Omnichannel Retailing: An Exploratory Study of the Postadoption of Radio-Frequency Identification Technology contributing to the Quality of Financial Information

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ABSTRACT

This paper aims to examine the factors affecting the postadoption of RFID technology as part of omnichannel strategies in the retail industry. In addition, it evaluates how this innovation contributed to the improvement of the quality of corporate financial information. We employed an exploratory multiple-case study design based on qualitative research, by using semi-structured interviews, and public financial and sustainability reports as sources of evidence. The data collection and analysis were performed in 2022 for the pilot case of a manufacturer and the formal cases of three retailers. The results reveal that RFID postadoption is influenced by technological factors (relative advantage, observability, trialability, and perceived costs), organizational factors (top management support and firm size), and environmental factors (competitive pressure and external support). Surprisingly, loss recognition and loss provision are the most affected accounting practices, differently from what has been suggested by the accounting literature. We also found that item-level RFID enables increased frequencies of full inventory counts, providing inventory accuracy of records and real-time inventory visibility. This results in the improvement of accounting information quality in terms of relevance, faithful representation, timeliness, comparability, understandability, verifiability, and value-added. Our findings may contribute to both research and practice, as well as IS and accounting fields. We identified and investigated the phenomenon of the recent movement of RFID adoption by large retail companies listed in B3 during the COVID-19 pandemic in Brazil. Finally, we provide a theoretical model based on the TOE framework integrated to a construct of accounting information quality specifically developed for the RFID postadoption context.

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Introduction

The emergence of new digital channels has led retail companies worldwide to develop omnichannel strategies to integrate digital and physical channels into a single customer experience (Liu et al., 2022). The omnichannel strategy rests on craving an indulgence of avenues for customers to fetch products online from a desktop or mobile device or in a brick-and-mortar store, fostering convenience to address consumer needs in an integrated format. COVID-19 has accelerated the growth of omnichannel adoption as this crisis modified firms and consumer behaviors due to social distancing policies, the closing of physical stores, and limited access to goods and services (Trabucco & De Giovanni, 2021).

Retailers face challenges in the omnichannel environment to meet consumer demands for shorter lead times and higher product availability with lower costs (Park et al., 2021). These companies seek to reduce stockouts by maintaining accurate inventory data in the company’s systems (Bixler & Honhon, 2021). Inventory discrepancies are mainly caused by system transaction errors, theft of products, inventory shrinkage, and inventory misplacement that cause financial and operational impacts on the entire supply chain (Dai & Tseng, 2012).
A growing number of retail companies worldwide are implementing item-level RFID in their supply chains, especially in apparel industries (Zhang et al., 2018; Li et al., 2018; Cilloni et al., 2019). Radio Frequency Identification (RFID) became one of the most important technologies utilized in the Internet of Things (IoT) applications (Skiljo et al., 2020) providing means to achieve inventory accuracy, real-time inventory visibility, channel integration, and supply and demand alignment for omnichannel environments (Caro & Sadir, 2019). In addition, RFID adoption contributes to customer-oriented services such as ‘buy online, pick up in store’ (BOPS) (Caro & Sadir, 2019), smart shelves, and smart fitting rooms (Hauser et al., 2021). Thus, the resulting RFID benefits for retailers may include improved inventory ratios, increased operational performance and flexibility, reduced operational risks and costs, and enhanced sales efficiency and profitability (Shin & Eksioglu, 2015; Rejeb et al., 2020).

Academics and industry professionals consider RFID as an evolution of traditional barcode technology (Cilloni et al., 2019) due to its capabilities to encode, identify, trace, and track unique objects across manufacturing, inventory, and retail environments. The RFID system makes it possible to read multiple tagged objects simultaneously at high speed, as its reading range does not require physical or visual contact between the tag and the RFID reader (Goyal et al., 2016; Khayyam et al., 2022).

The industry growth of the global RFID market is expected to reach USD 17.4 billion by 2026 (Markets and Markets, 2021). In Brazil, the largest competing companies in the retail industry have been investing in omnichannel strategies. Retailers such as Lojas Renner, C&A, Centauro (Grupo SBF S.A.), Pernambucanas, Riachuelo, and Hering have recently disclosed information about their RFID projects as part of omnichannel initiatives in their annual financial and sustainability reports.

In the information systems (IS) literature, most studies focus on the intention and decision to adopt RFID, as well as the technological, organizational, and environmental factors affecting the early stages of RFID adoption in organizations (Bhattacharya & Wamba, 2015; Wamba et al., 2016; Reyes et al., 2016; Tu, 2018; Mabad et al., 2021; Mahdaly & Adeinat, 2022). Nevertheless, a successful adoption does not ensure the achievement of technology diffusion at the enterprise level. For this reason, research must advance toward the next stages of the widespread use of technological innovation in the company (Zhu et al., 2006).

This research gap indicates the need to examine the RFID postadoption in organizational settings in which the technology use is spread throughout the value chain activities. In addition, we also identified the absence of omnichannel issues in most of the RFID studies on the retail industry. Thus, we formulate the first research question of this study:

RQ1. How do technological, environmental, and organizational factors impact the postadoption of RFID technology aligned to omnichannel strategies in retail companies?

Moreover, few studies examine the effects of RFID adoption on perceived benefits. For instance, Reyes et al. (2016) findings present positive impacts of RFID implementation on customer service, productivity, asset management, and communication of timely and accurate information to relevant parties. RFID and IoT applications improve enterprise accounting information by combining business data and financial data (Dai & Ge, 2015), and facilitate high-precision financial statements (Arif et al., 2020).

The accounting research field presents new solutions to produce and share accounting information through the RFID adoption, and to provide benefits to corporate digital reporting and disclosure. Studies provide insights regarding the improvement of accounting practices regarding specific-unit costing, real-time inventory costing data, last in first out (LIFO), and other stock valuation methods (Vasarhelyi et al., 2015), dynamic pricing (Caro & Sadir, 2019; Cornacchiene et al, 2023), depreciation and amortization methods, fair value accounting, obsolescence trend models and auditing (Krahel & Titera, 2015).

Nevertheless, the existing literature needs more empirical evidence on the practical use of RFID solutions and their implications on accounting (Valentinetti & Munoz, 2021). Considering this second research gap, the present study attempts to address the following research question:

RQ2. How do accounting practices change due to RFID postadoption?

Finally, we present the third research question regarding the accounting information quality and its qualitative attributes based on Valentinetti and Munoz (2021) and Wu et al. (2019):

RQ3. How does the RFID postadoption significantly enhance the qualitative characteristics of financial information (relevance, faithful representation, understandability, timeliness, comparability, and verifiability)?

This paper contributes to both IS and accounting research fields by proposing an integrated theoretical model that addresses the postadoption of RFID technology and its effects on accounting practices and accounting information quality, thereby extending the TOE framework (Tornatzky & Fleischer, 1990).

Our research identified and examined the recent movement of RFID adoption by large retail companies in Brazil as part of their omnichannel strategies. Considering that this phenomenon has not been investigated, we believe that our findings open up opportunities for further studies and provide insights to industry professionals and organizations regarding the aspects of RFID's actual use and the improvement of the quality of financial reports for decision-making.

This paper is divided into five sections. Following this introductory section, the second section presents a resulting model of the literature review on technology adoption, RFID, and accounting information quality research. The third section describes the research methodology including the pilot and the three formal cases study. Next, the results are discussed by addressing the research questions.
and developing propositions. Finally, the conclusion section presents implications, contributions, limitations, and suggestions for future research.

**Literature Review**

**The technology–organization–environment (TOE) framework**

The adoption of technological innovations by people and companies is one of the most studied topics in IS research, which resulted in different theoretical models. The unified theory of acceptance and use of Technology (UTAUT) is one example of a widely used framework that focuses on individual behavior in adopting innovations such as big data analytics (Iguma, & Riccio, 2020), influenced by factors of performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003).

Our study focuses on technology adoption at the organizational level. The technology–organization–environment (TOE) framework provides a theory that examines three dimensions of a company’s context that influence the decision to adopt a novel technology (Tornatzky & Fleischer, 1990). TOE is considered the most accepted framework by qualitative (Ramanathan et al., 2017), mixed method (Tu, 2018), and quantitative research studies on the adoption of innovative technologies in organizational settings (Lai et al., 2018). These innovations include m-commerce (Justin et al., 2022), blockchain (Kouhizadeh et al., 2020), big data (Maroufkhan et al., 2020), and business analytics (Nam et al., 2019) in different industries including manufacturing, retail, IT, and healthcare (Maroufkhan et al., 2020).

In addition, the accounting literature examines the adoption of generalized audit software (Widuri et al., 2016), audit analytics (Li et al., 2018), and advanced data analytics (Krieger et al., 2021).

The use of the TOE framework has been observed in the RFID adoption in the logistics industry (Mahdaly & Adeinat, 2022), construction firms (Mabab et al., 2021), supply chain management (Tu, 2018), small and mid-sized enterprises (Fosso Wamba et al., 2016), retail industry (Bhattacharya & Wamba, 2015; Tsai et al., 2010), and manufacturing industry (Wang et al., 2010).

Although much of the extant literature focuses on the decision-making process to implement new technology, there is an increasing research interest in the long-term and continued evolution of the use of technologies by companies.

Zhu et al. (2006) developed a model that integrates TOE framework dimensions as antecedents of the three-stage assimilation of e-business innovations by firms: initiation is the stage of evaluating the potential benefits of e-business to improve organizational performance (preadoption); adoption is the decision-making stage on the e-business adoption (formal adoption); and routinization refers to the full-scale deployment in which e-business becomes an integral part of the value chain activities (postadoption) (Zhu et al., 2006).

Junior et al. (2019) reported multiple impacts of ERP adoption on farms considering three levels of adoption: evaluation, adoption, and routinization. Nam et al. (2019) use the concept of assimilation rather than routinization as the third stage of IT adoption, which means achieving a more efficient performance of business activities than competitors. Hence, the TOE three-stage model is considered suitable for our scope of study on the actual use of RFID solutions.

Our literature review also revealed that very few studies assess the impacts on the benefits received from RFID adoption by organizations. For instance, Reyes et al. (2016) proposed that customer service, productivity, asset management, and communication are the subconstructs of perceived benefits from RFID. The results show that these benefits increase as a company progress through the three stages of RFID adoption.

The present study focuses on the communication dimension according to Reyes et al. (2016), in terms of the perceived improvement of timely and accurate information produced and disseminated to internal and external users of the company, especially, the accounting information quality (AIQ).

In the financial accounting literature, the study on AIQ encompasses different earning quality proxies: earnings persistence; value relevance; timeliness; earnings smoothness; quality of accruals; loss avoidance; conservatism; and timely loss recognition (TLR) (Dechow et al., 2010; Paananen & Lin, 2007; Okezie et al., 2020).

On the other hand, IS research examines the AIQ produced by accounting information systems (AIS). The AIS enables the potential application of management and financial accounting practices and may be characterized by attributes of the accounting information produced (Daoud, 2013).

Thus, the three-stage TOE model is considered suitable for the scope of this study. We propose a conceptual framework for the actual use of RFID in Omnichannel retailing, integrating it with an AIQ construct developed from the accounting literature specifically for the RFID technology adoption context.

**TOE Technological factors**

The technological factors refer to the characteristics and usefulness of an innovation (Tornatzky & Fleischer, 1990). An increasing number of studies have incorporated the diffusion of innovation (DOI) theory (Rogers, 2003) to assess the technological factors of
the TOE framework (Mahdaly & Adeinat, 2022; Mabad et al., 2021). Similarly, the present study considers five characteristics of DOI theory: relative advantage, compatibility, complexity, trialability, and observability.

Relative advantage refers to the extent to which "an innovation is perceived as being better than the idea it supersedes" (Rogers, 2003). RFID offers many advantages over barcode technology in inventory scanning by multiple parallel readings of RFID tags attached to products (Khayyam et al., 2022). Tao et al. (2017) reveal that RFID improves operation performance by mitigating inventory misplacement and shrinkage.

Complexity is the degree to which "an innovation is perceived as relatively difficult to understand and use" (Rogers, 2003). A high level of complexity can influence negatively the adoption of a new technology. RFID implementation is challenging due to a series of issues regarding the diversity of RFID tags and devices, data management, hardware and software integration, and technical expertise (Bhattacharya & Wamba, 2015).

Compatibility is the degree to which "an innovation is perceived as being consistent with the needs of the existing practices of the potential adopters" (Rogers, 2003). RFID is often combined with process innovations and other applications. Thus, companies prevent adopting RFID if they perceive that the innovation cannot be integrated with their existing systems and practices (Mahdaly & Adeinat, 2022).

Trialability can be defined as the extent to which "an innovation may be experimented with on a limited basis" (Rogers, 2003). Trialability can lead to a decrease in the level of uncertainty, offers opportunities for reinvention during the innovation trial, and may accelerate its adoption due to early exposure among businesses (Maroufkhani et al., 2020). Companies conduct RFID pilot projects to experiment with the innovation in a reduced setting, assess its results and decide whether or not to implement it on a full scale (Sarac et al., 2010).

Observability is "the degree to which the results of an innovation are visible to others" (Rogers, 2003; Maroufkhani et al., 2020). The Chiu et al. (2017) study on the adoption of broadband mobile applications reports the visibility of the diversity and growth of technology use and its results in companies.

Perceived costs of innovations include expenses such as hardware, software, system integration, and staff training, and therefore may inhibit their adoption despite the perceived benefits (Tu, 2018). Initiating and financing the innovation costs demand massive financial capital (Lai et al., 2018). Previous literature reveals that the cost of investment and the uncertainty of return on investment are one of the main barriers to RFID adoption (Shin & Eksioglu, 2015).

**TOE Organizational factors**

The organization context refers to the internal aspects such as resources, assets, products, and services (Chiu et al., 2017). Top managers generally make the RFID adoption decision. In addition, they provide direction and promote commitment to creating a suitable environment for innovation (Bhattacharya & Wamba, 2015).

Firm size includes the organizational structure and its slack resources. Larger firms are usually more capable of mobilizing the necessary capital and absorbing risks and costs when making experiments with new technologies (Fosso Wamba et al., 2016). According to Thiesse et al. (2011), large retailers and manufacturers were responsible for the first well-publicized trials of RFID adoption.

**TOE Environmental factors**

The environmental context refers to external issues of the organization regarding suppliers, clients, competitors, and other participants (Chiu et al., 2017).

Competitive pressure refers to the influence of the industry and competitors creating a strong incentive for a company to adopt technological innovations to remain relevant in the market. There are cases where technology deployment is due to corporate mandates or government regulations (Mahdaly & Adeinat, 2022; Tu et al., 2018).

External Support refers to computing and training support provided by RFID manufacturers of tags and devices, service providers, and consultants. This characteristic may influence positively RFID adoption depending on the level of their internal IT expertise and resources (Mabad et al., 2021; Bhattacharya & Wamba, 2015).

**Accounting Information Quality (AIQ)**

AIQ is financial information that is useful for decision-making, understandable, and adequate to the users’ specific needs (Hendriksen & Van Breda, 1999). The Conceptual Framework for Financial Reporting proposed by the Financial Accounting Standards Board (FASB) and the International Accounting Standard Board (IASB) presents a descriptive hierarchy with two primary characteristics of financial information (relevance and faithful representation) and their support characteristics (understandability, timeliness, comparability, and verifiability). Our study uses these qualitative characteristics based on IASB (2018):

- Relevance: the ability to significantly influence the achievement of the objectives of accounting information (accountability and decision-making). This significant influence occurs when information has confirmatory value, predictive value, or both.
Faithful Representation: consists of representing the information in the most possible way of completeness, neutrality, and material error-free.

Understandability: clear and concise information must be presented in a way that responds to the needs and knowledge base of users and the nature of the information presented.

Timeliness: information is timely if it is made available to users before it loses its usefulness for decision-making and accountability.

Comparability: the comparison of similar information between entities or different periods of the same entity, allows identifying similarities and differences between two phenomena.

Verifiability: implies that different experienced and independent observers can reach a consensus on the information by representing it faithfully.

Kanakriyah (2016) demonstrates the influence of AIS on the improvement of AIQ in terms of relevance, reliability, comparability, understandability, consistency, and neutrality. Ou et al. (2017) assessed the influence of implementing ERP systems on the reliability and relevance of accounting information in Chinese manufacturing companies.

Drum et al. (2017) investigated the workarounds in an ERP environment and their impacts on AIQ characteristics. Their results show the achievement of completeness, neutrality, and accuracy in the financial information, rather than relevance and faithful representation.

Wu et al. (2019) developed an AIS based on a blockchain (BC) and RFID transaction model, capable of producing personalized financial reports, therefore improving relevance, neutrality, timeliness, and the cost-benefit balance of accounting information. Additionally, value-added refers to the benefits and advantages provided by the information for those who use it. This is one of the 16 dimensions of the performance model for information quality (PSP/IQ) proposed by Kahn et al. (2002), who combined product and service aspects of information quality.

In the end, the model resulting from the review of theoretical and empirical studies is illustrated in Figure 1.

**Figure 1: Conceptual model**

### Methodology

Qualitative research is exploratory and useful when the topic is new, when existing theories do not apply to it, or because the population under study has never been addressed before (Creswell, 2013).

In qualitative research, the case study is one of the most used research strategies (Rashid et al., 2019). Multiple-case design is preferred to understand a real-world phenomenon in the context in which it occurs (Yin, 2014). Cases are grouped and rigorously conducted to elaborate conclusions. Researchers undertake in-depth exploration of a program, an event, or a process, and collect detailed information through various data sources on the same topic to be the basis for replicating or confirming the results (Creswell,
2013). Thus, our study adopts the exploratory multiple-case study design and the replication approach proposed by Yin (2014). The design process begins with theory development, followed by case selection and case study protocol refinement based on the insights obtained from the pilot case study. Each particular case is treated as a complete study, looking for converging evidence concerning the facts and conclusions, which in turn require replication by other individual cases (Yin, 2014), as illustrated in Figure 2.

![Figure 2: Multiple-case study design](image)

**Source:** Yin (2014) adapted by the authors.

The quality of our exploratory design of multiple case studies was assessed through tests of reliability, construct validity, and external validity (Yin, 2014; Treiblmaier, 2019; Rashid et al., 2019). To maximize reliability, we formulated a case study protocol to provide standardized step-by-step guidance for investigators to follow in all cases (Nuijten et al., 2019). The protocol comprises the overview of the study, the data collection procedures, the interview guide, and the case study reporting guide. In addition, we also created a database (Yin, 2014) to organize all data collected for the case study, including recorded interviews, transcripts, notes, email messages, contacts, and public reports of the companies.

The semi-structured interview guide was elaborated based on the theoretical platform, including the questionnaires developed by previous studies on RFID adoption. This guide is divided into three groups of open-ended questions. The first group focused on the enterprise, the interviewee’s functional area, and the chronological events of the RFID project. The second addresses the contextual aspects of RFID adoption. Finally, the third group addresses the changes in accounting practices, AIS and AIQ due to the RFID adoption.

A pilot case study is a preliminary case developed to improve the case study protocol, the interview guide, and the data collection plan that the researcher will follow in the formal case studies (Yin, 2014). The case selected for the pilot study is a large manufacturer (P1) which is considered one of the most successful cases of RFID adoption in the country (Table 1). Indeed, the pilot provided important insights that contributed to guiding the final research project through the recent set of empirical observations along with the theories provided by the literature.

The triangulation of multiple data sources can contribute to enhancing the construct validity (Yin, 2014). This can be achieved by providing multiple assessments of the same phenomenon and converging data to determine the consistency of a finding. Furthermore, the collected data can be validated by following the same protocol procedures to interview people from different areas and companies (Khayyam et al., 2022).

We collected data using semi-structured interviews as the main source of evidence. The areas responsible for conducting RFID projects in retail companies are generally supply chain management teams, logistics teams, or loss prevention teams. Controllership and accounting teams not only provide information on accounting and auditing issues, but they also have their point of view on RFID adoption in inventory management.

To increase the reliability of the study, we invited an accounting consultant as an additional source of evidence, who was not related to the three companies of this study. He provided insights about accounting practices and helped classify the qualitative characteristics of accounting information regarding RFID adoption. Furthermore, public documentation such as financial reports and sustainability reports served as an important source of evidence for triangulation.

External validity can be ensured through the generalization of a particular set of results to a broader theory. The analytical generalization method consists of using a previously developed theory to compare with the empirical results of the cases. Case studies are generalizable to theoretical propositions, not to populations (Yin, 2014).

According to the literal replication logic, two or more cases are selected based on the prediction that the cases will produce similar outcomes (Khayyam et al., 2022). Thus, we employed a theoretical sampling rather than a random sampling (Ramanathan et al., 2017), and selected cases that are likely to “replicate previous cases or extend the emergent theory” (Eisenhardt, 1989).
To determine the target population of this study, we researched RFID technical publications such as (RFID Journal, 2023; GS1 Brasil, 2023; IoP Journal, 2023), and also interviewed consultants (RF Consulting, 2023) and RFID technology service providers (Acura, 2023; Beontag, 2023). The results revealed the curious fact that most of the companies that adopted RFID solutions in the last five years in Brazil are retailers, more specifically, seven large apparel retail companies using omnichannel strategies.

Finally, three retail companies were selected for the formal case study (Table 1). All these retailers were awarded by RFID technical publications, representing the most advanced cases of RFID adoption among retail competitors. In addition, they are listed companies on the B3 (Brazil stock exchange and over-the-counter market), and their financial reporting is elaborated according to the International Financial Reporting Standards (IFRS). The respondents were chosen according to purposeful sampling guidelines (Khayyam et al., 2022).

For each case in the study (P1, C1, C2, and C3), we contacted and interviewed professionals from the team responsible for the RFID implementation and the accounting team. Ethical considerations were followed to ensure that respondents were fully aware of their participation roles in the study. As requested by all the participants in the consent forms, companies’ and people’s names were protected and not mentioned in our paper. Due to the small population of large retailers in Brazil, we do not provide detailed descriptions of companies in Table 1, as their identities would be easily recognizable (Rashid et al., 2019). Due to the Covid-19 pandemic, interviews were conducted through online conference platforms in 2022. The recorded interviews were transcribed and imported into the Atlas.ti software for qualitative data analysis (Atlas.ti, 2023).

| Table 1: Pilot and formal cases, participants, and interviews |
|-------------------|-------------|----------|-------------|------|---------|
| Id    | Company                       | Industry       | Team          | Job Position                                      | Visits | Duration  |
| P1    | Pilot Case: Large ceramic and porcelain manufacturer in the Americas. Supplier of dining appliances (plates, cups) | Manufacturing  | RFID Project  | Logistics Manager                                  | 2      | 2 h       |
|       |                                |                | Accounting practices | (1) Logistics Manager, and (2) Executive of Administration and Finance | 1      | 1 h 25 min |
| C1    | Case 1: Large retail network of sporting goods in Latin America. | Retail         | RFID Project  | Senior Corporate and Business Development Manager | 1      | 1 h       |
|       |                                |                | Accounting practices | (1) Controllership Director, and (2) Loss Prevention and Asset Security Planning Manager | 2      | 2 h 30 min |
| C2    | Case 2: Multinational chain of fast-fashion retail clothing stores | Retail         | RFID Project  | Senior Business Planning Executive                  | 2      | 2 h       |
|       |                                |                | Accounting practices | Accounting and Report Manager                       | 1      | 30 min    |
| C3    | Case 3: Large omni retailer in fashion and lifestyle in Brazil | Retail         | RFID Project  | (1) Risk Director, (2) Project Consultant, and (3) Loss Prevention Manager | 1      | 1 h       |
|       |                                |                | Accounting practices | Senior Accounting Manager                           | 1      | 1 h       |
| APC1  | Accounting consultant          | Retail         | Accounting practices | Accounting Practices Coordinator in Retail Industry | 1      | 2 h 20 min |
|       |                                |                |                | Total                                              | 13 h 45 min |
Data collection and data analysis were conducted concurrently as an iterative process, in line with the assumption of the grounded theory method that theory emerges from data. The qualitative coding process allows building the bridge between data collection and theory development to explain these data. This process consists of separating, classifying, and synthesizing data by comparing data segments for data analysis (Charmaz, 2014; Hajdas et al., 2020; Riihimaki & Pekkola, 2021). We followed the four stages of the coding process proposed by Charmaz (2014): initial, focused, axial, and theoretical coding.

In the initial coding, 350 nodes were identified and associated with the respondents' quotes. Then, some nodes were eliminated, therefore preserving the most significant ones. At the end of the focused coding stage, the remaining 285 nodes were grouped in the axial coding stage, resulting in 66 subcategories and 17 categories. Finally, the theoretical coding stage establishes the relationships between categories, and these results will be revealed and discussed in the next section. The resulting model of this analysis was generated with the use of Atlas.ti software (Appendix A). Table 2 presents the 17 categories and their related number of nodes by source of evidence of each case: interviews (C1, C2, and C3); financial statements (C1 Fin, C2 Fin, and C3 Fin); sustainability reports (C1 Sust, C2 Sust, and C3 Sust); and interview with accounting consultant (APC1).

Table 2: Categories and sources of evidence

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<td>Accounting Information Quality (32)</td>
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<td>Full Inventory counts: monthly, weekly, daily (10)</td>
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Results and Discussion

In this section, the results are aligned with the theoretical concepts and constructs from the literature review and discussed along with the development of the resulting propositions and the theoretical model, to address each of the research questions.

How technological, environmental, and organizational factors impact the postadoption of RFID technology aligned to omnichannel strategies in retail companies

Relative advantage

Inventory accuracy and real-time inventory visibility are the RFID main benefits, while operational efficiency is considered a secondary advantage by retailers C1, C2, and C3. They revealed that RFID enables companies to perform an increased frequency of inventory counts, therefore ensuring the accuracy of inventory levels by identifying losses and failures to make timely and appropriate adjustments to inventory.
For example, C1 used to perform inventory cycle counts three times a year. On the other hand, full inventory counts with RFID are performed every week in all physical stores of the retail company. P1 used to scan each one of the products tagged with barcodes. The annual inventory count required shutting down the factory consequently causing a loss of revenue. Nevertheless, the use of RFID enabled the company to read RFID tags without opening the pallets. This improvement in agility and safety made it possible to perform inventory cycle counts throughout the year.

The greater inventory accuracy allows retailers to mitigate the risk of stockouts and to use product stocks of physical stores for omnichannel sales. Thus, customers receive their products more quickly. On the other hand, traditional physical counts are usually challenging and expensive to perform, and therefore infrequent so they are not sufficient to reduce inventory inaccuracy throughout the year (Goyal et al., 2016).

In line with previous studies on RFID adoption intention (Tu, 2018; Mabad et al., 2021; Mahdaly & Adeinat, 2022), the relative advantage is confirmed as the main factor of the actual use of RFID technology.

Observability

The RFID adoption provided significant improvements in information quality available to diverse internal areas of the companies for decision-making. For example, C1 reported that their loss prevention team can analyze product movements in physical stores much faster, and thus elaborate action plans to mitigate losses for the next week. Supply chain management, financial, accounting, business planning, purchasing, replenishment, and sales areas also benefited from RFID according to respondents.

Although observability was not confirmed by previous studies as a relevant technological factor of RFID adoption intention, our study provides evidence of the increasingly widespread use of the technology across the company, thus reducing uncertainty and motivating both internal areas and competitors to adopt RFID (Maroufkhani et al., 2020).

Compatibility

All respondents reported no major occurrences of incompatibility problems with existing processes and technologies in the companies. P1 stated that “the adoption of worldwide standards facilitates deployments”. The company already used the GS1 standard for bar codes and then adopted the GS1 EPC standard for RFID implementation. Likewise, the three C1, C2, and C3 have adopted the same standard for RFID smart tags. Thus, none of the respondents reported serious compatibility issues that could threaten the use of the RFID technology. Besides, we found no consensus on the results of previous studies regarding this technological factor.

Complexity

All respondents agree that RFID implementation is a complex process that requires great execution capacity and that it must be technically and financially feasible. They revealed that an integrated solution with other systems such as ERP (enterprise resource planning) and WMS (warehousing management system) is crucial to achieving greater benefits and performance from RFID technology.

C1 highlighted the importance of the RFID project design, while C2 and C3 consider the change management process as a critical success factor to overcome technology complexity problems. For example, C1 redesigned all operational processes of stores to meet the RFID project requirements, changing significantly how stores operate and impacting indirectly all company areas and processes. Similar to previous studies (Mabad et al., 2021; Mahdaly & Adeinat, 2022), we found no confirmation that complexity is a relevant factor for the adoption and use of RFID. This finding may be related to the fact that large companies have the necessary resources and expertise to employ in their projects.

Trialability

P1 ran two RFID pilot projects. The first pilot focused on item-level RFID while the second tested a pallet-level RFID system. Due to cost issues, they decided to deploy the second solution. RFID tags are attached to boxes containing sets of 12 or 24 plates, rather than tagging each plate, for example. C1 ran their pilot project in 2018. With the approval of the results by the Board, the implementation of the technology in physical stores and distribution centers was completed in 2019. C2 and C3 reported similar experiences.

Although trialability has not been considered by previous studies on RFID adoption intention, there is evidence of its influence on the actual use of the technology. Pilot projects offer companies the opportunity to test the technology and define specific solutions for their business, or even decide not to implement it (Maroufkhani et al., 2020).

Perceived Costs

Respondents reported that tag price and tagging costs have decreased, while the availability of cheaper reading devices has increased over the last few years. According to C1, part of their suppliers delivers their products with RFID tags. In the case of C2, as suppliers produce on demand for the company, they sew the RFID tags on the final products, while additional costs are covered by the retailer. Nevertheless, they warned about the costs involved in the processes of implementing the RFID system infrastructure and maintaining operations, which demand very careful planning by management.
Tu (2017) confirmed that perceived costs have a significant impact on RFID adoption intention, while other studies did not. In this study, the perceived costs are relevant to determine the strategies for expanding the use of technology in the company.

Proposition 1: Relative advantage, observability, trialability, and perceived costs are technological factors affecting the RFID postadoption in omnichannel retailing.

Top management support

All respondents revealed that their RFID projects received support from top management. For example, the main RFID project sponsor in C1 was the CFO who was personally involved in approving and monitoring its development. In C3, the RFID project was a top-down strategic project. The Board and the main executives were mobilized around the project. In line with the recent studies on RFID adoption intention (Mabad et al., 2021; Mahdaly & Adeinat, 2022), top management support represents an organizational factor of influence on RFID postadoption.

Firm size

The four cases are large companies that have made huge investments in technology including the RFID project. Retailers C1, C2, and C3 have developed major projects aligned with omnichannel, digital transformation, and supply chain modernization strategies, through the integration of artificial intelligence and machine learning applications, blockchain, ERP, and WMS systems. For example, C2 modernized its distribution center and invested in software (WMS and demand forecasting) and hardware for inventory replenishment in physical stores. Thus, similar to Mahdaly and Adeinat (2022) and Mabad et al. (2021), the present study confirms the influence of firm size as an organizational factor on RFID postadoption.

Proposition 2: Top management support and firm size are organizational factors affecting the RFID postadoption in omnichannel retailing.

Competitive Pressure

The trend of adopting omnichannel strategies by retailers, specifically the largest apparel retailers, has been observed in recent years in the country. The adoption of RFID solutions is associated with this phenomenon as confirmed by respondents.

C1 revealed that the company considered Amazon's case and realized that RFID adoption could contribute to captivating consumers and increasing sales through digital channels, in addition to the benefit of providing inventory accuracy. According to C2, physical fashion retail was one of the most affected economic sectors by the pandemic. In 2020, the company closed all of its physical stores, which forced it to redirect its investments to meet e-commerce needs.

Previous studies presented contrasting results regarding the influence of competitive pressure on RFID adoption intention. In our study, the evidence shows that this is a valid environmental factor that affects technology adoption and use.

External Support

According to P1, the selection of an adequate RFID service provider is crucial for the success of the project. Nevertheless, in C1, C2, and C3, the RFID project of software and hardware integration was an in-house solution.

For C2, the RFID market is evolving in Brazil. According to C3, the country has recently received more investment due to the increased demand for RFID tags. For example, companies like Avery Dennison are installing factories in the country. However, in P1’s view, the RFID tag manufacturing sector is still restricted and concentrated in a few players. Despite the growth of companies that provide RFID solutions, many of them do not fully master the technology implementation.

As per previous studies (Tu, 2018; Mabad et al., 2021), external support is confirmed as a relevant environmental factor in RFID adoption and use. The growth of the RFID market in Brazil is likely to offer new solutions for more and more enterprises in different sectors.

Proposition 3: Competitive pressure and external support are environmental factors affecting the RFID postadoption in omnichannel retailing.

How accounting practices change due to RFID postadoption

In C3, the Controllership area implemented a real-time inventory routine for monitoring the costing process, which accesses the business area's database through a data analytics application. This solution, using item-level RFID information, makes it possible to correct any inappropriate allocation of costs, thus improving the quality of accounting information.

The accounting literature suggests changes in accounting practices regarding aggregated valuation methods such as LIFO and average costing, due to the presence of real-time inventory costing data (Krahel & Titera, 2015) because they are not considered accurate measurements (Vasarhelyi et al., 2015).
Nevertheless, all respondents reported no changes in the use of costing methods. Although retailers C1, C2, and C3 have adopted item-level RFID for product tracking and tracing purposes, they are still assessing information at the stock-keeping unit (SKU) level from ERP systems in their accounting practices.

We can identify an individual product by the electronic product code (EPC) encoded on its RFID tag. However, we are using the SKU level in accounting practices. For example, if I have ten shirts, the RFID system identifies each one of them. But in the end, all that matters to accounting is the existence of ten items of the same SKU (C1).

C3 clarifies that the use of product item-level information is more adequate for business and sales areas: "In accounting, this ends up being a little transparent. Currently, we do not use this level of information directly to the balance sheet preparation". In addition, the weighted average cost is the practice currently adopted in compliance with the international standard for financial statements disclosing (IFRS).

### Losses recognition and losses provision

All three retailers agree that loss recognition and loss provision are the accounting practices most affected by RFID adoption for AIQ improvement. Surprisingly, among the insights offered by the accounting literature, this topic was not anticipated by previous studies. For example, C3 used to perform traditional inventory counts annually at brick-and-mortar stores and twice a year at distribution centers. Due to the longer intervals between inventory counts, inaccuracies in the loss provision estimates caused distortions in the financial reporting results.

Nevertheless, the advent of item-level RFID enabled monthly full inventory counts in physical stores, representing a very important evolution. This allowed the effective recognition of inventory losses as well as the elimination of estimates for loss provision. C1 reported similar results through weekly inventory counts in physical stores that improved the quality of accounting information.

**Proposition 4**: Loss recognition and loss provision are the most affected accounting practices by item-level RFID postadoption, therefore contributing to the improvement of accounting information quality.

### How RFID postadoption significantly enhance the qualitative characteristics of financial information (relevance, faithful representation, understandability, timeliness, comparability, and verifiability)

#### Accounting Information Quality

Based on the information provided by the accounting teams of the three cases C1.E2, C2.E2, and C3.E3, we evaluated the qualitative characteristics of the accounting information improved by the adoption of RFID, with the support of the accounting practices consultant APC1.

- **Relevance**: Inventory visibility ensures the accuracy of inventory records, and consequently both the confirmatory and predictive value (e.g. provision for losses) of accounting information.
- **Faithful Representation**: Due to the mitigation of issues regarding inventory shrinkage, spoilage, misplaced inventories, and transaction errors, the accounting information is improved in completeness, neutrality, and freedom from error.
- **Timeliness**: RFID enables greater accuracy and responsiveness of inventory management through real-time inventory information, in addition to timely recognition of inventory losses minimizing the need for estimating loss provision, for example.
- **Comparability**: The RFID adoption by business partners can help the standardization of inventory management procedures and how accounting information is produced and shared for comparison purposes.
- **Understandability**: The information is presented clearly and concisely so that it can be comprehensible and meet the needs of different types of users for their decision-making. RFID systems have the potential to create vast amounts of data, allowing the analysis of financial and non-financial information using business analytics tools.
- **Verifiability**: The RFID system makes it possible to accurately check inventory values in accounting with product physical items through the integration of company information systems such as ERP and WMS.
- **Value-added**: The benefits of RFID are perceived by internal areas and users of the organization (supply chain, marketing, sales, accounting), external users (financial statements), and customers as well.

**Proposition 5a**: The item-level RFID enables full inventory counts on a monthly, weekly, and daily basis, providing greater benefits in inventory accuracy and real-time inventory visibility, and therefore improving the accounting information quality.

**Proposition 5b**: Relevance, Faithful Representation, Timeliness, Comparability, Understandability, Verifiability, and Value-added are the accounting information quality characteristics improved by RFID adoption.

### Conclusion

The present study investigates the recent phenomenon of RFID postadoption by large retail companies in the omnichannel context, including other topics that have not yet been addressed in the literature.

Previous studies have focused on the intention or decision to adopt RFID, and thus their reach is limited to people's perceptions of the early stages of the technology, making it difficult to assess the real benefits of its ongoing utilization in organizations. In this
study, we focus on the communication benefits of the RFID postadoption, more specifically, the improvement of accounting information quality.

We used the well-established TOE model from the IS literature and identified the relevant factors and how they affect the RFID post-adoption: technological factors (relative advantage, observability, triability, and perceived costs); organizational factors (top management support and firm size); and environmental factors (competitive pressure and external support).

We also found which accounting practices were affected by RFID postadoption and how they changed. The accounting literature provides insights concerning RFID and IoT adoption. Nevertheless, respondents did not confirm changes in stock valuation, costing, or pricing methods. Surprisingly, the most relevant finding is related to changes in loss recognition and loss provision, which was not anticipated by previous studies.

The big deal of the RFID technology in retail is to enable full inventory counts much more frequently than traditional partial cycle counts, therefore providing timely and accurate inventory information for internal users across the company, therefore improving the quality of accounting information. Based on the accounting literature, we outline the qualitative characteristics of accounting information specifically for the RFID post-adoption context: relevance, faithful representation, timeliness, comparability, understandability, verifiability, and value-added.

We provide evidence of the influence of TOE contextual factors on RFID post-adoption, which in turn contributes to improving the quality of accounting information. In addition to the theoretical model and propositions, we developed the dimensions of accounting information quality in the specific context of RFID technology. Thus, our study offers contributions to both IS literature and accounting literature.

This exploratory multiple-case study is limited by its focus on a small population of large companies in the apparel retail sector. Concerning future research, we suggest an in-depth case study, for instance, to assess RFID benefits on an entire supply chain of suppliers, retailers, and customers.

Empirical survey research is recommended to study the retail industry more broadly on the RFID postadoption, as well as quantitative research to study this phenomenon using financial accounting measures such as Timely Loss Recognition.

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