A Proposed Model to Integrate Drone Technology in Accounting for Long Term Contracts: A Cash Flow Management Perspictive

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Abstract: *The accounting profession is undergoing a significant transformation due to the impact of artificial intelligence, robotic process automation, and big data. One of the latest areas of research in this field is exploring the potential use of drones for accounting and auditing tasks. However, this study takes a different approach by proposing a theoretical framework that utilizes drones for cash flow management in long-term construction projects. The proposed framework suggests that drones can be utilized as a supplementary tool to remotely conduct project site inspections and monitor construction progress. The framework addresses the percentage of completion method for recognizing revenues from long-term contracts and highlights the benefits of using drones, such as improved data quality, cost and time efficiency, increased safety during site inspections, and overall effectiveness.*

1. Introduction

The business environment has recently been experimenting new technologies in AI and robotic automation. This has resulted in putting these technologies into action in several business sectors. In addition, recently there is a growing attention given to the adoption of robots in executing some business operations that is considered repetitive, time consuming, or even dangerous. These technologies are not only affecting business operations in general, but also affecting the accounting profession. In this regard, these technologies are profoundly reforming the operations done by the accountant to a new dimension. Artificial Intelligence (AI) and robotic automation are increasingly utilized to perform many accounting and auditing tasks, such as remote auditing, accounting robotic automation, and data analytics to assess in business decision making [7]. The use of robots and AI in accounting has been increasing in recent years. Accounting involves a lot of repetitive tasks, which can be automated through the use of robots and AI. This technology can significantly improve the efficiency and accuracy of accounting processes.

One of the areas where robots and AI are being used in accounting is in data entry. Manually entering data is a tedious and time-consuming process, and errors can easily occur. However, robots and AI can be trained to extract data from various sources and input it into accounting software automatically. This not only saves time but also reduces errors, making the process more accurate. Another area where robots and AI are being used is in the analysis of financial data. AI algorithms can analyze large amounts of financial data and identify trends and patterns that humans might miss. This can be particularly useful in identifying potential fraud or financial irregularities. Robots can also be used to perform complex calculations, such as forecasting cash flow or calculating tax liabilities, which can be time-consuming and prone to errors if done manually. In addition, robots and AI can be used to improve the speed and accuracy of financial reporting. They can be programmed to generate financial statements automatically based on data entered into accounting software. This can reduce the time it takes to prepare financial reports and ensure that they are accurate and consistent [7].

However, the use of robots and AI in accounting does raise some concerns. One concern is that it may lead to job losses as some tasks that were previously done by humans can now be done by machines. There is also a risk of errors occurring in the programming or implementation of robots and AI, which can have serious consequences for financial reporting. Overall, the use of robots and AI in accounting has the potential to improve efficiency, accuracy, and speed. However, it is important to carefully consider the potential risks and ensure that appropriate controls are in place to mitigate them [3, 7].

One of the objectives of the accounting profession is to protect the company's resources and ensure their

efficient usage. "Cash" is one of them. Cash is the most crucial resource for a corporation because it is the company's most liquid asset. The successful management of a company's cash flows is critical since it affects the company's survival.

Business entities may be involved in building projects that necessitate the payment of large sums of money to the project's contractors. This study connects accounting for long-term contracts from the perspective of cash flow management with the use of drones to examine the decision of cash outflows disbursements. The technique of employing drones to take high-quality photos and videos to support a variety of complicated corporate activities [3] has been the subject of numerous research projects in a variety of fields. Oksana *et al.* [9] claimed that drones are regarded as a system of technological sensors for collecting data on IoT technology principles for company management reasons. This new technology is increasingly being used in day-to-day operations and fields like accounting, supply chain management, risk management, inventory management, and construction projects. Previous literature recognized and highlighted several advantages when organizations use drones to carry out specific tasks, including cost savings in terms of resources used, improved efficacy and efficiency of operations, and safety considerations while gathering data in specific circumstances. These alleged benefits have opened up more prospects for drone deployment, ranging from environment-based inspections to inspections of bridges and highways. Additionally, the community has seen a significant use of drones to immediately benefit societies, particularly during disasters. For instance, [16] investigated the possibility of utilizing drones to plan and carry out flood relief efforts. Establishing communication, collecting data, analyzing the situation, reducing risks, and planning for the transportation of goods are among the responsibilities.

The accounting industry, on the other hand, has just begun experimenting with drones to automate and expedite a number of routine and repetitive operations. For instance, several accounting firms are currently replacing inventory management with drones in order to evaluate ongoing audits. Appelbaum and Nehmer [3] projected that breakthroughs and technologies related to remote-controlled drones will drastically disrupt several old and tedious accounting and auditing duties in the future. Therefore, it is asserted that the accounting profession is on the verge of a technological transformation that will result in "robotic-enabled" processes.

Also, the accounting literature that examines the application of this technology in the field offers numerous instances. For example, auditing companies that deal with inventory management and resource estimations can use drones as a tool to assess in the inventory estimation process. In this case, the auditor can utilize the drone to fly over the natural resource region and take pictures for the estimation of the inventory. The auditor or accountant would afterwards determine the value of the natural reserve using the acquired photographs and videos they had received from the drone [5, 15].

In a similar line, PricewaterhouseCoopers (PwC) has started testing the first audit of an inventory count using drone technology in 2017. This technology was tested by PwC at a coal mine in the UK. The auditor evaluated the obtained photographs to determine the estimated volume of the coal in the reserve, and from that data the value of the natural reserve was determined. Yet, there are a number of benefits to consider when employing drones in auditing procedures, such as:

1) Time-efficiency.
2) Measurement precision.
3) The perceived advantages in terms of health and safety.

Drones are also used in agricultural operations since they can access big, difficult-to-reach areas. Also, farmers can see nutritional deficits in crops from the air, and firefighters can use the device to monitor the spread of bushfires from various angles [3, 5, 15].

Moreover, drones are employed in construction projects at various stages, starting with the initial site inspection and continuing through project completion. By using drones with image capture software, site assessments that once required up to two or three weeks to perform in person may now be finished in only a few hours. Drone use in long-term construction projects might also be investigated through a connection to the accounting industry by looking at its potential as a brand-new tool for managing cash flows [9, 15]. According to the information provided by the drone, payments made by the project owner to the project contractor can be identified in this regard. The amount of these payments, however, ought to be calculated based on how much of the project is still left to finish. When project revenues are realized and match pertinent costs, the accountant, from an accounting standpoint, makes the payments relating to the project. In this case, the cost-to-cost basis-based percentage of completion method is employed for long-term projects. In this instance, the cost to total estimated billing of the project is used to calculate the project's current completion rate. In this study, we suggest a new application that will be used to evaluate how well construction projects are managing their cash flow by utilizing data from drones.

This study, which is purely theoretical, suggests using drones as an additional tool to conduct project site inspections in order to assess and monitor the progress of the building process and cash flow management. It offers a fresh perspective on a new technology to take into account, making the accountant's duty in terms of managing funds more dependable, efficient, and practical, particularly during times of lockdown.

As a result, this study is significant because:

1) It expands on earlier research on the use of new technologies in the accounting profession by suggesting the use of drone technology in long-term construction projects.
2) Using drones for auditing purposes will be a useful tool to take into account, particularly in situations where the auditor is not physically there to collect the data.
3) Linking the utilization of drones in improving the cash flow management.

The following section of this study will provide a general explanation on drone technology. The use of drone technology in the real estate sector is then briefly described after that. The revenue recognition principle for lengthy construction projects is then discussed. Finally, a suggested framework is provided to link the use of drone technology to the estimation of the long-term construction project's completion rate. Conclusion and potential areas for further research are then covered.

2. Harnessing the Power of Drones in Long Term Construction Projects

The use of drones in long-term construction projects is well established in civil engineering, both in terms of practical application and in scientific study, according to recent studies in the field of civil engineering technology. For instance, [15] described how the profession of civil engineering has seen a growing deployment of drone use in recent years. The researchers examined the efficacy and efficiency of drones as an additional inspection tool for bridges and highways, according to that report. According to the study, using drones allowed for the field inspection of the bridge to be completed more cheaply and efficiently. In the same situation, drones can gather information from perilous bridge locations. In turn, this will preserve human safety and safeguard the lives of those who do the inspection personally. Moreover, drones gather better-quality data, resulting in better site management choices and actions.

Prior studies, however, have identified a number of difficulties with the use of drones in construction projects, including the following:

1) Weather conditions.
2) Brightness exposures brought on by the sun or snow.
3) Flying the drone in dark areas.
4) Drone flight restrictions.
5) Objects and obstacles in the flying path [16].

However, using drones in building projects has the potential to be a fantastic addition to current inspection techniques and has already been shown to be more effective and efficient [15].

3. Accounting for Long Term Contracts and the Percentage of Completion Method

Accounting for long-term contracts is a complex process that involves the recognition of revenue and expenses associated with a particular contract over the duration of the project. Long-term contracts typically involve large sums of money and extended periods, making it essential for companies to implement an accounting method that provides accurate financial reporting. One such method is the percentage of completion method, which involves recognizing revenue and expenses based on the degree of completion of a project.

Under the percentage of completion method, a company recognizes revenue and expenses proportionate to the degree of completion of a project. This means that revenue and expenses are recognized as work progresses on the project, rather than being recognized when the project is completed. The percentage of completion is calculated by comparing the costs incurred to date with the total estimated costs for the project.

The percentage of completion method requires accurate and consistent record-keeping, as well as reliable estimates of costs and completion percentages. Companies must maintain detailed records of costs incurred, including direct and indirect costs, such as labor, materials, and overhead. They must also track the progress of the project, typically using benchmarks such as completed units or time elapsed. The percentage of completion method has several advantages over other accounting methods for long-term contracts. It provides more accurate financial reporting by recognizing revenue and expenses as work progresses on the project. This allows companies to better manage their cash flow and make more informed decisions about future projects. It also provides a more accurate reflection of a company's financial position, as it recognizes the full impact of a project on revenue and expenses over its entire duration.

However, the percentage of completion method is not without its drawbacks. It requires accurate and consistent record-keeping, as well as reliable estimates of costs and completion percentages. This can be challenging for companies that lack the necessary resources or expertise. Additionally, the method can be sensitive to changes in estimates, such as changes in the cost of materials or labor, which can lead to significant adjustments in revenue and expenses.

In conclusion, accounting for long-term contracts is a complex process that requires careful consideration of the appropriate accounting method. The percentage of completion method is a commonly used approach that provides more accurate financial reporting and allows companies to better manage their cash flow. However, it requires accurate and consistent record-keeping, as well

as reliable estimates of costs and completion percentages. Companies must carefully weigh the advantages and disadvantages of the method to determine if it is the best approach for their specific needs.

4. The Rise of AI and Robotic Process Automation in the Accounting Profession

As was previously mentioned, the accounting industry is being significantly impacted by emerging technologies in many different ways. In this context, technologies like blockchain, AI, data analytics, and Robotic Process Automation (RPA) are being adopted more and more in a variety of accounting roles like continuous auditing and accounting analytics [2, 3, 7]. The term "dronification" was coined by academics in the accounting literature to describe the process of using drones or Unmanned Aerial Vehicles (UAVs) to capture images and videos that may be used in business operations [6, 15]. Recently, academics have highlighted the potential uses of drones in business operations. According to [6], drones are used as a system of technological sensors to gather data on the IoT technology's guiding principles for business management objectives. The use of this technology in several industries is becoming more practical for some daily tasks (i.e., civil engineering and long-term construction projects). Drone use in company operations may provide a number of benefits, including cost, time, and effort savings, improved operational efficiency, and increased safety. These advantages are seen as opening up prospects for the use of drones in a variety of contexts, from environmental assessments to large-scale construction projects (i.e., bridges and highways).

For the accounting industry, drone technology can be used to automate and speed up some tedious and typical accounting tasks. Research in this field revealed that technology is currently providing useful solutions in the field of inventory management systems. Ciampa *et al.* [6] predicted that robotic and AI-based developments relating to remote-controlled drones will have a substantial impact on the future of the accounting profession. They described how this profession is undergoing a technological transition based on robots, artificial intelligence, and machine learning. Drones have become increasingly popular in recent years due to their ability to perform various tasks, including capturing aerial footage and providing an overview of large areas. In the field of accounting, drones can also be used for a variety of purposes.

One application of drones in accounting is for inventory management. Drones can be used to capture images of inventory and provide real-time data on inventory levels. This can help companies track inventory levels more accurately and prevent loss or theft. Additionally, drones can be used to perform physical inventory counts, which can save time and reduce the risk of errors. Another use of drones in accounting is for site inspections. Drones can be used to perform site inspections of construction projects or other sites, providing visual documentation of progress and potential issues. This can help companies better manage projects and identify areas that need attention.

Drones can also be used for asset management. They can be used to capture images of assets, such as equipment or buildings, and provide data on their condition. This can help companies identify areas where maintenance is needed, which can help extend the life of assets and prevent costly repairs. In addition to these applications, drones can also be used for environmental accounting. They can be used to capture data on air quality, water quality, and other environmental factors, providing companies with data they can use to improve their environmental performance [11].

However, there are also some potential drawbacks to using drones in accounting. One potential issue is the cost of purchasing and maintaining the equipment. Additionally, there may be legal and regulatory issues to consider, such as obtaining necessary permits and complying with privacy laws.

5. Using Drones to Improve Cash Flows in Construction Projects

As mentioned earlier, the use of drones in construction projects has been on the rise in recent years, as it offers numerous benefits in terms of efficiency, safety, and accuracy. One of the significant advantages of using drones is its ability to enhance cash flow management in construction projects. Cash flow management is crucial in any construction project, as it ensures that there is enough cash available to pay for the project's expenses at any given time. Drones can enhance cash flow management in the following ways:

1. Accurate Data Collection and Analysis Drones equipped with cameras, sensors, and GPS can collect accurate data on project progress, including the amount of material used, the number of workers on-site, and the status of the project's schedule. This data can be analyzed in real-time to determine whether the project is progressing as planned or if there are delays that may impact cash flow. The data can also be used to forecast future expenses and revenues, allowing project managers to make informed decisions to ensure adequate cash flow.
2. Improved Site Inspection and Monitoring Drones can provide a bird's-eye view of the construction site, allowing project managers to inspect and monitor the site remotely. This can significantly reduce the time and resources required for on-site inspections, resulting in cost savings that can be redirected to other project expenses. Additionally, remote monitoring can help detect potential issues early,

allowing for swift action to prevent costly delays and disruptions.

3. Enhanced Safety The use of drones in construction sites can significantly enhance safety by reducing the need for workers to perform hazardous tasks such as climbing scaffolds or working at heights. This can reduce the risk of accidents and injuries, resulting in lower insurance premiums and worker's compensation claims that can impact cash flow.

4. Improved Communication and Collaboration Drones can be used to capture visual data and share it with project stakeholders, such as contractors, subcontractors, and investors. This can enhance communication and collaboration, reducing the risk of miscommunications that can lead to costly errors and rework. Improved collaboration can also result in better cost control and budget management.

In conclusion, the use of drones in construction projects can significantly enhance cash flow management by providing accurate data collection and analysis, improving site inspection and monitoring, enhancing safety, and improving communication and collaboration. As technology continues to evolve, it is likely that drones will play an even more significant role in construction projects, leading to further cost savings and improved cash flow management. Drones have the potential to be a valuable tool for accounting professionals. They can be used for a variety of tasks, including inventory management, site inspections, asset management, and environmental accounting. However, companies must carefully consider the potential benefits and drawbacks of using drones and ensure that they comply with all legal and regulatory requirements. From the perspective of financial accounting, when ownership is passed from the seller to the buyer and the service is rendered, revenues are typically recognized at the point of sale. Yet, accounting for lengthy construction projects is rarely a straightforward procedure. Based on the progress of the construction project, contractors in these projects accrue money over time. If it is possible to estimate the present progress toward finishing the project, the construction firm (or the contractor) can accomplish this and collect income according to the lifespan of the construction project. As a result, the organization needs to determine how far along the project is on a regular basis.

Yet, in financial accounting, the auditor physically inspects the books to verify and measure the assets. In order to assess the project's progress level in this regard, the auditor (or a recognized third party) should be on-site at the construction site. Under some unforeseen circumstances, it might not be practicable or safe for the auditor-or even a third party-to be present on the job site. Also, it could be difficult for the auditor to travel to the construction site due to geographical restrictions. We propose a new mechanism to perform the auditor's site inspection through the use of a remote audit model that relies on drones to replace the physical existence of the auditor, keeping in mind the accessibility of the drone. The availability of (1) the auditor who possesses the necessary drone photography and videography skills, (2) the drone with the required specifications and technology to take videos and pictures of the construction site, and (3) AI-enabled software that includes logarithms to compare the captured videos and pictures with the blueprints for the construction site are all required in the following proposed process. The proposed procedure (shown in Figure 1) is set up so that the auditor flies a drone above the construction site and takes pictures from various perspectives. The auditor then confirms that all of the photographs were successfully captured. The software then compares the photographs obtained by the drone with the blueprints for the construction project once the auditor submits the images for analysis. The software then displays the construction project's completion rate as a percentage. Furthermore, [6] proposed four procedures for the usage of drones in construction inspection. Figure 2 shows these four steps.

Figure 3 (as proposed by [11]) displays a flowchart of cash flow management when a drone is utilized to determine the percentage of completion. As depicted in the figure, the client (the project owner), the project consultant (the lead consultant), and the project contractor are the three main participants in a normal construction project. Typically, the lead consultant is hired by the client (the project owner) to oversee and keep an eye on the project contractor's work. So, the consultant should approve of the project contractor's work. The contractor will require financial payments from the project owner in accordance with the project's progress. In this situation, the customer will pay the contractor after getting the lead consultant's signature on the payment certificate.

Other factors to take into account when using drone technology in auditing for long-term construction projects revenue recognition include:

1) The drone should be certified and approved by the auditor.
2) Ownership and control of the drone should be granted to the auditor.
3) The ERP system used should take into account the logarithms used to compare the captured images and videos with the construction site blueprints.
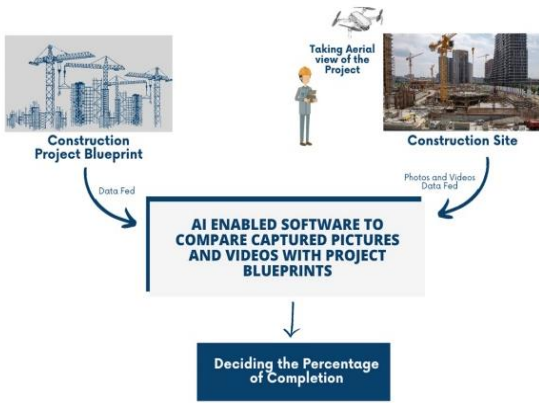4) The auditor should approve the logarithms used.

Figure 1. Applying the drone technology on revenue recognition of construction projects [13].
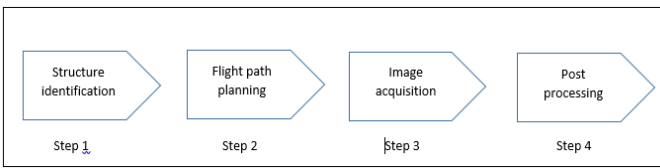

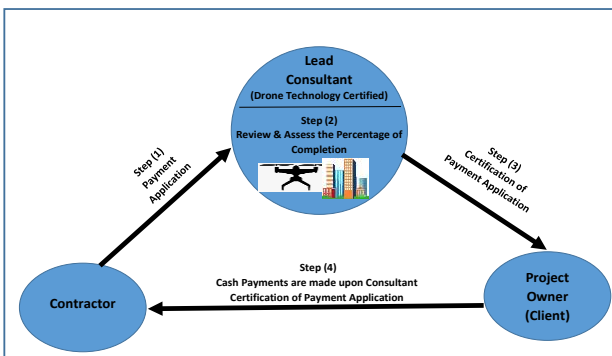Figure 2. Inspection workflow divided in four steps [6].

Figure 3. Proposed drone-enabled cash flow management in construction project [11].

6. Conclusions and Ways Forward

Because of the current, fast advancements in technology, it is seen that firms are undergoing significant alterations [2, 14]. Also, the use of robotic automation for some monotonous operations carried out by the auditor and the accountant has drawn more attention in recent years [10] than well as the deployment of remote auditing [10]. Consider using drones as one of these robotic technologies. This research recommended using drones in long-term construction contracts where the auditor must periodically evaluate the progress of these projects. The use of drones for inspections of bridges and highways is already common in the civil engineering sector, according to the literature [9, 15]. However, the use of this technology in the accounting and auditing fields is still in its infancy, and additional study is still required [3, 5]. Theoretically, this study explored the potential for using drone-shot photos and videos to evaluate auditors and gauge the progress of lengthy building projects. It is highly advised to do further study in this area in the future to put the theory into practice. To determine if this concept can be used in actual practice, applied study should be done in this area [4, 11]. The construction industry has been one of the most labor-intensive and capital-intensive industries. Construction projects require a substantial amount of resources, including time, money, and manpower. As such, efficient cash flow management is critical in ensuring that there is enough cash available to pay for the project's expenses at any given time. The use of drones in construction projects has been on the rise in recent years, offering numerous benefits in terms of efficiency, safety, and accuracy. One of the significant advantages of using drones is its ability to enhance cash flow management in construction projects. The paper provided the following advantages when considering the use of drones in construction projects to enhance cash flow management:

- Accurate Data Collection and Analysis: Drones equipped with cameras, sensors, and GPS can collect accurate data on project progress, including the amount of material used, the number of workers on-site, and the status of the project's schedule. This data can be analyzed in real-time to determine whether the project is progressing as planned or if there are delays that may impact cash flow. The data can also be used to forecast future expenses and revenues, allowing project managers to make informed decisions to ensure adequate cash flow.
  With drones, construction managers can easily track project progress, such as material delivery and usage, the amount of time spent on-site, and the number of workers on-site. By having real-time access to this data, project managers can optimize the use of resources, avoid unnecessary delays, and maintain project timelines, thereby improving cash flow management.
- Improved Site Inspection and Monitoring: Drones can provide a bird's-eye view of the construction site, allowing project managers to inspect and monitor the site remotely. This can significantly reduce the time and resources required for on-site inspections, resulting in cost savings that can be redirected to other project expenses. Additionally, remote monitoring can help detect potential issues early, allowing for swift action to prevent costly delays and disruptions.
  Drones can also be used for surveying and mapping the construction site, producing 3D models, and measuring the progress of the project. With drones, construction managers can remotely track and monitor the progress of the project, identify issues that may affect the budget, and make timely decisions to maintain the project's timeline and budget. By reducing the need for on-site inspections, drones can help minimize the risk of accidents and injuries, which can affect the project's budget and timeline.

- **Enhanced Safety**

The use of drones in construction sites can significantly enhance safety by reducing the need for workers to perform hazardous tasks such as climbing scaffolds or working at heights. This can reduce the risk of accidents and injuries, resulting in lower insurance premiums and worker's compensation claims that can impact cash flow.

In addition, drones can be equipped with thermal sensors, night vision cameras, and other technologies to identify potential hazards, such as unstable soil or dangerous weather conditions. By detecting and preventing potential hazards, drones can help avoid accidents that can affect the budget and timeline of the project.

- **Improved Communication and Collaboration**

Drones can be used to capture visual data and share it with project stakeholders, such as contractors, subcontractors, and investors. This can enhance communication and collaboration, reducing the risk of miscommunications that can lead to costly errors and rework. Improved collaboration can also result in better cost control and budget management.

By providing real-time updates and visual data, drones can facilitate collaboration between different stakeholders in the construction project. With access to the same data, project managers, contractors, and investors can make informed decisions, identify areas of improvement, and manage the budget more effectively. This can help prevent budget overruns, which can affect the project's cash flow and profitability.

It is also crucial to emphasize that careful regulatory and policymaking considerations would be needed before adopting this technology. For instance, [8] emphasized that organizations must create and maintain adequate controls for these new technologies by regularly updating current policies addressing information security, privacy, and confidentiality in accordance with judicial authorities. According to [3], a significant portion of the advantages of drone use will depend on drone-enabled software applications, drone-enabled security applications, and the technology's expanded potential. In conclusion, the use of drones in construction projects can significantly enhance cash flow management by providing accurate data collection and analysis, improving site inspection and monitoring, enhancing safety, and improving communication and collaboration. As technology continues to evolve, it is likely that drones will play an even more significant role.

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