versus GPT-4 is probably of interest, it is beyond the scope of this current paper.

²¹ A parameter is a technical term which loosely corresponds to the capability of the model.

²² Giacaglia, G. (Jan 22, 2019). *How IBM Watson works*. Medium. <https://medium.com/@giacaglia/how-ibm-watson-works-40d8d5185ac8>

²³ As of March 18, 2023, premium users can select between “Legacy” GPT-3.5, “Turbo” GPT-3.5 (a streamlined version of ChatGPT 3.5 allowing for more rapid responses) or the new GPT-4 model, as reported by Kinsella, B. (2023). *GPT-4 is Better Than GPT-3.5 - Here Are Some Key Differences*. Synthedia. <https://synthedia.substack.com/p/gpt-4-is-better-than-gpt-35-here>.

In our opinion, Pandora’s box has been opened and will not be shut – LLMs like ChatGPT are here to stay. Since there is no ignoring these tools, accountants should learn to harness the capabilities and strengths of these tools while being aware of their pervasive weaknesses. As “the language of business”, the domain of accounting is inseparably linked to text interpretation and generation. LLMs are purpose-built for textual tasks like these, and can support accountants’ work in tasks like:

- Drafting memos for clients, even those of a somewhat technical nature (for example, discussing the difference between financial reporting and taxation methods of depreciation)
- Summarizing regulatory requirements for given topics
- Synthesizing and comparing large bodies of text, like comparing financial reporting standards between US GAAP to IFRS
- Conducting analytical procedures on comparative financial statements
- Preparing footnotes to financial statements based on numeric and textual input data
- Helping auditors gain an understanding of an entity and its industry environment²⁴
- Brainstorming risks as part of Enterprise Risk Management or fraud assessment tasks

ChatGPT has even demonstrated some surprising capabilities in generating computer code, journal entries, and preparing financial statements, though its abilities in these areas require improvement, as demonstrated previously.

STRENGTHS AND WEAKNESSES

²⁴ Public Company Accounting Oversight Board (PCAOB). (2010, August 5). *Auditing Standards* (AS 2101.07 and 12.09). Retrieved from <https://pcaobus.org/oversight/standards/auditing-standards/details/AS1015>

In our interactions with ChatGPT, we found that it was sometimes surprisingly able, demonstrating the following strengths:

- 1) Ability to **understand and ingest professional language** used in accounting, auditing, and tax standards and then **output responses using conversational English**
- 2) **A wide (though not deep) variety of domain knowledge** (i.e., it knows a little about a lot of things)
- 3) Ability to **generate responses in a conversational, understandable voice**
- 4) Ability to **generate specialized text** such as computer code, journal entries, and financial statements
- 5) Ability to **identify and censor explicit, suggestive, or otherwise harmful language**.²⁵

On the other hand, we found that ChatGPT demonstrated many weaknesses. Such weaknesses may be partially remediated in future evolutions or versions, but they describe ChatGPT (GPT-3.5) as of February 2023:

- 1) **At this point in time, LLMs do NOT have specialized knowledge in the accounting domain.** Therefore, ChatGPT lacks the ability to distinguish between particular nuances or key indicators in financial text. Because its training data is not specialized for the field of accounting, it may not detect which accounting method is to be used when there are

²⁵ Perrigo, B. (2023). OpenAI Used Kenyan Workers on Less Than \$2 Per Hour to Make ChatGPT Less Toxic. *TIME*. Retrieved Jan 30, 2023, from <https://time.com/6247678/openai-chatgpt-kenya-workers/>

several alternatives, or distinguish between acquiring a given financial instrument as an asset or issuing a financial instrument as a liability or equity.

- 2) **LLMs knowledge is limited to a particular timeframe.** ChatGPT’s current knowledge cutoff is 2021. That is, it is unable to discuss current events or incorporate recent changes into its knowledge. This is particularly problematic for accountants when accounting, auditing, or tax standards change.
- 3) Because its knowledge is based on an amalgamation of training material over time, **ChatGPT does not readily distinguish current and active information from superseded or outdated information.** For example, it has recommended superseded accounting standards in its interactions with us. This is particularly problematic because accounting standards, regulations, and tax law change over time.
- 4) **LLMs’ coherent, conversational explanations may provide users with a false sense of confidence in its abilities,** even though its responses may be factually inaccurate. The “fluency heuristic” documented in psychology research shows that, the easier a concept is to process, the more likely a person is to evaluate it as correct.²⁶ LLMs’ skill at conversational language (its “fluency”) are likely to bias their users towards believing that their responses are correct.
- 5) **In its current version (GPT-3.5), ChatGPT does not reliably cite its sources.** When requested to provide citations, the references it provides may not refer to material which actually exists. In our interactions with ChatGPT (GPT version 3.5) has “referenced”

²⁶ Hertwig, R., Herzog, S. M., Schooler, L. J., & Reimer, T. (2008). Fluency heuristic: A model of how the mind exploits a by-product of information retrieval. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 34(5), 1191–1206. <https://doi.org/10.1037/a0013025>

journal articles, providing plausible titles and the names of recognized accounting authors, but such articles were never actually written! This weakness is being targeted for remediation in GPT-4. Other LLMs like BlenderBot 3 by Meta and ChatGPT as embedded within Microsoft Bing possess the ability to cite their sources.²⁷

6) **LLMs may “hallucinate” and assume information that was not provided in a prompt.** As observed in Example 1, ChatGPT assumed a cost of goods sold or gross margin ratio and relied on this assumption to prepare the journal entry to record the cost of goods sold and its effect on inventory, although we never provided it with this information.

7) **LLMs do not always provide explanations or their rationale for answering:**

Depending on the underlying models and algorithms used, LLMs are not always able to explain their methods or rationale (i.e., they are a black box). Research is underway to help improve the visibility and interpretability of neural networks, models, and algorithms used in AI tools like LLMs. Additionally, because of the “black box” nature of the machine learning models powering LLMs, LLMs’ response to the *same prompt* may differ between different users or may change for a given user at different points in time.

²⁷ Vincent, J. (2022). Meta is putting its latest AI chatbot on the web for the public to talk to. What could possibly go wrong? *Tech / Artificial Intelligence*. Retrieved Jan 30, 2023, from <https://www.theverge.com/2022/8/5/23293281/meta-ai-chatbot-blenderbot-3-web-access-research-safety>

- 8) Unlike Watson on Jeopardy,²⁸ **ChatGPT does not provide a confidence level for its responses** to assist users in identifying which responses are most likely to contain errors.
- 9) As an LLM, ChatGPT suggests text based on its training data. Therefore, it may **unwittingly plagiarize another work product or and may be unable to recognize copyrighted text.**

FIVE PRINCIPLES FOR THE EFFECTIVE APPLICATION OF CHATGPT AND OTHER LLMS

In our opinion, accounting and financial professionals should consider LLMs like an eager, confident, and coherent, but ultimately unknowledgeable subordinate. Such subordinates can certainly be useful, but their abilities should be strategically leveraged and their work must be carefully monitored.

Based on an integration of accounting and auditing standards and the Artificial General Intelligence (AGI) Safety Fundamentals Training set of programs,^{29, 30} we propose the following five suggestions and controls to effectively apply LLMs in the accounting domain.

1. Use LLMs as an ability-enhancer with human-in-the-loop computing: Leverage

LLMs' general knowledge across a variety of domains to *complement* a human worker.

²⁸ Ferrucci, D., Brown, E., Chu-Carroll, J., Fan, J., Gondek, D., Kalyanpur, A. A., Lally, A., Murdock, J. W., Nyberg, E., Prager, J., Schlafer, N., & Welty, C. (2010, 2010 Fall). Building Watson: An Overview of the DeepQA Project. *AI Magazine*. <https://www.aaai.org/Magazine/Watson/watson.php>

²⁹ *AGI Safety Fundamentals*. (2022). BlueDot Impact. Retrieved Jan 30, 2023 from <https://www.agisafetyfundamentals.com/>

³⁰ *ARCHIVED: 2022 Alignment Fundamentals curriculum*. (2022). BlueDot Impact. Retrieved Jan 30, 2023 from https://docs.google.com/document/d/1mTm_sT2YQx3mRXQD6J2xD2QJG1c3kHyvX8kQc_IQ0ns

The best partnership with an AI tool like an LLM is to have a human-in-the-loop. LLMs can conduct routine and mundane tasks quickly, but it is critical to have a human use judgment, verify the output of the LLM, and make final decisions. *For example*, use an LLM to introduce the main themes of a subject, prepare a rough draft, identify the distinguishing characteristics of a specific industry, and synthesize and compare bodies of text across a variety of domains, but then proceed with human judgment and skill.

2. **Decompose complex tasks:** LLMs are better at introductory tasks than higher skill tasks. However, LLMs may be effectively used by dividing large tasks into smaller subtasks that lead to the completion of a collective, larger task. *For example*, task the LLM with calculating only a single portion of the balance sheet rather than an entire balance sheet.
3. **Exercise substantial professional skepticism and ensure alignment.** LLMs can be a useful resource to help draft language, but their outputs must not be relied upon blindly. Instead, their outputs must be skeptically reviewed and edited based on accountants' individual and collective expertise, and ensuring that it is aligned with the accountants' objectives in the prompt. *For example*, accountants should adopt a skeptical mindset and critically assess the responses provided by LLMs as required of auditors in AS 1015, paragraph .07.³¹
4. **Be wary of LLMs' quantitative skills:** We recommend that accountants explore and leverage the abilities of LLMs in retrieving, synthesizing, interpreting, comparing, and drafting textual content, but we strongly caution accountants against attempting to rely

³¹ Public Company Accounting Oversight Board (PCAOB). (2010, August 5). *Auditing Standards* (AS 1015.07). Retrieved from <https://pcaobus.org/oversight/standards/auditing-standards/details/AS1015>

upon LLMs for quantitative tasks. *For example*, as identified earlier, LLMs may have trouble preparing accurate journal entries and doing calculations.

5. **Provide reinforcement:** Artificial intelligence has the ability to learn from humans with reinforcement learning. ChatGPT learns from its users, and subject matter experts can provide valuable feedback so that the same error does not repeat. *For example*, as identified earlier and in the appendix, ChatGPT had repeated problems calculating Altman Z-scores even when it was reminded of the formula and values that were already provided. We expect that LLMs in general (and ChatGPT in particular), will get better at reinforcement learning as they continue to be developed.

CONCLUSION

Our examination was conducted on ChatGPT using GPT-3.5 in January and February 2023. ChatGPT and other LLMs are advancing rapidly. On March 14, 2023, OpenAI announced the newest version of its knowledge model, GPT-4. To provide timely insights, this paper defers a comparison of GPT-3.5 versus GPT-4 for future research. In addition to comparing versions of the GPT knowledge model, we recommend future researchers explore ChatGPT's capabilities in forensic data analysis in tasks such as examining a dataset for conformity with Benford's law, identifying duplicate transactions, vouching and tracing transactions, and comparing data from one table to another.

Sam Altman, the CEO of OpenAI, describes ChatGPT aptly: **ChatGPT is “impressive but not robust.”**³² That is, ChatGPT may be impressive in a user's first use, but after 100 uses, a user realizes its vulnerabilities. *The primary takeaway for forensic accountants right now is that they proceed with caution when working with ChatGPT or any other LLM.* The principles and recommendations noted in this paper offer prudent guidance for the use of LLMs and should benefit accounting professionals now and for some years to come.

³² Altman, S. (Jan 17, 2023). *StrictlyVC in conversation with Sam Altman (OpenAI)* [Interview]. Strictly VC. <https://www.youtube.com/watch?v=ebjkD1Om4uw&t=0s>

References

- Altman, S. (Jan 17, 2023). *StrictlyVC in conversation with Sam Altman (OpenAI)* [Interview]. Strictly VC. Available at: <https://www.youtube.com/watch?v=ebjkD1Om4uw&t=0s>
- Bass, Dina. (2023). *Microsoft Invests \$10 Billion in ChatGPT Maker OpenAI*. Bloomberg News. Available at: <https://www.bloomberg.com/news/articles/2023-01-23/microsoft-makes-multibillion-dollar-investment-in-opena>
- BlueDot Impact. (2022). *AGI Safety Fundamentals*. Available at: <https://www.agisafetyfundamentals.com/>
- _____. (2022). *ARCHIVED: 2022 Alignment Fundamentals curriculum*. Available at: https://docs.google.com/document/d/1mTm_sT2YQx3mRXQD6J2xD2QJG1c3kHyvX8kQc_IQ0ns
- Brown, T., Mann, B., Ryder, N., Subbiah, M., Kaplan, J. D., Dhariwal, P., Neelakantan, A., Shyam, P., Sastry, G., and Askell, A. (2020). *Language models are few-shot learners*. *Advances in neural information processing systems*: 33, 1877-1901.
- Burger, M., K.T. Smith, L.M. Smith, and J. Wood. (2022). *An Examination of Fraud Risk at Oil and Gas Companies*. *Journal of Forensic and Investigative Accounting*: 14(1), 74–85.
- OpenAI. (2022). *Introducing ChatGPT*. Available at: <https://openai.com/blog/chatgpt/>.
- “ChatGPT”. (2023). *ChatGPT Jan 9 Version*. OpenAI. Accessed on January 17, 2023 at <https://chat.openai.com/chat>.
- _____. (2023). *ChatGPT Jan 30 Version*. OpenAI. Accessed on January 31 and February 2, 2023 at <https://chat.openai.com/chat>.
- Ferrucci, D., Brown, E., Chu-Carroll, J., Fan, J., Gondek, D., Kalyanpur, A. A., Lally, A., Murdock, J. W., Nyberg, E., Prager, J., Schlaefter, N., and Welty, C. (2010, 2010 Fall). *Building Watson: An Overview of the DeepQA Project*. *AI Magazine*. <https://www.aaai.org/Magazine/Watson/watson.php>
- Giacaglia, G. (Jan 22, 2019). *How IBM Watson works*. Medium. Retrieved Jan 30, 2023 from <https://medium.com/@giacaglia/how-ibm-watson-works-40d8d5185ac8>
- Hertwig, R., Herzog, S. M., Schooler, L. J., and Reimer, T. (2008). *Fluency heuristic: A model of how the mind exploits a by-product of information retrieval*. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 34(5), 1191–1206.
- Kinsella, B. (2023). *GPT-4 is Better Than GPT-3.5 - Here Are Some Key Differences*. Synthedia. <https://synthedia.substack.com/p/gpt-4-is-better-than-gpt-35-here>.
- Lachney, K. (2022). *An Exploration of Internal Controls and Their Impact on Fraud in Protestant Churches*. *Journal of Forensic and Investigative Accounting*, 14(3), 486–513.
- Microsoft. (2023). *Microsoft and OpenAI extend partnership*. Official Microsoft Blog. <https://blogs.microsoft.com/blog/2023/01/23/microsoftandopenaiextendpartnership/>

- Microsoft. (2023). *Reinventing search with a new AI-powered Microsoft Bing and Edge, your copilot for the web*. Official Microsoft Blog. <https://blogs.microsoft.com/blog/2023/02/07/reinventing-search-with-a-new-ai-powered-microsoft-bing-and-edge-your-copilot-for-the-web/>
- Narrativa. (2022). *What is GPT-3?* Available at: <https://www.narrativa.com/what-is-gpt-3/>
- Perrigo, B. (2023). *OpenAI Used Kenyan Workers on Less Than \$2 Per Hour to Make ChatGPT Less Toxic*. TIME. Available at: <https://time.com/6247678/openai-chatgpt-kenya-workers/>
- Public Company Accounting Oversight Board (PCAOB). (2010). Auditing Standards 1015.07, 2101.07, and 12.09.
- Serban, I. V., Sankar, C., Germain, M., Zhang, S., Lin, Z., Subramanian, S., Kim, T., Pieper, M., Chandar, S., and Ke, N. R. (2017). A deep reinforcement learning chatbot. *arXiv preprint arXiv:1709.02349*.
- Vincent, J. (2022). *Meta is putting its latest AI chatbot on the web for the public to talk to. What could possibly go wrong?* The Verge. Available at: <https://www.theverge.com/2022/8/5/23293281/meta-ai-chatbot-blenderbot-3-web-access-research-safety>
- Wood, D. et al. (2023). *The ChatGPT Artificial Intelligence Chatbot: How Well Does It Answer Accounting Assessment Questions?* Issues in Accounting Education, forthcoming.

ONLINE APPENDIX A:

This example was created by the authors.

This conversation was conducted on 2 Feb 2023 using ChatGPT Jan 30 Version.

LEGEND:

- The authors' own text (denoted by Times New Roman, a serif font).
- The authors' prompts for ChatGPT (*denoted by a bold, italic, sans serif font*)
- ChatGPT's responses (*denoted by a monospaced font*)
 - Writing mistakes that the authors identified will be denoted with: [sic]
 - Content errors that the authors identified will be denoted with: [error]

CONVERSATION:

Please prepare a journal entry to record the sale of 50 bicycles at \$500 each. The customers we sold the bikes to agreed to pay us within 30 days.

Journal Entry:

Date: 02/02/2023

Debit: Accounts Receivable (Asset) \$25,000

Credit: Sales Revenue (Income) \$25,000

Explanation: The company has sold 50 bicycles at \$500 each to customers, who have agreed to pay within 30 days. This results in an increase in Accounts Receivable as the company is owed \$25,000. Additionally, this sale also results in an increase in Sales Revenue, which represents the revenue earned by the company.

Customers have now paid the cash required for 49 of the bikes. Please prepare a journal entry to record this cash receipt.

Journal Entry:

Date: 02/02/2023

Debit: Cash (Asset) \$24,500

Credit: Accounts Receivable (Asset) \$24,500

Explanation: The company has received payment for 49 bicycles that were sold to customers. This results in a decrease in Accounts Receivable as the

company is owed \$1,000 less. Additionally, this payment also results in an increase in Cash, which represents the physical currency the company has on hand.

The remaining customer declared bankruptcy and we will not be able to collect on their account. Please prepare a journal entry to record this transaction.

Journal Entry:

Date: 02/02/2023

Debit: Allowance for Doubtful Accounts (Contra Asset) \$500

Credit: Accounts Receivable (Asset) \$500

Explanation: A customer who owed the company \$500 has declared bankruptcy and will not be able to pay their debt. To reflect this loss, the company debits the Allowance for Doubtful Accounts, which represents an estimate of the bad debt that may be incurred in the future. Additionally, this transaction also results in a decrease in Accounts Receivable, which represents the amounts owed to the company by customers.

Now, please assume we sell custom helmets for \$600. Assume a customer pays a deposit of \$300 on 2/1/23 for a custom helmet to be delivered on 4/1/23. The customer will pay their remaining balance upon receipt of the helmet. Please prepare the journal entries to be recorded on 2/1/23 and 4/1/23.

Journal Entry on 2/1/2023:

Debit: Cash (Asset) \$300

Credit: Deposits from Customers (Liability) \$300

Explanation: A customer has paid a deposit of \$300 for a custom helmet to be delivered on 4/1/23. This results in an increase in Cash, which represents the physical currency the company has on hand. Additionally, this deposit also results in an increase in Deposits from Customers, which represents the amounts owed to the company by customers for goods or services to be delivered in the future.

Journal Entry on 4/1/2023:

Debit: Sales Revenue (Income) \$300

Credit: Deposits from Customers (Liability) \$300

[error]

Debit: Cost of Goods Sold (Expense) \$450

Credit: Inventory (Asset) \$450

[error]

Explanation: On 4/1/2023, the company has delivered the custom helmet to the customer and recorded the final sale of \$600. The company first credits the Deposits from Customers for the \$300 that was previously paid. [error] This results in a decrease in Deposits from Customers [error] as the customer has now received the custom helmet. The company then debits Sales Revenue for the remaining \$300, which represents the revenue earned by the company. [error] Additionally, the company records the cost of goods sold of \$450 and a decrease in Inventory to reflect the cost of the helmet that was sold.

NEW CONVERSATION:

I've received the adjusted following trial balance for FICTITIOUS INC as of and for the year ended December 31, 2022. Please prepare a continuous statement of comprehensive income and a post-closing balance sheet based on this information:

Account	Debit	Credit
Accounts Payable		20
Accounts Receivable	50	
Cash	850	
Common Stock		300
Cost of Goods Sold	100	
Income Tax Expense	60	
Interest Expense	20	
Long-Term Note Payable		100
Building	100	
Retained Earnings		350
Revenues		500
Selling, General, and Administrative Expenses	80	
Short-Term Investment in Debt Securities, classified as Available for Sale	50	
Unrealized gain on available for sale debt securities		40
Total Debits / Credits	1310	1310

Continuous Statement of Comprehensive Income:

Revenues 500
Cost of Goods Sold 100
Gross Profit 400
Selling, General, and Administrative Expenses 80
Operating Income 320
Interest Expense 20
Income Before Taxes 300

Income Tax Expense 60
Net Income 240

Post-Closing Balance Sheet:

Assets:

Cash 850
Accounts Receivable 50
Short-Term Investment in Debt Securities, classified as Available for Sale 50
Total Assets 950

Liabilities:

Accounts Payable 20
Long-Term Note Payable 100
Total Liabilities 120

Owners' Equity:

Common Stock 300
Retained Earnings 530
Total Owners' Equity 830

Total Liabilities and Owners' Equity 950

Correct Answers:

FICTITIOUS INC.
Income Statement
For the Year Ended December 31, 2022

Revenues:	500
Cost of Goods Sold:	<u>100</u>
Gross Profit	400
Selling, General, and Administrative Expenses:	<u>80</u>
Operating Income:	320
Other Income (Expenses)	
Interest Expense	<u>(20)</u>
Income Before Income Taxes:	300
Income Tax Expense:	<u>60</u>
Net Income	<u>240</u>
Other Comprehensive Income	
Unrealized gain on available for sale debt securities	<u>40</u>
Comprehensive Income	<u>280</u>

FICTITIOUS INC.
Balance Sheet
As of December 31, 2022

Assets		Liabilities	
Current Assets		Current Liabilities	
Cash	\$ 850	Accounts Payable	<u>\$ 20</u>
Accounts Receivable	50	Total Current Liabilities	20
Investment in Debt Securities	<u>50</u>		
Total Current Assets	<u>950</u>	Long-Term Liabilities	
		Note Payable	<u>100</u>
Long-Term Assets		Total Long-Term Liabilities	100
Building	<u>100</u>		
Total Long-Term Assets		Total Liabilities	120
Total Assets	<u>\$ 1050</u>	Owners' Equity	
		Common Stock	300
		Retained Earnings	590
		Accumulated Other	<u>40</u>
		Comprehensive Income	
		Total Owners' Equity	<u>930</u>
		<u>Total Liabilities and Equity</u>	<u>\$ 1050</u>

ONLINE APPENDIX B:

This conversation is based on “An Exploration of Internal Controls and Their Impact on Fraud in Protestant Churches”, by Kent Lachney in Journal of Forensic and Investigative Accounting, Volume 14: Issue 3, Special Issue 2022

This conversation was conducted on 2 Feb 2023 using ChatGPT Jan 30 Version.

LEGEND:

- The authors’ own text (denoted by Times New Roman, a serif font).
- The authors’ prompts for ChatGPT (*denoted by a bold, italic, sans serif font*)
- ChatGPT’s responses (*denoted by a monospaced font*)
 - Writing mistakes that the authors identified will be denoted with: [sic]
 - Content errors that the authors identified will be denoted with: [error]

CONVERSATION:

I’d like your help evaluating and proposing internal controls to reduce the likelihood and magnitude of fraud in protestant churches. First, I’m going to provide you with background information about these churches. After I provide you with background information, I’ll ask you a series of questions about internal controls.

Sure, I'd be happy to help evaluate and propose internal controls for reducing the likelihood and magnitude of fraud in Protestant churches. Please go ahead and provide the background information.

“According to research conducted by the National Association of Evangelicals of 4,249 pastors, 80 percent of pastors serve in congregations with fewer than 200 people, and 55 percent have fewer than 100 people in their church. Since most medium and small churches are comprised of close friends and family members, they may have an attitude of “this can never happen to us.” In addition, only 14 percent of the pastors said they received financial training from their seminary, and only 9 percent said the denomination has “many resources” to help them with church finances (Kluth, 2017). When a heightened sense of employee trust is combined with a lack of internal controls, churches are more vulnerable to embezzlement and fraud.”

“The population for this study was selected from Protestant churches in the Central Louisiana (CENLA) area. The researcher used convenience/purposeful sampling to select five small to medium-sized churches and interviewed each church's financial administrator or representative.”

“A summary of each of the churches studied in this research is provided.

Participant One has an average attendance of 50 per week and is in a historic facility in a downtown area of one of the largest cities in CENLA area. Attendees primarily give tithes and offerings through online giving. Weekly receipts average \$1,800.

Participant Two is in a rural area. It has an average weekly attendance of 300. About half of the offering is made by checks, and the other half is received through online giving. Weekly receipts average \$57,000.

Participant Three has a weekly church attendance of approximately 300. Weekly receipts average \$30,000. Sixty-four percent are received by check, 35 percent through online giving, and less than 1 percent is received in currency.

Participant Four is in a downtown area of CENLA. Typically, 200 people attend weekly. The receipts average \$8,000 weekly. The majority (83%) of donations are received through online giving. Sixteen percent is received through checks while 1 percent is received through currency.

Lastly, Participant Five has fewer than 20 members. Most of the members attend weekly. Gifts and offerings average \$1,600 weekly. On-line giving accounts for about 20 percent, while the majority (80%) of contributions are made by check.

According to the church size designations described previously, two of the churches are small and three are medium size. In the two small churches, offering envelopes are not used."

"The researcher studied each participant's church to determine how it employed internal controls related to the control environment to reduce fraud risk. The control environment centers on risk management serving as the basis for the other components. Rae, Sands, and Subramaniam (2017) noted all facets of the control environment consist of integrity, which includes the ethical environment. Argun and Dağlar (2016) explained that a component required to commit fraud was to allow the perpetrator to commit a crime. In addition, Trompeter, Carpenter, Desai, Jones, and Riley, Jr. (2013) underscored the importance of minimizing the chance to commit fraud was to increase internal controls, stressing the organization's culture by emphasizing an ethical tone at the top and looking for red flags or fraud risk indicators (Harvey, 2021). They emphasized these factors significantly reduce the opportunity for fraud. By understanding the opportunities that churches may unknowingly present to fraudsters to commit dishonest acts, administrators can initiate internal controls to reduce the potential for fraud."

"Organizational structure. Four of the churches have a senior pastor, other ministers, and administrative staff. All the senior pastors are full-time. The smallest church has a pastor and no additional support staff. In one of the churches, the pastor is considered the "boss." He is active in the decision-making and spending process. The support staff is full-time in three of the churches. One of the churches has a church council and a committee system that makes decisions on behalf of the church. The church council is made up of the chairpersons of certain committees as well as three at-large members who serve on a one-year rotation basis. The pastor and ruling elders are the highest levels of leadership in one of the churches.

Four participants have committees that supervise the finances of the church. Most of the churches have a Finance Committee or Stewardship Ministry Team that consists of the treasurer, pastor, and other church members. Two of the churches have an Investment Committee. The treasurer, investment advisor, and several church members specifically look at the church's long-term investments. In one church, there are no committees. For example, the pastor and ruling elders prepare a budget and present it as information to the church members. However, this church is the only one that does not seek approval from the congregation."

Based on the background information provided, the following internal controls can be proposed [error]³³ to reduce the likelihood and magnitude of fraud in Protestant Churches: [sic]

1. Separation of duties: Assign separate individuals to perform different tasks such as receiving and depositing funds, reconciling accounts, and preparing financial reports. This helps to minimize the risk of fraud as it would be difficult for one person to cover their tracks.
2. Internal audits: Regular internal audits of financial records can help detect any fraudulent activity and ensure the accuracy of financial statements.
3. Financial training for pastors and administrators: Providing financial training to pastors and administrators can increase their understanding of best practices for financial management and help them recognize red flags for fraud.
4. Background checks for employees: Conducting background checks for new employees can help to identify any past fraudulent activities and ensure that the church is hiring trustworthy individuals.
5. Adequate documentation: Maintaining adequate documentation of financial transactions and making it readily available for review can help to detect any fraudulent activity.
6. Strong ethical tone: Maintaining a strong ethical tone throughout the organization can help to create a culture that discourages fraud and encourages transparency.
7. Online giving controls: Implementing secure systems for online giving and regularly reviewing transactions for unusual activity can help to minimize the risk of fraud through online channels.
8. Formal review processes: Implementing formal review processes for expenditures, contracts, and investments can help to detect any suspicious activity and ensure that decisions are made in a transparent and accountable manner.

I'd like your help thinking through internal control activities that protestant churches should implement to prevent, or at least reduce, the risk of fraud. What are the three categories of control activities? Please describe each category and provide me with at least one example control activity for each category.

Internal control activities can be categorized into three broad categories: preventive, detective, and corrective.

Preventive Control Activities: These are designed to prevent fraud from occurring. An example of a preventive control activity is having a clear code of ethics and conduct in place and communicating it to all employees, along with regular ethics training and reminders.

³³ We told ChatGPT that we would ask it a series of questions *after* we provided it with background information. Instead of waiting for our questions, it started generating content.

Detective Control Activities: These are designed to detect any fraud that may have taken place. An example of a detective control activity is regularly performing surprise audits, or having a tip-line in place for anonymous reporting of fraud or unethical behavior.

Corrective Control Activities: These are designed to address any fraud or unethical behavior that has been detected. An example of a corrective control activity is having a clear policy in place for investigating and prosecuting any fraudulent activity, along with a process for making victims whole again.

It's important to note that the most effective internal control activities are those that are integrated and work together as a system. For example, preventive controls may reduce the need for detective controls, and detective controls can identify areas for improvement in preventive controls.

I have several specific questions about control activities related to human relations, cash receipts and disbursements, and purchasing. Which internal control procedures should churches implement with regard to: a) hiring personnel; b) approving processes and authorization levels; c) securing assets; and d) segregating duties among employees?

a) Hiring personnel:

- Develop a comprehensive job description for each position, including education, experience, and reference requirements.
- Conduct background checks and verify references for new hires.
- Provide new employees with an orientation to the organization, including its mission, values, and policies, and emphasize the importance of integrity, ethics, and accountability.

b) Approving processes and authorization levels:

- Establish clear lines of authority and responsibility for approving expenditures, transactions, and access to financial records and systems.
- Establish a system of approvals and authorizations to ensure that only authorized personnel are able to approve transactions, enter data into systems, or make changes to financial records.
- Require multiple approvals for significant transactions and expenditures, such as wire transfers, check signatories, and large purchase orders.

c) Securing assets:

- Establish physical security measures to protect cash, bank deposits, equipment, and other valuable assets from theft, loss, or damage.
- Implement a system of checks and balances to ensure that cash and other assets are being properly accounted for and safeguarded.

- Implement procedures for safeguarding sensitive information, such as passwords, social security numbers, and financial records.

d) Segregating duties among employees:

- Divide responsibilities for different aspects of financial management and reporting among different employees.
- Assign different employees the responsibilities for recording transactions, reconciling accounts, and reviewing financial statements.
- Ensure that employees are not able to control more than one critical aspect of the financial reporting process, to reduce the risk of fraud or errors going unnoticed.
- Establish an internal audit function to periodically review financial records and transactions and provide independent assurance that the internal control activities are working as intended.

“Cash receipts: collections and deposits. Cases of embezzlement and other types of fraud are becoming more common in churches and other nonprofit organizations. Many of these occurrences could have been prevented, or at least minimized, by the implementation of basic internal controls related to cash receipts. Duncan and Flesher (2002) stressed that church leaders have a fiduciary responsibility to confirm that church assets are protected and used properly. A sound internal control system could help church employees and volunteers minimize the opportunity for fraud. “

Which internal control procedures should churches implement with regard to: a) cash receipts; b) disbursements; and c) purchasing?

With regard to cash receipts, churches should implement the following internal control procedures:

a) Cash Receipts:

1. Establish a clearly defined process for handling cash receipts, including documentation and reconciliation of all cash received.
2. Assign specific individuals to handle cash receipts, with clear instructions on the responsibilities of each person involved in the process.
3. Implement a system of dual controls, with two individuals responsible for counting and reconciling cash receipts, to reduce the risk of theft or fraud.
4. Regularly review and audit cash receipts records to ensure that all transactions are accurately recorded and accounted for.

b) Disbursements:

1. Implement a formal approval process for all disbursements, including the signing of checks by authorized individuals and the maintenance of a detailed record of all transactions.

2. Establish proper authorization levels for different types of disbursements, such as the payment of bills, the reimbursement of expenses, and the transfer of funds between accounts.
3. Ensure that all disbursements are supported by proper documentation, such as invoices, receipts, and bank statements.
4. Implement a system of dual controls for all disbursements, with two individuals responsible for verifying and signing off on each transaction.

c) Purchasing:

1. Establish a clear and documented purchasing process, including the approval of all purchases by authorized individuals.
2. Implement a system of dual controls for all purchases, with two individuals responsible for verifying the accuracy of purchase orders and invoices.
3. Ensure that all purchases are supported by proper documentation, such as purchase orders, invoices, and receipts.
4. Implement a system of regular audits of purchasing records to ensure that all transactions are accurately recorded and accounted for.

“Monitoring is a vital aspect of fraud prevention and is the most important method of assessing the effectiveness of an organization’s internal controls. Monitoring consists of conducting evaluations to verify the five components of internal controls are working (Wilkins and Hann, 2014).” Which monitoring controls should a church implement to mitigate fraud risks?

Monitoring internal controls is a crucial aspect of fraud prevention. Here are some monitoring controls that a church could implement:

1. Regular Auditing: Conducting regular internal audits of financial statements, transactions, and records. This can help detect any irregularities or inconsistencies.
2. Separation of Duties: Reviewing job responsibilities and ensuring that critical tasks are separated among multiple individuals. This helps reduce the risk of fraud by a single person.
3. Documentation Review: Reviewing and reconciling financial records and transaction logs to ensure accuracy and completeness.
4. Performance Evaluations: Regularly evaluating employee performance, including a review of their adherence to internal control procedures.
5. Trend Analysis: Analyzing financial data over time to detect any unusual or suspicious activity.
6. Employee Surveillance: Monitoring employee activities and communication, such as emails or chat logs, to detect any potential fraud.
7. Surprise Inspections: Conducting unannounced inspections of physical assets or cash receipts to ensure proper safeguarding.

These are just a few examples of the types of monitoring controls that a church could implement. It's important to tailor the monitoring controls to the specific needs and risks of the church to effectively prevent fraud.

Protestant churches have a distinctive method of cash receipts – the collection of congregational offerings. What internal controls over cash receipts should churches implement to mitigate the risk of misappropriation of cash offerings?

To mitigate the risk of misappropriation of cash offerings in Protestant churches, the following internal controls over cash receipts can be implemented:

1. Segregation of duties: Separate the duties of collecting, counting, and depositing offerings to reduce the risk of fraud. For example, different individuals could be responsible for each of these tasks.
2. Bank reconciliation: Reconcile the church's bank statements with its records on a regular basis to ensure that all offerings have been deposited and accounted for.
3. Secure storage: Store offerings securely, for example in a locked box or safe, until they can be deposited in a bank account.
4. Depository agreements: Establish formal deposit agreements with financial institutions to ensure proper handling of offerings.
5. Documentation: Maintain detailed records of all cash receipts and disbursements, including offerings.
6. Supervision: Provide regular supervision and review of the cash handling processes to ensure they are being followed properly.
7. Auditing: Conduct regular internal and/or external audits of the cash handling processes to verify their accuracy and identify any potential fraud.

Some churches have a minimal number of professional staff members – perhaps even less than three employees. Some of these employees will be trained to perform ministerial activities rather than business activities. Please reconsider the internal control activities you've proposed earlier. How should a church with three or fewer employees adapt the internal control activities you've proposed to accommodate their limited number of employees and their employees' unique skills?

Smaller churches with a limited number of employees and unique skills can still implement effective internal control activities to prevent or reduce the risk of fraud. Here are some suggestions:

1. Cash Receipts:

- Implement a dual custody procedure, where one person collects the offerings and another person records and deposits the cash.
- Create a clear policy for handling cash receipts, including regular bank deposits and reconciliation of the accounts.

2. Disbursements:

- Use checks for all disbursements and require dual signatures for larger transactions.
- Have a clear policy in place for the approval and authorization of disbursements.

3. Purchasing:

- Assign purchasing responsibilities to a designated individual with clear purchasing policies and procedures.
- Obtain competitive bids for larger purchases.

4. Segregation of Duties:

- Assign different responsibilities for tasks such as processing transactions, reconciling accounts, and preparing financial reports.
- Train employees on their responsibilities and the importance of segregation of duties.

5. Monitoring:

- Have an independent person periodically review the financial records to ensure accuracy and completeness.
- Implement a fraud reporting policy and encourage employees to report any suspected fraud.

In conclusion, churches with a limited number of employees can still implement effective internal control activities to reduce the risk of fraud. The key is to have clear policies and procedures, segregation of duties, and periodic monitoring.

ONLINE APPENDIX C:

This conversation is based on “An Examination of Fraud Risk at Oil and Gas Companies”, by Marcus Burger, Katherine Taken Smith, L. Murphy Smith, and Justin Wood in Journal of Forensic and Investigative Accounting, Volume 14: Issue 1, January–June 2022

This conversation was conducted on 2 Feb 2023 using ChatGPT Jan 30 Version.

LEGEND:

- The authors’ own text (denoted by Times New Roman, a serif font).
- The authors’ prompts for ChatGPT (*denoted by a bold, italic, sans serif font*)
- ChatGPT’s responses (*denoted by a monospaced font*)
 - Writing mistakes that the authors identified will be denoted with: **[sic]**
 - Content errors that the authors identified will be denoted with: **[error]**

CONVERSATION

I'd like your help with four sets of forensic accounting questions.

Sure! I'd be happy to help you with your forensic accounting questions. Please provide the four sets of questions.

Here's my first set of questions. The following table provides revenue volatility information (the standard deviation of total revenues divided by total assets).

Table 1:

Oil and Gas Firms:

Year	Mean	Standard Deviation
2010	3,961.95	22,573.42
2011	4,991.28	28,552.26
2012	4,269.08	24,723.52
2013	4,353.96	23,436.84
2014	4,606.52	22,673.34
2015	3,342.82	15,219.37
2016	2,837.34	13,007.59
2017	3,624.85	16,315.62
2018	4,734.91	20,875.56
2019	5,021.41	20,910.85

Other Industries:

Year	Mean	Standard Deviation
2010	2,270.30	10,554.08
2011	2,431.29	11,096.93
2012	2,452.90	11,425.52
2013	2,463.25	11,626.68
2014	2,605.42	12,082.76
2015	2,680.24	12,717.29
2016	2,774.15	13,198.76
2017	2,991.28	13,937.63
2018	3,277.70	15,117.68
2019	3,616.59	16,857.99

Referring to the previous two tables, please compare revenue volatility in the oil and gas industry to the volatility observed in other industries (based on the standard deviation of total revenues to total assets) from 2010 through 2014, in 2015, and then in 2018 and 2019.

Based on the data provided, the oil and gas industry has a higher level of revenue volatility compared to other industries from 2010 through 2014. This is indicated by the higher standard deviation of total revenues divided by total assets for the oil and gas industry compared to other industries during this period. For example, in 2014, the standard deviation for the oil and gas industry is 22,673.34, while the standard deviation for other industries is 12,082.76.

In periods of revenue declines, which risk mitigation strategies may oil and gas firms engage in to reduce losses?

In periods of revenue declines, oil and gas firms may engage in several risk mitigation strategies to reduce losses, such as:

1. Cost cutting measures: reducing operating costs, suspending or cancelling capital expenditures, and optimizing supply chains.
2. Diversification: expanding into new markets, investing in alternative energy sources or new technologies.
3. Hedging: using financial instruments such as derivatives to reduce the impact of price fluctuations on revenue and cash flow.
4. Optimizing production: improving production efficiency, reducing downtime, and increasing output.
5. Mergers and Acquisitions: acquiring or merging with other companies to increase market share and reduce competition.
6. Debt restructuring: renegotiating debt obligations, extending loan maturities or converting debt to equity.

These are some of the common risk mitigation strategies that oil and gas firms may engage in during periods of revenue declines. However, the choice of strategy will depend on the specific circumstances and financial position of the firm.

In general, how do oil and gas firms attempt to reduce business risk?

Oil and gas firms attempt to reduce business risk through several methods, including:

1. **Diversification:** expanding into new markets, investing in alternative energy sources, or entering into new product lines to reduce reliance on a single source of revenue.
2. **Hedging:** using financial instruments such as derivatives to reduce the impact of price fluctuations on revenue and cash flow.
3. **Cost management:** reducing operating costs, optimizing supply chains, and implementing best practices to improve operational efficiency.
4. **Contract negotiation:** securing long-term contracts with customers or suppliers to reduce revenue volatility.
5. **Risk assessment and management:** conducting regular risk assessments to identify potential risks and implementing measures to mitigate or manage those risks.
6. **Maintaining strong financial position:** maintaining strong cash reserves and a healthy balance sheet to withstand economic or market fluctuations.
7. **Innovations and technology adoption:** investing in technology and innovation to improve production efficiency and reduce business risks.

These are some of the common methods that oil and gas firms use to reduce business risk. The specific risk mitigation strategies will depend on the company's financial position, market conditions, and other factors.

Do such strategies help to smooth operating income? Do such strategies increase or decrease business complexity? Do such strategies potentially make it easier or harder to conceal fraud?

1. **Help to smooth operating income:** The risk mitigation strategies used by oil and gas firms can help to smooth operating income by reducing the impact of price fluctuations, securing long-term contracts, and improving operational efficiency. However, the effectiveness of these strategies in smoothing operating income will depend on the specific circumstances of the firm and the risks it faces.
2. **Business complexity:** The risk mitigation strategies used by oil and gas firms can potentially increase business complexity, especially if they involve diversification into new markets or investing in new technologies. However, this increase in complexity can also bring benefits such as reduced dependence on a single source of revenue and improved operational efficiency.
3. **Concealing fraud:** The risk mitigation strategies used by oil and gas firms can potentially make it harder to conceal fraud, especially if they involve increased transparency, risk assessments, and improved internal controls. However, if the risk mitigation strategies are not properly implemented or monitored, they can also create new

opportunities for fraud to occur.

In summary, the impact of risk mitigation strategies on operating income, business complexity, and the potential to conceal fraud will depend on several factors, including the specific strategies employed and the implementation and monitoring of those strategies.

Here's my second set of questions.

These are the Ten Largest Oil and Gas Companies by 2019 Total Revenues (Numbers in Millions of U.S. Dollars)

Name	Headquarters	Total Revenue	Total Assets
Exxon Mobil Corp	Irving, TX	255,583	362,597
Chevron Corp	San Ramon, CA	139,865	237,428
Marathon Petroleum Corp	Findlay, OH	123,949	98,556
Phillips 66	Houston, TX	107,293	58,720
Valero Energy Corp	San Antonio, TX	102,729	53,864
Energy Transfer LP	Dallas, TX	54,213	98,880
World Fuel Service Corp	Miami, FL	36,819	5,992
Plains GP Holdings LP	Houston, TX	33,669	29,969
Schlumberger LTD	Houston, TX	32,917	56,312
Enterprise Product Partners LP	Dallas, TX	32,789	61,733

Which firm is likely to have the most complex of financial reporting and, therefore, the greatest risk of financial statement fraud?

It is difficult to determine which firm is likely to have the most complex financial reporting and the greatest risk of financial statement fraud based solely on the information provided.

There are several factors that contribute to the complexity of financial reporting and the risk of financial statement fraud, including the size and scope of a company's operations, the number and diversity of its products and services, the number of subsidiaries and geographic locations, the use of derivatives and other financial instruments, and the accounting and reporting policies used by the company.

In general, larger and more complex companies tend to have a higher risk of financial statement fraud, but this is not always the case. Companies with simpler operations can also be at risk of financial statement fraud, especially if they have weak internal controls or a lack of transparency.

It is important to note that financial statement fraud can occur in any company, regardless of size or complexity, and that companies must be vigilant in implementing and monitoring appropriate internal controls to prevent and detect such fraud.

Here's my third set of questions. I'd like you to consider three fraud risk factors: sales growth, Altman's Z-score, and leverage. Please help me examine industry averages for those three fraud factors and also calculate firm-specific factors for the top ten largest oil and gas firms to provide insight into fraud risk.

Prior research suggests that firms in financial distress are significantly more likely to experience financial misstatements (Kreutzfeldt and Wallace 1986) and that management is more likely to engage in earnings management or even fraud to attempt to disguise potentially temporary poor performance (e.g., Kinney and McDaniel 1989; Stice 1991). Altman's Z-score is widely known for its ability to predict bankruptcy or other financial distress (MacCarthy, 2017). Spathis (2002), in a study examining financial statement fraud in Greece, provides evidence that Altman's Z-score can also be used to help detect financial statement fraud. We use the Z-score to examine the financial pressures currently faced by firms the oil and gas industry that might impact fraud risk.

We calculate the Altman Z-score as follows:

$$Z=0.012X1+0.012X2+0.033X3+0.006X4+0.999X5,$$

where $X1$ = working capital / total assets,

$X2$ = retained earnings / total assets,

$X3$ = earnings before interest and taxes / total assets,

$X4$ = market value equity / book value of total liabilities, and

$X5$ = sales / total assets.

In general, a Z-score above 3.0 indicates a safe balance sheet, between 1.81 and 2.99 indicates a "caution" zone, and below 1.81 indicates financial distress (Faulkenberry, 2020).

Management may also be incentivized to commit financial statement fraud to avoid violating debt covenants (Dechow et al. 1996). As a proxy for closeness to debt covenants, we examine financial leverage (total debt to total assets).

Using data from Compustat, each fraud factor is measured for the top ten largest oil and gas firms, listed in Table 3 in descending order by firm size. The factors are measured for 2018 and 2019 to examine current values and short-term trends. At the bottom of Table 3, we present the factor averages for the top ten firms along with the overall industry average.

Table 3: Fraud Risk Measures for Top Ten Oil and Gas Firms

Name	2018 Sales Growth %	2018 Leverage %	2018 Altman Z	2019 Sales Growth %	2019 Leverage %	2019 Altman Z
Exxon Mobil Corp	18%	43%	0.83	-9%	45%	0.73
Chevron Corp	25%	39%	0.65	-12%	39%	0.61
Marathon Petroleum Corp	44%	52%	1.05	28%	56%	1.27
Phillips 66	25%	50%	2.07	-4%	54%	1.84
Valero Energy Corp	26%	55%	2.24	-8%	58%	1.92
Energy Transfer LP	33%	64%	N/A*	1%	65%	N/A
World Fuel Service Corp	18%	68%	4.57	-7%	68%	4.57
Plains GP Holdings LP	30%	50%	N/A	-1%	52%	N/A
Schlumberger LTD	8%	48%	0.48	0%	57%	0.60
Enterprise Product Partners LP		25%	57%	N/A	-10%	58%
	N/A					

Top Ten Firm Average	25%	53%	1.70	-2%	55%	1.65
Industry average	44%	48%	0.52	8%	23%	0.56

Notes: Prior research suggests that sales growth, leverage, and Altman's score are associated with an increased probability for fraud. The table presents these factors for 2018 and 2019 for the top ten largest oil and gas firms, listed in ascending order by total revenues scaled by total assets.

Sales growth equals the year-over-year change in sales revenue divided by the prior year's sales revenue.

Leverage equals total debt to total assets. Both sales growth and leverage are multiplied by 100 and presented as percentages.

Altman's Z-score combines working capital, retained earnings, earnings before interest and taxes, market equity leverage, and sales to derive a measure of bankruptcy risk. N/A's indicate that a firm does not have public equity; the traditional Altman's Z-score is valid only for public equity firms.

For comparison, the table also presents averages for the top ten firms and the oil and gas industry overall.

The table presents the fraud risk measures of the top ten largest oil and gas firms based on sales growth, Altman Z-score, and leverage. Sales growth measures the year-over-year change in sales revenue, while leverage represents the total debt to total assets ratio. The Altman Z-score is a measure of bankruptcy risk, which combines several financial ratios to provide an overall view of the financial health of a firm. According to the table, the top ten firms had an average sales growth of -2% and 25% in 2019 and 2018 respectively, an average leverage of 55% in 2019 and 53% in 2018, and an average Altman Z-score of 1.65 in 2019 and 1.70 in 2018. The industry average for sales growth was 8% in 2019 and 44% in 2018, leverage was 23% in 2019 and 48% in 2018, and Altman Z-score was 0.56 in 2019 and 0.52 in 2018. The results indicate that the top ten firms had a higher leverage and lower Altman Z-score compared to the overall industry average, which may suggest an increased risk for financial statement fraud.

Based on the information provided in Table 3, how do the top ten largest oil firms' sales growth compare to the industry average?

The average sales growth for the top ten largest oil firms is -2% whereas the industry average is 8%.

Based on the information provided in Table 3, how do the top ten largest oil firms' leverage compare to the industry average?

The top ten largest oil firms have an average leverage of 53%, which is higher than the overall industry average leverage of 48%.

Based on the information provided in Table 3, considering their leverage, are the top ten largest oil firms at a greater risk of violating debt covenants and perhaps of managing earnings to satisfy debt covenants?

The information provided in Table 3 does not include information on debt covenants or whether these firms may be at risk of violating them, so it is not possible to determine whether the top ten largest oil firms are at a greater risk based on their leverage alone.

Based on the information provided in Table 3, how do the top ten largest oil firms' Altman Z-scores compare to the industry average?

Unfortunately, the information in Table 3 does not provide the Altman Z-scores for the top ten largest oil firms or the industry average, [error] so it is not possible to compare them based on this information.

$Z = 0.012X_1 + 0.012X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$,

where X_1 = working capital / total assets,

X_2 = retained earnings / total assets,

X_3 = earnings before interest and taxes / total assets,

X_4 = market value equity / book value of total liabilities, and

X_5 = sales / total assets.

In general, a Z-score above 3.0 indicates a safe balance sheet, between 1.81 and 2.99 indicates a "caution" zone, and below 1.81 indicates financial distress (Faulkenberry, 2020).

Based on the information provided in Table 3, how do the top ten largest oil firms' Altman Z-scores compare to the industry average?

The information provided in Table 3 does not include the values of X_1 to X_5 for the top ten largest oil firms and the industry average, so it is not possible to determine how their Altman Z-scores compare to the industry average.

Based on the information provided in Table 3, considering their Altman Z-scores, which firms are at risk for fraud?

It is not possible to determine the risk of fraud based solely on Altman Z-scores. The Altman Z-score is a financial metric used to assess the likelihood of a company being in financial distress. A low score may indicate financial distress, but it does not necessarily mean that a company is committing fraud. Other factors, such as a company's internal controls, governance, and regulatory compliance, should also be considered when assessing the risk of fraud.

Please calculate the Altman Z-scores for the companies listed in Table 3.

I'm sorry, I cannot calculate the Altman Z-scores without the numerical values for the five variables (X_1 to X_5) required to perform the calculation. The Altman Z-score formula is $Z = 0.012X_1 + 0.012X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$, and the values for X_1 to X_5 must be obtained from the financial statements of each of the companies.

Here's my fourth set of questions:

Oil and gas firms are at risk for fraud. Knowing this fact, firms should seek help in safeguarding their operations and financial reports from the disastrous effects of fraud. Where can a company find such help?

A company can find help in safeguarding against the risk of fraud from several sources such as:

1. **Internal audit departments:** The internal audit department can conduct risk assessments and internal controls evaluations to identify areas of vulnerability to fraud.
2. **External auditors:** External auditors can provide independent assurance on the accuracy and reliability of the company's financial reports and the effectiveness of its internal controls.
3. **Professional services firms:** Firms such as accounting, consulting, and legal firms can provide expertise and support in identifying and mitigating fraud risks.
4. **Industry associations:** Industry associations, such as the Association of Certified Fraud Examiners, offer educational resources, training programs, and other resources to help companies detect and prevent fraud.
5. **Government agencies:** The Securities and Exchange Commission (SEC) and the Federal Bureau of Investigation (FBI) are among the government agencies that can provide support and guidance on preventing fraud in the oil and gas industry.

It is important for companies to take proactive steps to prevent fraud and to establish a robust fraud risk management program to detect and respond to any potential incidents.