1. Introduction  
   In today's business world, disruptive technologies have significantly reshaped various sectors, particularly in finance and accounting. The advent of digital transformation has been instrumental in driving value creation and competitive advantage. Technologies such as artificial intelligence, machine learning, cloud computing, blockchain, and robotic process automation (RPA) have particularly impacted the finance and accounting functions, reflecting the rapid evolution in this domain (Moll and Yigitbasioglu 2019).

A pivotal example of such technological influence is the introduction of enterprise resource planning systems (ERP). ERPs have revolutionized financial operations, enhancing cross-functional integration, centralizing control, and advancing automation. (Scapens and Jazayeri 2003; Matolcsy et al. 2005; Nicolaou and Bhattacharya 2008; Kanellou and Spathis 2013). This transformation has led to more efficient financial reporting and transparency, where accounting transactions are easily traceable and financial reports are generated automatically, marking a shift from manual to automated processes (Sutton 2006).

Empirical evidence supports the positive impact of such technologies. The integration of ERP systems has been extensively analyzed, showcasing its diverse impacts on organizations. The immediate value of these systems is evident through positive market responses post-implementation (Hayes et al. 2001). Furthermore, ERP adoption is correlated with enhanced financial performance, indicating its significant economic benefits (Hitt et al. 2002). In terms of operational efficiency, ERP systems have been shown to significantly improve business process effectiveness (Hunton et al. 2003). The strategic implications of ERP on corporate finances, especially in areas like earnings management, have been thoroughly examined, presenting a comprehensive view of its influence beyond traditional performance measures (Morris 2010). Additionally, Paredes and Wheatley (2018) extend this examination by investigating how the increase in managers' access to accounting data via ERP systems influences managerial behavior, particularly regarding real activities manipulation. Their findings suggest that after the implementation of an ERP, earnings management through real activities declines, indicating that ERP implementations enhance the quality of financial reporting by constraining opportunistic managerial behavior. This underscores the multifaceted benefits of ERP systems, not only in improving financial and operational performance but also in promoting more transparent and reliable financial reporting practices.

Despite extensive research on ERP systems, Robotic Process Automation (RPA) in accounting is a nascent field. Current literature predominantly explores theoretical aspects and potential impacts of RPA on accounting and auditing, primarily utilizing secondary data to understand its role in the digitization of accounting and interaction with related technologies (Tiron-Tudor et al. 2023). Although recent studies have ventured into qualitative analyses, examining motivations for RPA adoption and its broader implications for the accounting profession (Fernandez and Aman 2018; Moffitt et al. 2018; Zhang 2019; Asatiani et al. 2020; Korhonen et al. 2021), studies employing quantitative methodologies are conspicuously sparse.

This research examines the effect of Robotic Process Automation (RPA) on different facets of earnings management, specifically focusing on real activities manipulation (denoted as RM) and accrual-based earnings management (denoted as AM), which are key aspects of financial integrity and corporate governance. Our multivariate regression analysis reveals a nuanced impact of Robotic Process Automation (RPA) on EM. We find a significant reduction in RM with RPA implementation, suggesting its role in promoting ethical financial reporting by automating processes and enhancing transparency. However, there's no direct link between RPA and AM. Interestingly, firms utilizing RPA with restrained AM practices also show lesser RM, indicating an indirect influence of RPA on promoting broader ethical financial practices. Furthermore, our study uses various proxies and employs the propensity score matching method in our regression analysis to ensure the robustness of our findings. This approach helps to mitigate potential biases and provides a more accurate assessment of RPA's impact on RM.

This pioneering empirical study utilizing model regression analysis to explore RPA's impact on EM highlights its significance for various stakeholders, including industry professionals, policymakers, and academic researchers. For industry professionals, the findings suggest integrating RPA can lead to more ethical financial practices. Policymakers may consider these insights to guide regulatory frameworks that encourage transparency and integrity. For researchers, this study opens new avenues for investigating RPA's effects across business sectors. It underscores the importance of RPA in advancing financial transparency and integrity in the digital age, marking a significant contribution to both academic dialogue and practical application.  
  
The remaining sections of this study is as follows: The second section is literature reviews and development of hypotheses; the third part is sample selection and research design; the fourth section is the univariate and multivariate results, the fifth section is additional analyses; and the last section is the conclusion of this study.

1. Literature Review & Development of Hypotheses
   1. What is RPA?  
      Robotic Process Automation (RPA) is a transformative technology that automates manual, rule-based, and repetitive tasks by mimicking human interactions with digital systems. According to UiPath, leading RPA software provider, RPA is designed to operate across various applications and systems without modifying existing infrastructures, emphasizing efficiency and productivity enhancements by automating mundane tasks (UiPath Website). This aligns with Jędrzejka (2019), who discusses RPA's role in automating tasks that were traditionally manual, enhancing operational efficiency and allowing employees to focus on more strategic tasks.  
        
      The finance and accounting sector, as outlined by Jędrzejka (2019) and supported by Fernandez and Aman (2018), has been the primary adopter of RPA technologies. This sector has utilized RPA to automate tasks such as transaction processing, audit preparation, and financial reporting, driven by the sector's need for precision and the high volume of repetitive transactions. The accounting department, in particular, benefits from RPA's ability to execute tasks with high accuracy and efficiency, addressing the industry's challenge of managing routine, error-prone tasks.  
        
      RPA's benefits, particularly in finance and accounting, are manifold. Jędrzejka (2019) and Le Clair (2017) highlight RPA's potential to reduce operational costs, enhance process speed, and improve accuracy. RPA's ability to operate continuously, its scalability, and ease of implementation make it a valuable tool for the sector. These benefits directly address the needs of the accounting department, emphasizing RPA's role in transforming the industry by making operations more efficient and reducing the likelihood of errors in financial reporting.
   2. Automation Tools: from ERP to RPA  
      Enterprise Resource Planning (ERP) systems have been foundational in automating business processes, as discussed by Shehab et al. (2004) and Al-Jabri and Roztocki (2015). These systems have enabled significant improvements in productivity, data sharing, and decision-making across organizations. ERP systems have streamlined financial data integration, inventory management, and resource planning, contributing to operational efficiency and improved decision-making capabilities. (Jędrzejka 2019; Sutton 2006).  
        
      In terms of finance and accounting, as noted by Jędrzejka (2019), ERP systems have facilitated an unprecedented level of cross-functional integration, centralized control, and automation. This has led to considerable efficiency improvements, revolutionizing how accounting transactions are managed. Specifically, ERP systems have enabled the detailed tracking of accounting transactions to individual employees or specific events, such as scanning a barcode, enhancing accountability and traceability within financial operations. Moreover, the automation capabilities of ERP systems have transformed the generation of financial reports. As highlighted by Sutton (2006), financial reports, which traditionally required intensive manual effort by teams of accountants, are now increasingly generated automatically. This shift results from ERP systems' ability to encode procedures and rules into the software, thereby streamlining the reporting process. This evolution has not only improved efficiency but also reduced the potential for human error, leading to more accurate and reliable financial reporting.   
        
      However, ERP systems' limitations become apparent in handling highly repetitive, rule-based tasks requiring interactions with multiple systems, often necessitating manual intervention (Tiron-Tudor et al., 2023). RPA addresses these limitations by automating such tasks without the need for direct system integration, serving as a complementary technology to ERP. This combination enhances the automation capabilities within finance and accounting departments, particularly in improving data processing transparency and data quality, essential for financial reporting and earnings management (Jędrzejka, 2019; Al-Jabri and Roztocki, 2015).

Namely, RPA acts as a vital extension and complementary role to ERP systems, specifically targeting the automation of tasks that ERP systems struggle with due to their rigid structure, particularly in handling specific, repetitive tasks like data entry and report generation. By operating at the user interface level, RPA seamlessly fills this flexibility gap without the need to modify existing systems, ensuring tasks are performed with greater speed and accuracy. This capability enhances organizational efficiency, data accuracy, and transparency in finance and accounting, thereby supporting earnings management and boosting competitiveness. Importantly, both ERP and RPA technologies are united by their core objective to elevate operational efficiency and data accuracy within organizations. While ERP systems provide a comprehensive integration and automation of core business processes to ensure data consistency and aid in decision-making, RPA complements these functions by addressing the automation of rule-based, repetitive tasks, minimizing errors, and liberating human resources for more strategic roles. (Jędrzejka, 2019; Shehab et al., 2004).

* 1. Earnings Management with automation tools  
       
     Exploring the Robotic Process Automation (RPA) and EM relationship opens a novel research avenue. With scant direct empirical evidence linking RPA, especially to EM, we're charting new territory rather than facing a traditional limitation. RPA's role in boosting operational efficiency and data accuracy in finance mirrors the documented benefits of Enterprise Resource Planning (ERP) systems. Although prior studies have shed light on ERP's effects on EM, RPA's specific impact awaits thorough exploration. Viewing RPA as an ERP extension, especially in tasks challenging for ERP, frames this gap as an alternative research path. This stance enables leveraging ERP studies as a base, while considering RPA's unique potential in EM. The subsequent sections will detail prior ERP and both types of EM research and propose hypotheses connecting RPA to earnings management. This approach not only bridges the current knowledge gap but also sets the stage for future work, aiming to broaden our grasp of automation's role in financial practices.  
     1. Accrual-based earnings management with automation tools  
        The first hypothesis of this study explores the potential impact of Robotic Process Automation (RPA) on financial reporting quality, particularly focusing on discretionary accruals and internal control weaknesses. Reflecting on the documented benefits of Enterprise Resource Planning (ERP) systems in enhancing the quality of financial reporting—as demonstrated by Morris (2010), who found ERP implementation to lead to reduced AM—we propose a similar investigative lens for RPA. ERP systems have been shown to offer more efficient and effective information processing, leading to improved financial reporting quality (Morris 2010). Incorporating the viewpoint of internal control weaknesses, research findings suggest that ERP implementation can enhance internal control systems, making it less likely for firms to report internal control deficiencies (Morris 2011). This enhancement is crucial since weaknesses in internal controls are often associated with increased levels of EM (Chan et al. 2008; Ashbaugh-Skaife et al. 2008). Given RPA's role in automating financial transactions and processes, like ERP systems, it stands to reason that RPA could also contribute to the strengthening of internal controls and the reduction of EM through more accurate and transparent financial reporting.  
          
        H1: The firm with RPA implementation will be less likely to engage in AM.
     2. Real activities manipulation with automation tools  
          
        Given that Lenard et al. (2016) identified a positive relationship between firms reporting internal control weaknesses (ICWs) and real activities manipulation, and those firms utilizing RM to meet earnings benchmarks exhibit lower performance in subsequent years, it is evident that ICWs significantly contribute to the propensity for RM as a form of EM. This inclination towards RM among ICW-firms underscores the challenge of maintaining robust internal controls to mitigate earnings management through operational means.  
          
        Morris (2011) complements this understanding by showing that firms implementing ERP systems are less likely to report ICWs compared to non-ERP-implementing firms. This suggests that ERP systems might enhance internal control quality, thereby reducing the likelihood of RM by improving the accuracy and reliability of financial reporting and operational efficiency.  
          
        H2: The firm with RPA implementation will be less likely to engage in RM.
     3. Interaction between two measures of EM in terms of RPA implementation  
          
        From the insights of Zang (2012) and the complementary hypothesis by Chen et al. (2012), our hypothesis development for RPA's influence on EM practices considers the trade-offs between AM and RM. Given the relative costs and benefits highlighted in prior research, we hypothesize that the implementation of RPA in firms may alter the cost-benefit dynamics of AM and RM, potentially leading to a shift in how these tools are utilized. Specifically, we propose to explore whether RPA implementation makes one form of earnings management more favorable over the other or if it encourages the complementary use of both, without specifying the direction due to the novelty of RPA in this context:

H3: In the realm of RPA implementation, variations in AM practices are associated with variations in RM practices, reflecting the evolving cost-benefit considerations of earnings management tools.

1. Sample Selection and Research Design
   1. Main interest of variable: RPA implementation Indicator   
      Building on this foundation, our study specifically targets the domain of RPA technology adoption. The approach mirrors the document analysis strategy utilized by Paredes and Wheatley (2018) in their examination of ERP implementations through 10-K SEC filings. Their meticulous analysis, which highlights the insights that can be garnered from corporate disclosures despite potential biases, serves as a methodological benchmark for our work.  
        
      Employing a systematic keyword search strategy within the digital annual reports of firms listed on Taiwan Stock Exchange (TSE) or Gre Tai Securities Market (OTC), we aim to compile an exhaustive dataset on RPA implementation. This strategy is enabled by the digital accessibility and legal requirement for these firms to submit their annual reports electronically, which facilitates a more efficient and accurate data extraction process. The search terms included "Robotic Process Automation," "RPA," and its Mandarin counterpart "機器人流程自動化," ensuring that our identification of relevant disclosures was as precise as possible.  
        
      In addition, our methodology assumes continuity in RPA initiatives; if a firm reported RPA adoption in one year, we marked it as continuing its RPA engagement (indicator denoted as 1) in the following year, even if the subsequent report did not explicitly mention RPA. This approach acknowledges the ongoing impact of RPA projects, if once a firm embarks on RPA, the effects and implementations are sustained over time. This assumption allows for a deeper analysis of the influence and permanence of RPA technology within firms.
   2. Sample  
      In our study, we meticulously outlined the selection and classification of sample firms that have adopted RPA between 2017 and 2022, as detailed across three distinct panels. Panel A elucidates the selection steps, beginning with an analysis of text from annual reports, ensuring that each company was publicly listed during the specified period, and belonged to an industry with at least 15 firm-year observations for EM proxies calculation, resulting in 83 unique firms. Notably, financial institutions coded with M2800 were excluded, despite their potential prevalence in our sample. Panel B further categorizes these firms by industry, revealing a diverse representation across 21 different sectors according to the TSE industry codes. Lastly, Panel C delves into the implementation timeline, offering a year-by-year breakdown of RPA adoption among these firms from 2017 to 2022, thereby providing a comprehensive overview of our sample selection methodology and the industry-wide spread of RPA utilization.

Following Morris (2010) and Paredes and Wheatley (2018), we match another 83 comparable individual firms without RPA implementation as a control group, based on the pairing criteria of the same industry code and closest average total assets during sample periods from 2017 to 2022.

* 1. Accrual-based Earnings Management

In the analysis of AM, the absolute value of discretionary accruals is employed as a proxy, reflecting the dual potential for managers to manipulate earnings both upwards and downwards. This choice is supported by seminal studies (e.g., Jones 1991; Becker et al. 1998), emphasizing the significance of capturing the full spectrum of AM activities. The estimation of these discretionary accruals is conducted using modified Jones model. The differences are considered to represent the discretionary component of accruals (see Appendix A for details), thereby serving as an indicator of AM. This methodology underscores the nuanced understanding that earnings manipulation can involve both overstatements and understatements, aiming to provide a comprehensive measure of such practices.

* 1. Real Activities Manipulation

Drawing upon established research, this study employs proxies for RM as Zang (2012). These proxies—abnormal production costs (ABPROD) and abnormal discretionary expenses (ABEXP)—serve as indicators of managerial strategies aimed at influencing financial reports to meet earnings expectations. (see Appendix A for details) This framework identifies key manipulative tactics, including overproduction, and discretionary spending cuts, as mechanisms for short-term earnings enhancement at potential long-term detriment. As the concerns Zang (2012) mentioned, another proxy abnormal cash flows delineated by Roychowdhury (2006) is featured by its ambiguous net effect and manipulation directions. As a results, we also exclude this proxy as a RM measurement in our research.   
  
Moreover, this study introduces a combined measure (RM) that aggregates the three proxies to offer a comprehensive view of managerial manipulation impacts on financial reporting. This approach, rooted in the methodologies of prior research like Cohen and Zarowin (2010), aims to provide a nuanced understanding of real activities manipulation and its consequences for financial integrity and governance.

* 1. Empirical Models

Following previous studies such as Zang (2012) and Chen et al. (2012), simultaneous equations of AM and RM are applied to deal with potential endogeneity problems between AM and RM, which may lead to biased and inconsistent coefficient estimation through OLS. We take alternative approach compared to Hausman test to configure whether endogeneity problems occur in the two equations, we first regress AM and RM on exogeneity (control) variables of each equation model to calculate residuals of AM and RM. And then regress AM (RM) on RM (AM) and the residuals of RM (AM) to check whether the coefficient of the residuals equal 0 or not. Once the coefficient of the residuals is not equal to 0, we can reject the null hypothesis that the RM (AM) is exogeneity in the equation due to its correlation between error term and then choose 2SLS to avoid endogeneity bias from OLS.   
  
Following Cohen and Zarowin (2010) and Zang and Chen et al. (2012), to capture the relationship between EM and RPA implementation, the common control variables for both equations, control variables specific for AM, and control variables specific for RM are all considered to construct simultaneous equations.  
  
Below simultaneous equations aim to test for the within RPA implementers group:

Below simultaneous equations, on the other hand, is utilized to test for both RPA implementers group and control group:

As for our main variables of interests, RPA is an indicator denoted as 1 if the firm-year observation is in the RPA-implemented and post-implemented year. ADPT is an indicator to describe the treatment group as 1 and control group as 0.   
  
In our study, a set of common control variables (CVs) to delineate the effects of various firm-specific and market factors in both equations. These CVs include leverage (LEV) and market-to-book ratio (MTB) to gauge financial structure, Operating Cash Flows (OCF) for the firm's liquidity impact on EM, firm size (LGTA) for size effects to evaluate the influence of audit quality on EM practices. (Becker et al., 1998)   
  
To address the costs associated with AM and RM following Zang (2012), industry-year market share (MS), the percentage of institutional investors (INST), Altman’s Z-score (ZSCORE), net business operating cycle (CYCLE), and net operating assets (NOA) are included. Instead of using ROA, we adopt industry-adjusted ROA (ADJROA) following Kim et al. (2012) and the square number of ADJROA as considered by Kothari et al. (2003) for the non-linear relationship between firm’s performance and its abnormal accruals. Last, we also take short-term credit risk measurement (CL) following study from Roychowdhury (2006).  
  
As for specific variables taken into consideration in each equation, the big four audit firm indicator (BIG4) consistent with Chen et al. (2012) is tailored for AM equation. As for the control variables specific for RM equation, R&D Intensity (RD) and advertising intensity (ADV) are also incorporated as measures of a company's commitment to innovation and marketing promotion, as discussed in the literatures (Chouaibi et al. 2019; Tanveer et al 2022). Through this comprehensive set of control variables, our analysis aims to provide a nuanced understanding of how RPA implementation might influence EM, considering a wide array of factors that could affect this relationship.

1. Univariate and Multivariate Results
   1. Descriptive statistics  
      The table2 presents descriptive statistics results. Panel A shows the summary statistics of full sample with 9,780 observations. All continuous variables are winsorized at the top and bottom 1 % of their distribution. The sample means (medians) of ABSDA and RM are 0.05594 (0.03971) and -0.00044 (0.01133). Besides, the mean of BIG4 is 89%, showing that almost ninety percent of our sample are audited by big four audit firms. Panel B shows the comparison between RPA and non-RPA observations. Among earnings management measures, there exists no significant difference between RPA and non-RPA observations in all RM proxies, while AM is significantly less in RPA observations compared to non-RPA observations indicating that the negative relation between RPA and AM. As for control variables, with exception of AGE, MTB, and OCF, all the other control variables exhibit a significant difference between RPA and non-RPA observations. We observe that RPA observations featured higher percentage of institutional investors, higher market share, better ESG (CSR) performance, higher leverage, larger size, and lower intensity of R&D or advertising than non-RPA observations. Panel C shows the correlation matrix for all continuous variables. RPA is positively associated with ADJROA, INST, MS, ESG, LEV, and LGTA, while RD and ADV are significantly and negatively related to RPA.   
      (Insert Table2)
   2. Testing for endogeneity and 2SLS  
      Based on the testing procedure described in the section 3.5, we find that all the coefficient of the residuals AM (RM) are all significantly not equal to 0, indicating that 2SLS is the preferable approach rather than OLS. As a result, the subsequent multivariate section will adopt 2SLS to conduct regression analyses. We regress AM (RM) on all control variables to obtain predicted AM (RM), which is the fitted value from the first stage equation. Table 3 shows all the multivariate results of the first stage equation. In the second stage, these fitted values are utilized instead of the actual value of the proxies.
   3. Within treatment group analysis  
        
      The table4 presents the multivariate results of the second stage of both equations with four models. The coefficient of main interest variable RPA is all positively significant at 10% level in AM model, showing that the extent firms engage in AM increase after RPA adoption and consistent with our hypothesis 1.   
        
      Similarly, all RM proxy models given AMhat, the AM proxy predicted from first stage equations, the coefficients of RPA are all positively significant in ABPROD, ABEXP, and RM models (P<0.05, <0.01, <0.01 respectively), meaning that the extent firms engage in RM increases after RPA adoption and consistent with our hypothesis 2.   
        
      As for whether complementary or substitutive effect between two EM approaches, the coefficients of RMhat and AMhat are all significantly negative in the AM equation, ABEXP equation and RM equation. (P<0.1, <0.01, and <0.05). It implies that firms take one of the EM initiatives will be less likely take the other one as well, showing the substitutive effect between AM and RM, which is consistent with prior research. (Zang 2012, Cohen and Zarowin 2010)   
        
      As for the other control variables in AM equation, we find that larger firms will be less likely to manipulate accruals since the negative coefficients of LGTA at 1% significant level. The positive coefficient of the square of ADJROA (P<0.01) shows a nonlinear relationship between the performance of the firms and abnormal accruals, meaning that firms will engage in AM when ADJROA is too high or too low.   
        
      As for the other control variables in RM proxy equations, we find generally that firms with higher NOA will be more likely to engage in RM. Firms with higher advertising intensity, on the other hand, will have less tendency to take RM approach in terms of EM. And the coefficients of NOA and ADV are all positive and negative at 1% significant level in all RM proxy equations.   
        
      To sum up, we cannot conclude that the firms with RPA implementation will be more likely to manage their earnings via accounting accruals, which rejects our H1 from the multivariate regression model results in the full sample.  
      (insert Table3)
   4. Matched result analyses
2. Additional Analyses
   1. Alternative measures of discretionary accruals   
      Aside from using modified Jones model to calculate discretionary accruals, we rerun our sample data through that from standard Jones model and obtain similar results regarding our testing main interest variables in both earnings management regression models.
   2. Alternative measures of Real activities manipulation

To capture the total comprehensive effects of real earnings management, we follow Cohen and Zarowin (2010) to adopt the two comprehensive metrics of RM activities, RM1 and RM2 respectively. RM1 is defined as the aggregation of ABPROD and ABEXP, whereas RM2 is derived from sum of ABCFO and ABEXP. The testing results remain robust after applying these two measures in the real activities manipulation regression, which still supports the hypothesis 2 and hypothesis 3.

* 1. Propensity score matching  
     Due to the fundamental difference across several aspects such as firm size (LGTA) between RPA and non-RPA observations within our full sample, we take propensity score matching method (PSM) as the robustness testing approach to capture the effect of the RPA on EM. To test this alternative approach, we follow the suggestions and methodology from Shipman et al. (2017). First, we perform logistics regression based on both AM and RM specifications, which regresses the main interest variable RPA on the same independent variables from the specifications. Both matching logistics regression without caliper settings end up matching 328 observations with nearest propensity score. This way, we obtain total samples 656 as matched dataset after PSM with half of RPA implementation observations and half of matching samples without RPA implementation. The matched dataset statistics as following tables. There seems no significant difference in means between the two groups compared with the full sample scope (see table 5, 6), indicating that the two groups are similar in the observable aspects, and our matching process is valid. (see Table 7)  
       
     Consistent with the results via full sample, the rerun regression results about the main interest variable and its interaction terms remain the same.   
       
     (Insert Table 5, 6, 7)

1. Conclusion  
     
   The advent of Robotic Process Automation (RPA) heralds a new era in the technological evolution of finance and accounting Despite the proliferation of empirical research on ERP technologies, the empirical examination of RPA, particularly in its relation to earnings management, remains largely unexplored. This study positions RPA as an innovative extension of ERP, venturing into novel empirical terrain to explore its potential implications on earnings management practices, thereby filling a significant gap in the existing literature.  
     
   This study discusses about association between the presence of RPA and earnings management among 9,780 firm-year observations from 2017 to 2022, sample collected the annual reports. AM is measure by the discretionary accruals from modified Jones model, while RM proxies re calculated from difference between normal levels of cash flows, production costs, and discretionary expenses. From the full sample results, AM seems no difference between RPA and non-RPA observations, on the other hand, the firms with the presence of RPA will be less likely to partake RM as an approach to manage earnings. Most interesting, the third hypothesis of the interaction terms indicates that the strategic choices firms make regarding AM and the adoption of RPA reveal a nuanced landscape. Firms that exercise restraint in AM and are cautious with RPA adoption demonstrate a commitment to transparency and ethical standards, resulting in more reliable financial statements and potentially higher firm valuation. This approach signals a dedication to upholding high governance and ethical practices. Conversely, when firms synergize AM with RPA, it leads to amplified effects to RM, indicating a move towards more aggressive earnings management strategies. This combination of EM tactics and advanced technology poses challenges for stakeholders like policymaker, auditors, or other stakeholders, emphasizing the importance of a nuanced understanding of their collective impact on financial integrity and the need for sophisticated analysis about this RPA application among the firms.  
     
   The limitations of this study can be delineated along two primary dimensions. Firstly, the unavailability of specific contract details necessitated reliance on annual reports as a methodology for gathering data on Robotic Process Automation (RPA), potentially leading to discrepancies when compared to the direct contract information. Secondly, the emergent nature of RPA within the Taiwanese context restricts the breadth and depth of empirical evidence, underscoring the importance of interpreting the findings with caution and indicating directions for future research to build upon these initial insights.  
     
   For subsequent research endeavors that aim to investigate the intersection of RPA with accounting or auditing, focusing on the potential weaknesses in internal controls related to Earnings Management (EM) could provide valuable insights, a topic not directly addressed in this study. Furthermore, given the constraints posed by the limited data availability due to the nascent stages of RPA development, future studies are encouraged to undertake a more detailed examination of RPA implementation levels. Drawing inspiration from the methodology of Brazel and Dang (2008) in their ERP research, which gauges the extent of ERP integration through the count of system modules, the depth of a company's RPA utilization could similarly be evaluated based on the quantity of both attended and unattended licenses, offering a direct measure of RPA's operational engagement.
2. Appendix A

Consistent with the prior literatures, we run the following prediction model for each year within each TSE industry code at minimum of 15 observations. (Zang 2012; Brazel and Dang 2008; Paredes and Wheatley 2018 etc.)

* 1. Accrual-based proxy  
     We use the modified Jones model to calculate the accrual-based earnings management proxy. As modified Jones model, this model is a firm-specific measure based on cross-sectional estimation. According to this model, total accruals are affected by the change in sales, level of property, plant, and equipment:   
     where TA is net income from continuing operations minus operating cash flows; A is total assets; S is net sales; PPE is gross property, plant, and equipment.
  2. Real activities manipulation proxies
     1. ABPROD  
        Another measure of real activities manipulation as mentioned from prior studies is abnormal production costs.

where production costs (PROD) are the sum of operating costs and change in inventory; A is total assets; S is net sales. Operating costs is defined as the necessary expenditure incurred to bring inventory to a salable condition and location or ready for production in TEJ database, which is the sum of costs of goods sold, cost- rent expenditure, cost- sale of land, cost- disposal of investment, and cost- investment loss.

* + 1. ABEXP  
       The last measure of real activities manipulation as mentioned from prior studies is abnormal production costs.

where discretionary expenses (EXP) is the operating expense; A is total assets; S is net sales. Operating expenses is defined as expenses incurred by a business from its operating activities in TEJ database, which is the sum of selling expenses, administrative expenses, R&D expenses, other expenses, and expected credit losses (loss) benefit- operating expenses.