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Accounting for the Stars: Changing Financial Practices in the Space Industry

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Abstract. *The emergence of the New Space Age is bringing incredible business opportunities, while also leading to numerous challenges and a need for higher accountability. In light of these challenges, the aim of the present study is to highlight how the development of space-related activities affects conventional accounting practices and what changes may be needed to redefine these practices for the space industry. A systematic literature review approach was adopted to examine space-related challenges that may determine the need for redefining some of the contemporary financial accounting practices. An inductive approach, based on the challenges and issues identified, has been adopted to determine three key financial accounting areas that require revision in the context of the space industry. The study's findings are centered on the financial statements' context and purpose, accounting principles, and the qualitative characteristics of financial information, as well as the recording of space transactions and events. Based on these three main areas, we suggest that companies in the space industry should adapt their governance practices to create more transparency and trust to their stakeholders, reassess how some accounting principles are being addressed, and provide a series of suggestions in terms of reconsidering the recording of space transactions and events. This study provides important insights with regards to space accounting, with implications for academia and the accounting profession.*

Keywords: space economy, space accounting, financial accounting practices, challenges, systematic literature review.

Introduction

The evolution of the space industry has undergone significant transformation over the past three decades, giving rise to a New Space Age. This change can be attributed to the shift from a bilateral and relatively simple space system that prevailed in the 20th century to a more sophisticated and complex one emerging in the 21st century (Del Canto Viterale, 2023). Notwithstanding the benefits, the evolution of the space economy is also associated with various challenges, including the estimation of economic value (Bousedra, 2023; Crane et al., 2020), the standardisation of metrics (Punnala et al., 2024), organisational capabilities (Punnala & Ratilainen, 2024), and supply

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chain disruptions (Gonzalez, 2023). As indicated by Alewine (2020), this evolution is concurrently introducing new challenges to the accounting profession, besides those related to the space industry such as distance, gravity, inhospitable environments, and information (Wooten & Tang, 2018).

As predicted by Denis et al. (2020) and confirmed by industry reports (KPMG, 2023a; Bryce Tech, 2022), the exponential evolution of this industry has led to the emergence of new "unicorns" disrupting supply chains and contributing to the development of new business opportunities. Currently, the predominant economic activities in the space industry pertain to the manufacture and launch of satellites. However, in the long term, new space-business activities can be anticipated (KPMG, 2023b). Thus, considering the intricacy of space economic activities, both actual and future, the accounting profession could play a pivotal role in addressing certain challenges and thereby contributing towards enhancing the accountability of the space sector.

In response to Tucker and Alewine's (2024a) call for research, the present paper aims to analyse how the development of the space economy impacts conventional financial accounting practices and to explore the potential modifications required for applying these practices within the space context.

In this paper, the syntax space economy will be used in line with the definition provided by OECD (2019, p. 30) according to which "*space economy is the full range of activities and the use of resources that create and provide value and benefits to human beings in the course of exploring, understanding, managing and utilising space … space economy goes well beyond the space sector itself, since it also comprises the increasingly pervasive and continually changing impacts (both quantitative and qualitative) of space-derived products, services and knowledge on economy and society*".

To address the research objective, we conducted a systematic literature review, contributing to the extant literature on accounting for the space industry. By examining the challenges determined by the specificity of space economic activities, potential changes in conventional financial accounting practices were inductively determined. The identified elements were then discussed in terms of the need to change the context and purpose of financial statements, rethink certain accounting principles and qualitative characteristics of financial information, and reconsider space transaction reporting processes.

The subsequent sections of the paper are organised as follows: firstly, an overview of the relevant literature regarding the modern space economy and space accounting is provided; secondly, we present the methodology used; thirdly, we report the results and discuss the findings; finally, we outline the main conclusions, limitations and future research directions.

Literature review

Space economy in the 21st Century

The first commercial space efforts began in the mid-1990s after NASA decided to pay for services instead of investing in building assets (Anderson, 2023). This led to the Commercial Space Act of 1998, which created an investment initiative (Barton, 2022). Other important commercial milestones were the founding of Blue Origin and SpaceX, which led to the emergence of several start-ups with their own agendas (Denis et al., 2020). However, as Devezas et al. (2012) found, the number of events between 2000 and 2010 was about the same as the average number of events between 1960 and 1990. A similar pattern is seen in the number of satellites launched between 1957 and 2019, which has been steadily increasing since 2010 (Statista, 2022). In the early days of

space exploration, economic and commercial factors were among the reasons for these activities, although they were not the main motivation until the early 2000s (Bainbridge, 2009). According to the industry (Bryce Tech, 2022), since 2012, businesses and individuals have been paying more attention to the economic value of space-related activities which has led to a rapid increase in the number of deals, investors, and acquisitions of start-ups. Another report (European Space Policy Institute, 2024) shows that in 2023 the total investment increased from 163 million euros (in 2020) to 566 million euros.

Currently the main economic activities associated with the space industry are represented by satellite manufacturing and launching spacecraft and satellites into space (Rementeria, 2022). However, the expansion of the space economy can lead to a series of other business opportunities. As the literature shows the literature, the main economic activities that could result from the industrialisation of space are: energy generation (Zhang et al., 2021), farming (Nguyen et al., 2023), resource mining (Deberdt & Le Billon, 2023; Steffen, 2022), space manufacturing (Francesco et al., 2024; Ghidini et al., 2023), teleoperation - remote human interventions (Gregg, 2021), and physical and virtual space tourism (Beheshti et al., 2024; Zhang & Wang, 2022).

Many of these new economic opportunities are presented in the literature as a response to the United Nations Sustainable Development Goals. For example, Nguyen et al. (2023) argue, after reviewing the improvement in space horticulture over a period of five decades, that space farms could support circular environmental life-support systems. Similarly, Zhang et al. (2021) suggests that besides the applications of space energy in the field of space exploration and settlements, space energy could also constitute a supplement to the on-Earth energy resources. In the case of resource mining, the views tend to be somehow different. Deberdt and Le Billon (2023) argue that mining celestial bodies could respond to the need for green transitions, exploring the ethical and environmental dimensions and comparing them with terrestrial mining (land and sea). Likewise, Steffen (2022) is also focusing on the need for more understanding on the degree to which such activities could be carried out sustainably.

Despite the opportunities for economic growth, the development of the space economy may not be aligned with the pursuit of social goals. Although research on the ethics of space has been ongoing for more than three decades (Arnould, 2005), the exponential development of the industry has not contributed to a consensus. As Weinzierl (2018) argues, even in the context of an efficient space market, there is no guarantee that the agendas of private organisations operating in space will serve the needs of the public interest or be in line with ethical judgements. An evaluation of a sample of government and private space companies realised by Di Tullio and Rea (2024) revealed that both groups prioritise the social and environmental benefits of space exploration, while providing limited information on the negative impacts of their activities. Government actors place greater emphasis on their role in providing societal value, while private space organisations focus their discourse on economic value creation. A significant challenge associated with sustainable space activities is debris management. This issue has been frequently highlighted in the literature, especially in recent years (Smith et al., 2024; Sheer et al., 2023). However, nations are only beginning to define programmes and legal frameworks to address this topic, but the requirements might be too complex (Peña-Ramos & Ramírez-de Luis, 2020). However, as argued by Varughese et al. (2023), government interventions have the potential to be advantageous for private companies seeking to invest in the space industry from an economic perspective.

In addition to concerns regarding sustainability, there are also other economic challenges that have been determined by the complexity of the sector and by a certain degree of uncertainty

that can be linked to the space industry. These challenges pertain to the estimation of the economic values of space activities (Bousedra, 2023; Crane et al., 2020), the absence of standardisation metrics for the space economy (Punnala et al., 2024), organisational capabilities (Punnala & Ratilainen, 2024), and supply chain disruptions (Gonzalez, 2023). In light of these factors, accounting research has shifted its focus towards the impact on space industry development and the examination of how the profession can assist in addressing these challenges and contribute to the development of this sector (Alewine, 2020).

Space accounting

In the accounting literature, the concept of space accounting, initially introduced by Alewine (2020), has been described as an emerging accounting subfield. Although the author does not provide a formal definition of the concept in the paper, subsequent research has elaborated a definition that captures the essence of the concept: "*a sub-specialty branch of accounting science that enables the creation of accounting standards and information systems for monitoring and reporting all economic activities that occur during the discovery, research, understanding, management, and exploitation of space, and to enable the institutions to make conscious decisions on space activities and ensure sustainability*" (Tekbaş et al., 2022, p.19).

Alewine's 2020 paper established the foundation for research in the space accounting field by highlighting a series of challenges and research opportunities. In terms of the challenges, the author draws attention to costing methods, trust and assurance, the lack of frameworks, valuation, information, and other space-related elements. Concurrently, the author identifies a series of research opportunities in the domain of financial and managerial accounting, performance management, taxation, audit, accounting information systems, and sustainability accounting.

Subsequent research in the field of space accounting has focused on the accountability of space actors (Di Tullio et al., 2024; Granà et al., 2024; Lee & Fong, 2024), the role of management control in the space industry (Modell, 2024; Tucker & Alewine, 2024b; Tucker & Alewine, 2023; Tucker & Alewine, 2022), and sustainability reporting practices (Di Tullio & Rea, 2024). The accountability of space actors is a significant area of research due to the absence of legislation in the field. In this context, Di Tullio et al. (2024, p. 1289) are focusing on intelligent accountability - "*active and prolonged investigation over time*" as part of the pluralistic accountability in the new space economy. The framework defined by the authors encompasses three main points: firstly, horizontal spatial vectors, representing the procedures and institutions that shape hybrid accountability; secondly, vertical spatial vectors, which focus on the relationship between space actors; and thirdly, accountability-based accounting. In a forward-thinking accountability context, Granà et al. (2024) underline the importance of creative responses regarding what could be achieved and the expertise required to predict the needs of more or less distant future requirements. In a more pragmatic approach, Lee and Fong (2024) propose a five-step ecosystem framework to address companies' sustainability and accountability and demonstrate how companies can benefit from it by using the SpaceX company as a case study.

In relation to the management control function within the space economy, Modell (2024) establishes a philosophical framework by concentrating on human knowledge and influence, providing empirical insights concerning the role of accounting and control practices in space programmes. In a similar vein, Tucker and Alewine (2024b; 2023) have examined the contributions of management control in the space sector by focusing on space missions such as Apollo and Space Shuttle, whilst also conducting interviews with various experts (Tucker & Alewine, 2022).

A recent special issue of the Journal of Accounting, Auditing & Accountability, which focused on accounting for the New Space Age, also brought together the perspectives of scholars from a variety of backgrounds and areas of expertise, thus contributing to the expansion of space accounting research. However, as Tucker and Alewine (2024a) noted, the majority of studies were rather conceptual, reflecting the novelty of accounting research in this field and the potential for new research opportunities, one of which being the objective of this current study.

To achieve the aforementioned research objective, we sought answers to the following research questions, based on the presented literature:

RQ1. What are the key space business areas with the potential to reshape traditional financial accounting practices?

RQ2. How should financial accounting practices transform to address the uncertainties surrounding the space industry?

Methodology

To address the research questions, we conducted a systematic literature review in accordance with the framework proposed by Xiao and Watson (2019). This approach has been consistently employed in accounting research (Hussinki et al., 2025; Ozili, 2025; Kroon & Alves, 2023). This eight-step process for conducting a systematic literature review defined by Xiao & Watson (2019) is presented in the subsequent section in relation to the research objective.

Step 1. Formulate the problem

Accounting for the space industry, as presented in the literature, is an emerging subfield (Alewine, 2020) that requires further development. The majority of studies related to accounting in the space industry refer to the challenges encountered by the accounting profession, highlighting its considerable potential to contribute to space research (Tucker & Alewine, 2024a; Alewine, 2020). Accordingly, the problem statement pertains to examining the development of the space economy that may impact conventional financial accounting practices and exploring the potential modifications required for the application of these practices within the space context.

Step 2. Develop and Validate the Review Protocol

A literature review protocol is necessary to define the boundaries of the research (Massaro et al., 2016) and to increase review reliability (Xiao & Watson, 2019). In this step, we established the purpose of the research, the research questions, the strategy of the searching process, the assessment criteria and the way our results will be presented. To retrieve high-quality research, we conducted a search of articles indexed in the Web of Science (WoS) database given that it contains the most accurate research information (Sánchez-Núñez et al., 2020).

Step 3. Search the Literature

We conducted a comprehensive literature review to identify key syntaxes associated with the space economy. This involved targeting various constructs, including space debris, satellites, space tourism, space manufacturing, space mining, and new space economy. The exclusion criteria were based on document type, WoS Category: Core Economics, and language. Thus, we did not take into consideration books or conference proceedings, but only articles and review articles. Furthermore, we did not set any timeframe as we wanted to understand the evolution of research

in this area overtime. All authors reviewed and approved the protocol. The search syntax used is presented in Appendix 1.

Step 4. Screen for Inclusion

To decide whether the articles from the dataset should be retained or excluded for further analysis, we independently reviewed the abstracts of each research paper. This process resulted in the exclusion of 27 articles due to their irrelevance to the space industry, despite containing some of the targeted words. In addition, 75 articles were found to be irrelevant to the study's objective. Ultimately, the dataset was reduced to 36 articles. This process was conducted independently by two researchers and any divergent opinions on the inclusion or exclusion of articles were subsequently addressed and resolved. Figure 1 presents a PRISMA diagram, illustrating the search steps undertaken.

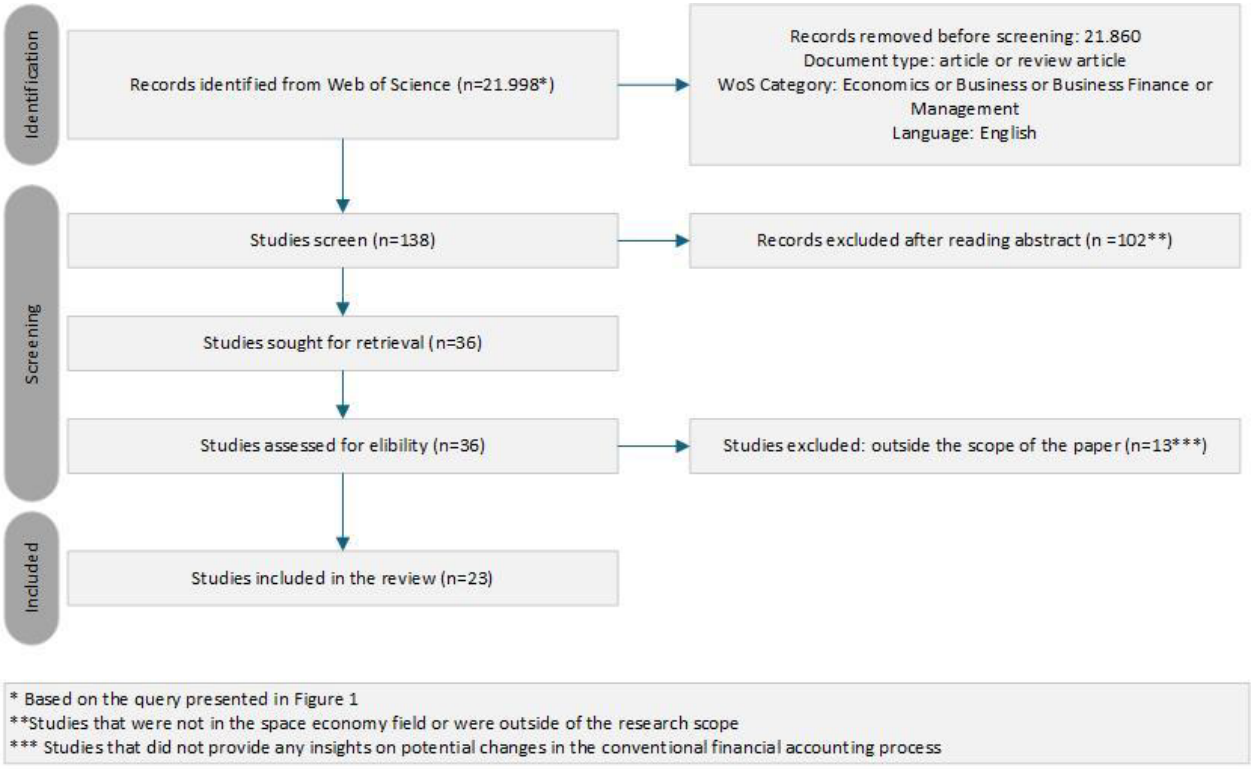

Figure 1. The searching and screening process

Source: adapted from Xiao and Watson (2019).

Step 5. Assess Quality

Following the retrieval of the 36 articles and their subsequent thorough review, a further assessment identified 13 articles as being irrelevant to the research due to their lack of insight regarding the economic challenges that could determine changes in the financial accounting practices of space companies. The finalised dataset comprised 23 articles that were subjected to further analysis, 17 of which were indexed in the first quartile of the CoreEconomics WoS categories, four of which were in the second quartile, and the final two in the third and fourth quartiles. 8 of the articles are published in Accounting, Auditing & Accountability Journal, 3 of

them are published in Environmental & Resource Economics, and the remaining ones are each published in the following journals: Abacus-A Journal of Accounting Finance and Business Studies, Applied Economics, Corporate Social Responsibility and Environmental Management, Ecological Economics, Economics Letters, European Journal of Operational Research, International Journal of Technology Management, Journal of the Association of Environmental and Resource Economists, Marketing and Management of Innovations, Mineral Economics, Omega-International Journal of Management Science, Tourism Management.

Step 6: Extracting Data

The articles included in the dataset were manually analysed by examining the aspects mentioned in the papers that could contribute to changes in the conventional financial accounting practices by using an inductive approach. To ensure the appropriateness of the coding process, this activity was performed in parallel by all the authors of the study and at the end of the individual assessments we discussed the differences and agreed on the resulting findings.

Step 7: Analyzing and Synthesizing Data

Following the completion and consensus on the subjects identified within the analysed papers, the elements were then inductively linked with areas of financial accounting practices that are likely to be subject to change in light of the space industry. The identified subjects were then organised in more general themes.

Step 8: Report Findings

The findings are reported in the subsequent section, organised under three main focus areas: context and purpose of the financial statements, principles and qualitative characteristics of financial information, and recording space transactions and events. Table 1 shows the main findings of the analysed papers that will be discussed in more detail in the following section.

Table 1. Main findings of the papers analysed

Article	Space related topic	Main findings
Adilov et al. (2015)	Debris management	Companies are launching too many satellites and are selecting technologies that produce more debris than is optimal for society. .
Adilov et al. (2023)	Debris management	An incentive mechanism that has a minimal impact on companies' operating costs based on interest-bearing and deorbiting performance bonds.
Alewine (2020)	Accounting/ Accountability	Explores space accounting and highlights the existence of many challenges and opportunities for accountants in the space industry.
Bernhard et al. (2023)	Debris management	Model for managing space debris based on dynamic game theory.
Bongers & Torres (2023)	Debris management	The optimal number of satellites is a negative function of the debris amount. The authors developed a dynamic investment model for satellites that considers space as a polluted environment subject to potential risks of collision and destruction of satellites, while addressing an unregulated market scenario where orbits are a shared resource and human activities in space generate negative impacts, notably in the form of space debris.
Cohen & Sopt (2024)	Accounting/ Accountability	Children perceive shortcomings in terms of the ethical and environmental aspects related to space exploration.

Article	Space related topic	Main findings
Di Tullio & Rea (2024)	Sustainability reporting	Space companies report positive environmental and social impacts and disclose fewer drawbacks.
Di Tullio et al. (2024)	Accounting/ Accountability	Accounting language is used to reflect and mobilise responsibility for those involved in economic space activities.
Dong et al. (2024)	Satellite supply chain	The relationship between government subsidies and blockchain can enhance supply chain efficiency.
Donou-Adonsou et al. (2024)	Sustainability	The launch of objects into space positively impacts footprint levels, global temperature, and emissions.
Grzelka & Wagner (2019)	Debris management	Provide an economic model that combines elements of patent law and space law to compare policy tools.
Kendal (2024)	Space mining	There is a need for stricter regulation of resource extraction to address climate change and the global concentration of wealth.
Lee & Fong (2024)	Space mining/ Sustainability	Identify sustainability issues and provide roadmaps for measures and standards for the space mining sector.
Modell (2024)	Accounting/ Accountability	The naturalized version of critical realism can help bridge the gap between the natural and social sciences in advancing insights into spatial accounting.
Nyka (2018)	Space Mining	International society is reluctant to regulate space mining activities, thus mining countries might start their own regulatory initiatives which could lead to a form of regulatory competition.
Peña-Ramos & Luis (2020)	Space mining	While the infrastructure for space asteroid mining is sound, many issues such as legal complexities, investments and research decline, and minimum viability should be addressed to determine feasibility.
Rao & Rondina (2022)	Orbit use	Provide an orbital-use model with endogenous collision probability and Kessler syndrome, demonstrating that once the economic incentives for launching satellites are modeled, autocatalytic debris growth is necessary.
Reddy et al. (2012)	Space tourism	Space travel is driven by humanity's desire for exploration; however, the interaction between supply and demand is necessary for these activities to be conducted. .
Ríos Muñoz et al. (2024)	Space mining	Although the potential to extract minerals from near-Earth objects is significant, the economic feasibility is uncertain due to the required technologies' low level of maturity.
Rouillon (2020)	Debris management	Development of a simplified physico-economic model of orbital environment and space activity which demonstrated that on the long-term, the expected population of active satellites is represented by an inverted-U shaped function of the launch rate.
Tucker & Alewine (2022)	Accounting/ Accountability	Given its interdisciplinary nature, management accounting research can significantly impact the space sector by solving the complex problems arising from space exploration, policy, and research.
Tucker & Alewine (2024a)	Accounting/ Accountability	Brings together, highlights, expands and promotes opportunities for scholars who wish to explore the possibilities for accounting research and practice can inform the space economy.
Tucker & Alewine (2024b)	Accounting/ Accountability	Management control plays a central role in contributing to and supporting organizational resilience during space exploration missions.

Source: Authors' own research based on WoS data.

Results and discussions

A thorough examination of the analysed set of papers has led to the identification of a series of financial practices that require refinement in the context of the space industry. While Alewine (2020) asserts that certain space-related transactions bear similarities to those previously established in other industries, only a limited number of practices were identified as being suitable for adaptation using conventional activities from other fields.

The first set of changes in the financial accounting practices should be focused on redesigning the context and purpose of financial reporting to account for the stakeholders' needs, redefining the duties and responsibilities of the directors, and revising corporate governance. Although these elements were identified in a relatively small number of papers, these should represent the basis of change in terms of financial accounting practices.

The framework developed by Lee and Fong (2024) places stakeholders and governance mechanisms at its core, with the aim of providing more insights on the environmental, social, and economic impact of space-related activities. Building on the framework proposed by Modell (2023), which can be used as a starting point for transfactual reasoning, we argue that this reasoning should be embedded in the organisations' governance practices. In the context of the space economy, the integration of transfactual reasoning within business processes could facilitate enhanced comprehension of the intricate space economy and mitigate associated risks.

From an accounting perspective, organisations should prioritise the identification of their key stakeholders and differentiate between the information they require, with a view to meeting the needs of these stakeholders. In addition to the regular categories of stakeholders, Cohen and Sopt (2024) propose a further category, representing the future beneficiaries of space exploration, i.e. children, who offer unique perspectives and have the potential to inform the evolution of space accounting. As emphasised by Tucker and Alewine (2022), certain stakeholders' challenges may be attributed to institutional and personal factors. Thus, the incorporation of pertinent information into annual reports can enhance transparency and alleviate barriers to innovation (Tucker & Alewine, 2024b). The absence of legal frameworks for the space economy and the associated uncertainties have been demonstrated to affect stakeholders' willingness for further research and investment (Peña-Ramos & Ramírez-de Luis, 2020). Therefore, by providing sufficient information to all relevant categories of stakeholders in the annual reports, the perceived value barrier could be reduced. However, as Di Tullio et al. (2024) argue, the integrity-based system should be centered on trust and simply providing information in the absence of trust and a cultural shift might not be sufficient.

Redefining the duties of the directors is a critical factor in the space economy, as they are required to act with greater diligence and to understand the impact of different risk scenarios for organisations. As presented by Arnould (2005), space ethics did not emerge until the late 1990s, and this shift in perspective may have been an act of leadership or a result of external requirements. In light of the absence of prevailing regulations, it is crucial for companies to prioritise enhancement of trust and the integration of ethical governance mechanisms at the core of their operations, in order to address the concerns of stakeholders and shareholders.

A subsequent category of practices that would benefit from redefinition in the context of the space industry pertains to the key accounting principles and the qualitative characteristics of financial information, as suggested by Tucker and Alewiene (2024a). Despite the absence of literature pointing to accounting principles and information characteristics, with the exception of timeliness, as discussed by Tucker and Alewiene (2024a), we have inductively associated some of

the principles with the operational disruptions, challenges, and risks identified in the literature. In terms of accounting principles, we argue that companies should pay more attention to going concern, materiality, and prudence. In relation to the qualitative characteristics of financial information, the focus will be on faithful representation, verifiability, and timeliness.

In the dataset analysed there were various papers, most of them outside of the accounting area, that focused on a series of economic challenges that could create difficulties in assessing the going concern assumption of space companies. Such risks arise particularly in the case of satellites and spacecraft due to the increase of orbital debris, but also in the case of space mining. Although initially considered to be a hypothetical phenomena, Kessler syndrome seems to become a reality. For example, Rao and Rondina (2023, p. 37) pointed out that under open access too many organisations might launch satellites as "they won't internalize the risks they impose on other orbit users". These debris fields could contribute to hindering the current and future space economic activities (Grzelka & Wagner, 2019). As Rouillon (2020) states, the management of the low Earth orbit could resemble a finding in the economy of fishery, where the long-term equilibrium is represented by an inverted-U shaped function of the fishery activity. The author states that over a longer period of time the collisions will become more frequent as the level of orbital debris increases. The same level of uncertainty is observed in the space mining sector, where authors are discussing about the lack of scientific knowledge and the ability to track asteroids and discover new ones, along with the unsustainable exploitation of such resources that can render "short-term profits but causing long-term damage" (Peña-Ramos & Ramírez-de Luis, 2020, p. 204). In a similar vein, Ríos Muñoz et al. (2024) argue that the costs related to explorations are significantly high and the potential return on investment may take decades to materialise. As can be observed from these two scenarios, space activities might be associated either with a limited lifespan or at some point some companies will no longer be able to support their business activities either due to the high associated costs or the complexities related to the unsustainable exploration of space. Thus, space organizations should put greater emphasis on meeting the going concern assumption.

As stated by Edgley (2014), the meaning of materiality has been developed episodically, due to changes in audit, investors' perceptions, economic conditions, and financial scandals. The emergence of the new space economy might represent a feasible juncture that contributes to a new development of the meaning, especially as it challenges traditional notions of asset value, risk, and economic impact in uncharted territories. Lee and Fong (2024) argue that in the absence of a method to clarify the context and boundaries, it is difficult to evaluate, monitor, and audit the environmental, social, and economic impact. Organisations in the space industry should try to define a concept of materiality that manages to capture the multifaceted nature of these activities, taking into consideration all factors that might influence the opinion of the financial statements' users. However, given the intricate nature of the factors, accountants might face a series of challenges. For example, Donou-Adonsou et al. (2024) found that the launch of objects into space can increase pollution and contribute to climate change through various factors such as: CO_2 and non-CO_2 footprint levels, increase in global temperature, and CO_2 and GHG emissions. While the economic impact of some elements can be easily quantified, for others there might not yet be generally accepted measurements models. For example, in the space mining context, Kendal (2024) brings into consideration the use of bioethical methodologies to address social issues. Similarly, by referring to orbital debris, Nyka (2018) argues that the reluctance of the international society to regulate space mining leads to additional challenges to correctly value space resources. Materiality

also emerges from the discussion about sustainable space activities (Di Tullio & Rea, 2024), as the authors emphasise the need for space companies to quantify the negative impact.

Although being one of the oldest accounting principles, the prudence principle received a significant level of attention in the last decades, being removed from the conceptual framework by the international and US standard setters in 2010, just to be reintroduced in 2018 (Georgiou, 2024). Given the fact that prudence can be seen as both a technical and a socio-political matter, as argued by Georgiou (2024), in light of the exponential development of the space economy, there might be several concerns related to the competing interests or ideologies. In the case of Earth orbit pollution, Adilov et al. (2015) states that companies will opt for the technologies with the lower costs which usually generate the most debris and that the voluntary guidelines provide insufficient incentives for companies. In this context, we argue that companies should demonstrate a sufficient level of prudence by acknowledging the material impact of the earth's orbit pollution despite the lack of legislation and regulations. In this respect, companies in the space sector should ensure that uncertainties and risks that could arise from future regulations are presented in their financial statements. However, in light of the complexities, the industry should work on developing new economic models to assess and quantify the impact, a fact that might pose significant difficulties in the absence of similar calculation models. Although some researchers tried to propose different scenarios, for example the deorbiting performance bonds (Adilov et al., 2023), these calculations could be considered mostly theoretical.

Based on the information presented in regard to the accounting principles, we consider that organisations should also reevaluate their level of transparency regarding the qualitative characteristics of the financial statements. Despite the lack of frameworks and calculation methods, space organisations should demonstrate their commitment in the faithful representation of the financial statements. At this initial stage, we argue that space companies should define a set of estimates at industry level either by taking into consideration the literature or adopt already existing models that have been proved to be accurate in other industries, such as the fishery economic function discussed by Rouillon (2020). More transparency is also needed in the case of sustainability information. As Di Tullio and Rea (2024) pointed out, space companies tend to report more positive environmental and social impacts compared to the negative ones. However, given that other sectors have a certain degree of regulation, the case of the space sector might pose several trust challenges.

In their 2024(a) paper, Tucker and Alweine discuss reconsidering the timeliness of the accounting information given the significant distance and the associated time lags, which can lead to incomplete data for a certain time of period. The authors are focusing both on the conceptual and practical implications of timeliness, arguing that this could lead to significant challenges. Such difficulties might be addressed by using predictive analytics and forecasting tools; however, overreliance on models could lead to a certain degree of deprofessionalization and companies should also account for the model bias and fairness.

The last category of practices focuses on recording space transactions and events. The literature analysed provided significant insights that we associated with the disclosure of the tangible and intangible assets, accruals, provisions and contingencies.

In terms of tangible assets balance, as presented in the literature review section, from a statistical perspective, theoretically there might be sufficient evidence related to the previously launched spacecrafts and satellites to develop reasonable economic models to assess the value of a tangible space asset. However, given the need to reconsider timeliness (Tucker & Alweine, 2024a)

and the increased degree of orbital debris which could lead to non-negligible degrees of collision (Bongers & Torres, 2023), along with the possibility of the Kessler syndrome occurrence as early as 2040 (Rao & Rondina, 2023), we argue that companies might face several challenges in determining the real value of the tangible assets that are in space at the end of a financial period. Tangible assets can be equipped with sensors that could transmit information about their physical integrity to some extent and deorbited satellites usually do not have a significant value at the end of their useful lives; however, in the case of spacecraft their reusability becomes a significant focus. Thus, organisations should redesign their valuation models to account for any physical damage and the potential additional damage that might be caused by returning to Earth. In the case of intangible assets, especially when it comes to potential licences to mine the space resources, as presented by Peña-Ramos and Ramírez-de Luis (2020), there is a lack of scientific knowledge and the ability to guarantee the tracking of space resources. In this regard, we focus on how companies should continue to reevaluate their licences or rights to mine space, in the event of such an economic scenario. This valuation should be conducted by taking into account the general accounting principles presented above and adopting technical methodological frameworks that are linked to terrestrial mining but take into account some of the space-related variables.

With regards to accruals, we focus on the timeliness challenges highlighted by Tucker and Alweine (2024) and possible delayed returns on investments (Ríos Muñoz et al., 2024), along with potential complex funding arrangements and we argue that the potential benefits should have a specific method of calculation that could be linked to several predefined milestones. However, there will still be a level of uncertainty in terms of when the potential benefits can be recognised. For instance, in the context of space mining, we posit that the recognition of potential benefits may occur subsequent to the completion of mining operations or the successful retrieval of resources, as Nyka (2018) posits that companies may conduct the processing of natural resources in space, given the associated costs and technical challenges of transport.

Redefining the process of recognising provisions and contingencies should emerge from the lack of regulations and the limited adderance to the voluntary guidelines. As emphasised by Adilov et al. (2023) deorbiting activities do not provide sufficient incentives, but as some regulations might be enforced in the following years, as suggested by Bernhard et al. (2023), especially in light of the increased probability of the Kessler syndrome (Rao & Rondina, 2023), it can be argued that companies should allocate a responsible value for contingencies or even potential decommissioning provisions. Furthermore, as highlighted by Dong et al. (2024) and Reddy et al. (2012), not all the risks can be hedged by insurance.

Conclusion

The main objective of the present study was to provide an analysis on how conventional financial accounting practices might need to be redesigned or reconsidered in the context of the space industry. By employing a systematic literature review, we organised the findings into three categories: context and purpose of the financial statements, principles and qualitative characteristics of financial information, and recording space transactions and events.

In terms of context and purpose of the financial statements of the companies in the space industry, we highlighted that the needs of the stakeholders may differ from the users of non-space industry financial sectors and that companies should readjust their governance practices to create more transparency and trust. Secondly, we uncover that some of the principles and the qualitative characteristics of financial statements may have specific meanings in the case of the space industry.

Given the complexity and uncertainty related to the space economy, we draw attention to assessing materiality, demonstrating due diligence in reinforcing the going concern assumption, and applying the appropriate level of prudence. Last but not least, we focus on the need to adopt additional valuation methods and specific recognition criteria of certain items included in the financial statements, discussing also the need for reconsidering accruals and provisions related to space transactions.

This study has implications for academia and the accounting profession. By analysing a dataset of relevant papers that addresses the economic challenges associated with the space industry, the current study serves as a starting point for more empirical studies in space accounting, by providing a set of elements that could be analysed in the case of space companies. In terms of the profession, the findings of these studies highlight a significant level of uncertainty and lack of accountability determined by the limited regulations and barriers of the industry, offering insights regarding the need for accounting practitioners with a more technical background that could contribute to the practical development of the space accounting subfield.

Notwithstanding the findings of this study, our work has a series of limitations. In terms of the methodological approach, our study was limited to the papers published in Wos in the Core Economics category. Given that some journals in this field might be reluctant to publish research related to space economy, future research could also consider including some journals outside this category for selecting papers that discuss challenges that might reflect on the accounting profession. This potential reluctancy might have contributed to the limited number of papers analysed, thus extending the screening area could contribute to a more nuanced understanding of these elements. While the objective of the present paper was limited to financial accounting practices, given the increased attention on managerial accounting in conjunction with the space economy, future research could direct their attention on how the traditional managerial accounting practices related to the space industry should be redesigned.

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Appendix 1. The query used for searching articles

TS=("new space economy" or "space tourism" or "commercial space exploration" or "commercial satellite*" or "space commerce" or "private space companies" or "space resource mining" or "space mining" or "space manufacturing" or "space sector investment*" or "space industry trends" or "space supply chain" or "new space economics" or "space entrepreneurship" or "satellite supply chain" or "orbital debris" or "space debris" or "debris management" or "space innovation*" or "space business innovation*" or "modern space economy" or "space infrastructure" or "satellites launching" or "space exploration")

Source: Authors' own research.