Georgiou, Andreas

Article

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Assessing the Alignment of IAS 38, IVS 210, and ISA 620: A Study on Intangible Asset Valuation Standards

Andreas Georgiou
Babes Bolyai University, Romania

Abstract

This article explores the regulatory frameworks governing intangible assets across three key standards: IAS 38 (accounting), IVS 210 (valuation), and ISA 620 (auditing). Employing both automated and manual similarity analysis techniques, the study investigates the structural and thematic alignment of these standards. Principal Component Analysis (PCA) using Voyant Tools and Python-based machine learning techniques, specifically TF-IDF vectorization and cosine similarity analysis provide an initial textual similarity assessment, followed by a binary-variable-based statistical analysis using SPSS. The study categorizes the comparative analysis into four major themes: recognition and measurement, disclosure and reporting, valuation approaches, and audit considerations. Findings indicate strong alignment between IAS 38 and IVS 210 regarding recognition criteria, valuation methods, and disclosure practices, while ISA 620 exhibits divergence due to its broader audit-centric focus. The results highlight potential gaps in standard harmonization and suggest avenues for refining the treatment of intangible assets in financial reporting, valuation, and auditing frameworks.

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Introduction

Based on current literature, some researchers (Lev., 2008) support development cost capitalization, while others, like Penman (2009), consider the uncertainty of realizing future economic benefits from R&D a reason to rely more on the combination of income statements and disclosures. It is essential to present the current professional standards used to report and evaluate internally generated assets to identify the advantages and disadvantages of the existing regulatory framework and the degree of their convergence.

Gong and Wang (2016) conducted research to measure the changes in the value relevance of research and development expenses after IFRS adoption. They discovered that institutional factors play a significant role in the value relevance changes during the transition from national GAAP to IFRS. Aboody and Lev, (1998) support that development cost capitalization of software is more informative to investors and that US GAAP should extend capitalization to other intangibles. They identify, though, that capitalization is pushed back by financial analysts mainly because it causes them to create erroneous forecasts, thus making their work more complicated. This view that capitalization complicates the forecasting process is also supported by Dinh et al. (2015b).

The core research question is: Are the provisions of the standards in the matter sufficient to ensure R&D accountability and SH protection? Based on the associated literature, there is no definitive answer, mainly due to the uncertainty related to R&D projects (Barker and Penman, 2020). There are valid arguments in favour and against the current standards. However, the mission of any standard is the net positive result and not an efficient framework, which would seem rather unrealistic. Ciftci and Zhou (2016) present contradicting views regarding capitalization and, subsequently, the importance of intellectual property protection legislation in relevance to disclosures of R&D projects.

The standards regulating intangible assets are IAS 38 for accounting and IVS 210 for evaluation. There is no specific audit-focused intangible asset standard with the exception of the ISA 620, which mentions the option of assistance by an auditor's expert in the case of "the valuation of complex financial instruments, land, and buildings, plant and machinery, jewelry, works of art, antiques, intangible assets, assets acquired, and liabilities assumed in business combinations and assets that may have been impaired" (IAASB, 2021). Invoking an expert has two major drawbacks; the first one is the extra audit cost generated by the additional friction. Cheng et al. (2016) found that development cost capitalization results in increased audit costs in China due to the high risk and additional work required, especially from industry experts who are nonetheless expensive by definition. Kuo and Lee (2017) conducted similar research across 21 countries and once again found evidence that development cost capitalization increases audit costs due to the elevated possibility of earnings management. Additionally, they found that the robustness of the legal framework pertaining to investor protection has an adverse effect on audit costs. However, they do not identify if this legal framework includes intellectual property rights protection. The protection of intellectual property rights is, in fact, as important for intangibles as the right of ownership for tangible assets. The obvious disadvantage of intangible assets is the relative easiness with which they can be duplicated or, in some cases, reverse-engineered, causing a significant loss of value for the inventors involved with development. This leads to the second drawback, which is intensely insinuated by Kuo and Lee (2017): the confidentiality required in an audit of internally generated intangible assets can only be safeguarded by non-disclosure agreements that any auditor or his expert would be

reluctant to sign, and the audited entity would be wary of its enforcement if it were based in a jurisdiction with loose intellectual property rights legal framework.

Tuttici et al. (2007) investigated the effect of the auditors' size and reputation along with the Securities Commission's enhanced monitoring on the reliability of development cost capitalization conducted by public entities in Australia. Their results seem to indicate that the auditors' quality and the Securities Commission's vigilance motivate management to use development capitalization more prudently than in cases where the auditor is not among the big five or the Securities Commission is lightly involved. They also find that younger R&D-intensive firms with high leverage levels, which used to promote high growth, capitalized more often. The industry sector also plays a significant role in the decision to capitalize.

The paper's main pillars will consist of a professional standards presentation describing their content and a subsequent similarity analysis combined with content analysis. Content analysis will be the first step in identifying the necessary variables to be used in the similarity analysis. Descriptive content analysis seems to be the most appropriate for professional standards analysis (Neuendorf, 2017). The process of defining the variables necessary begins with the thorough presentation of each professional standard related to internally generated intangible assets.

Similarity analysis is a method for comparing the similarity or dissimilarity of two or more objects based on their characteristics or attributes. It is often used in various fields, such as data mining, machine learning, and pattern recognition, to identify relationships or patterns in data.

There are several different approaches to similarity analysis, depending on the specific goals and characteristics of the data being analyzed. Here is a general methodology for conducting similarity analysis:

- Define the objects to be compared: The first step in similarity analysis is to identify the objects that you want to compare. These could be documents, Figures, text strings, or any other type of data that can be represented in a numerical or categorical form. In the current article's case, the objects are IAS 38, IVS210, and ISA620, which are the standards applied to intangible assets; ISA620 is more indirectly related since there is no dedicated auditing standard for intangibles.
- Extract features or attributes: Next, the features or attributes are extracted from the compared objects. These features could be numeric values, such as the length of a document or the brightness of an Figure pixel, or categorical values, such as the presence or absence of certain words or Figure features. In this case, this process involves the extraction of variables from the texts using content analysis. The variables need to be suitable for analysis and relevant to this research. This might be the most difficult part since it will define the content of the analysis and its quality.
- Choose a similarity measure: Depending on the nature of the data and the goals of the analysis, many different measures of similarity can be used. Some common measures of similarity include Euclidean distance, cosine similarity, Jaccard similarity, and Pearson correlation coefficient. This step relies heavily on the correctness of the variable selection. The type of values largely defines which similarity measures are appropriate.
- Calculate the similarity scores: Using the chosen similarity measure, the similarity scores between each pair of objects are calculated. The resulting similarity scores can then be used to rank the objects by similarity or to group them into clusters based on their similarity. The calculation is done using statistical software, namely SPSS (SPSS Inc. 2017, version 25), which is widely

used and considered reliable. Voyant Tools (version 2.6.2; Sinclair & Rockwell, 2023) is a more automated tool that uses a technique akin to principal component analysis, and it is used both for similarity analysis and supplemental content analysis. Additionally, the Scikit-learn machine learning library (Pedregosa et al., 2011) was utilized for text vectorization and similarity analysis. Specifically, TF-IDF (Term Frequency-Inverse Document Frequency) was employed to transform textual data into numerical representations, allowing for a quantitative comparison of IAS 38, IVS 210, and ISA 620. The similarity scores were then computed using cosine similarity, a well-established metric in text mining, to measure the alignment between document vectors (Han et al., 2012). This computational approach enhances the robustness of the analysis by eliminating common stop words and emphasizing key terms, ensuring a data-driven comparison of the standards.

- Analyse and interpret the results: Finally, the similarity analysis results are analyzed and interpreted to identify patterns or relationships in the data. This involves visualizing the results using graphs or plots or applying statistical tests to determine their significance.

It is important to note that the specific steps and techniques used in similarity analysis will depend on the goals and characteristics of the data being analyzed.

The main hypothesis for the current paper is that the professional standards share a similar approach to internally generated assets' valuation and recognition. The variables applied to the similarity analysis need to express framework directions on aspects such as definition, capitalization requirements, disclosures, and related costs. The similarity analysis will aim to show the convergence and the divergence of the standards on specific framework segments pertaining to internally generated intangible assets and on general aspects such as text size, which could be interpreted as a proxy for standard detail, for example.

Description of the content of the professional standards

AN OVERVIEW OF IAS 38

Area of implementation and exceptions

IAS 38, regarding intangible assets, outlines the accounting requirements for intangible assets, which are non-monetary assets without physical substance and are uniquely identifiable (either by being separable or arising from contractual or other legal rights). Intangible assets meeting the relevant recognition criteria are initially measured at cost, subsequently measured at cost or using the revaluation model, and amortized on a systematic basis over their useful lives (unless the asset has an indefinite useful life, in which case it is not amortized) (IASB, 2022).

The objective of IAS 38 is to prescribe the accounting treatment for intangible assets, which are not treated, specifically, according to another IFRS. The Standard requires an entity to recognize an intangible asset if, and only if, certain criteria are met. The standard also specifies how to measure the carrying amount of intangible assets and requires certain disclosures regarding intangible assets (IASB, 2022:IAS 38.1).

In terms of scope, IAS 38 applies to all intangible assets other than (IASB, 2022:IAS 38.2-3)

- financial assets (see IAS 32 Financial Instruments: Presentation)
- exploration and evaluation assets (see IFRS 6 Exploration for and Evaluation of Mineral Resources)

- expenditure on the development and extraction of minerals, oil, natural gas, and similar resources
- intangible assets arising from insurance contracts issued by insurance companies
- intangible assets covered by another IFRS, such as intangibles held for sale (IFRS 5 Non-current Assets Held for Sale and Discontinued Operations), deferred tax assets (IAS 12 Income Taxes), lease assets (IAS 17 Leases), assets arising from employee benefits (IAS 19 Employee Benefits (2011)), and goodwill (IFRS 3 Business Combinations)

At this point it is important to mention certain basic definitions related to the topic that will facilitate a more cohesive understanding of the framework.
The definition of the intangible asset itself: an identifiable non-monetary asset without physical substance. An asset is a resource that is controlled by the entity as a result of past events (for example, purchase or self-creation) and from which future economic benefits (inflows of cash or other assets) are expected. (IASB, 2022:IAS 38.8) Thus, the three critical attributes of an intangible asset are:

1. identifiability
2. control (power to obtain benefits from the asset)
3. future economic benefits (such as revenues or reduced future costs)

Identifiability is the most complicated attribute as a concept and thus some elaboration is in order: an intangible asset is identifiable when it: (IASB, 2022:IAS 38.12) is separable (capable of being separated and sold, transferred, licensed, rented, or exchanged, either individually or together with a related contract) or arises from contractual or other legal rights, regardless of whether those rights are transferable or separable from the entity or from other rights and obligations (Negkakis, 2015; Mirza et al., 2008).

As stated before a relatively broad variety of intangible assets exists, some examples of intangible assets are:

1. patented technology, computer software, databases and trade secrets
2. trademarks, trade dress, newspaper mastheads, internet domains
3. video and audiovisual material (e.g. motion pictures, television programs)
4. customer lists
5. mortgage servicing rights
6. licensing, royalty and standstill agreements
7. import quotas
8. franchise agreements
9. customer and supplier relationships (including customer lists)
10. marketing rights

Negkakis (2015) provides an example of assets whose intangible nature is not easily separable from their tangible nature, the CD of an OS (operating system). Obviously it is a combination of both natures into one asset, fortunately progress solved this issue by making most OS downloadable so the CD or DVD is no longer a part of the asset. This technological leap showed that the predominant asset was the intangible OS. But what happens in more complex situations where a hard science patent derives from a formula sequence or technique combined with a prototype instrument or tool? One could not function without the other and so Negkakis (2015) argues that the grade of incorporation of the intangible asset in the tangible should act as a 'litmus test'. The example of how to practically decide on the asset's nature is for example a software essential for operating a medical device which cannot be considered as an intangible since it is an inseparable component of the medical device. Thus the value of the software will be adding value to the

medical device without being recognised separately (Negkakis, 2015). Although this example provides an insight on the matter, there are more complicated cases where this rationale is not easily applicable and judgment is required (Mirza et al., 2008).

An entity can acquire intangible assets with the following ways:

1. by separate purchase
2. as part of a business combination
3. by a government grant
4. by exchange of assets
5. by self-creation (internal generation

Recognition and valuation requirements

The recognition and valuation of intangible assets must meet the following requirements:

- The definition of the intangible asset as mentioned above
- the recognition criteria

These requirements are valid for the costs regarding the initial generation as well as any additions, replacements or maintenance. However, replacements and additions are uncommon for intangible assets with the exception of whichever is defined in the interpretation of IFRS 20 stripping costs in the production phase of a surface mine (Negkakis, 2015).

Negkakis and Tachinakis (2013) provide some clarifications regarding the definition, specifically they describe the unclear term identifiable as to be distinguished so that any financial benefits could be sold, traded or borrowed. Also, they state that the definition term non-monetary does not mean without monetary value, the term rather illustrates the contradiction of not having the right to claim a stable fixed monetary revenue as with a promissory note for example.

In terms of recognition IAS 38 requires an entity to recognize an intangible asset, whether purchased or self-created (at cost) if, and only if (IASB, 2022:IAS 38.21)

- it is probable that the future economic benefits that are attributable to the asset will flow to the entity; and
- the cost of the asset can be measured reliably.

This requirement applies whether an intangible asset is acquired externally or generated internally. As long as the definition and the recognition criteria are met then the asset can be initially valued at cost (Negkakis, 2015; Mirza et al., 2008).

Intangible asset categories based on possession method

Based on how an entity comes in possession of an intangible asset, the intangible assets are divided into two categories:

1. Externally acquired intangible assets generated by individuals outside the entity. These assets can be acquired through purchase, trade or merger
2. Internally generated intangible assets generated within the entity through the process of research and development referred to from now on as R&D.

According to Negkakis (2015) internally generated goodwill is not recognised as an asset controlled by the entity and cannot be evaluated at cost since it is unidentifiable and does not derive from any contractual or other legal rights.

It is often difficult and complicated to assess whether an internally generated intangible asset qualifies for recognition because of problems in:

1. Identifying whether and when an identifiable asset comes into existence that will generate expected future economic benefits; and

2. Determining the cost of the asset reliably. In some cases, the cost of generating an intangible asset internally cannot be distinguished from the cost of maintaining or enhancing the entity's internally generated goodwill or of running day-to-day operations.

Hunter et al. (2012), seem to agree that managers are challenged by the task of measuring intangible related inputs and output in a clear and concise manner that would attribute values per intangible with precision.

Therefore, in addition to complying with the general requirements for the recognition and initial measurement of an intangible asset, an entity applies additional requirements and guidance to all internally generated intangible assets.

To assess whether an internally generated intangible asset meets the criteria for recognition, an entity classifies the generation of the asset into:

1. a research phase; and
2. a development phase.

Although the terms 'research' and 'development' are defined, the terms 'research phase' and 'development phase' have a broader meaning for the purpose of this standard.

If an entity cannot distinguish the research phase from the development phase of an internal project to create an intangible asset, the entity treats the expenditure on that project as if it were incurred in the research phase only. However, obviously entities could possibly abuse the distinction since it would accumulate massive losses in their financial statements, at least until their intangible asset would begin to generate some profits, assuming of course that it is a startup company relying strictly on that single project coming to fruition. In other cases, with projects in various stages, such a method would decrease the entity's profits by the cost of resources dedicated to research as well as development (Negkakis, 2015;IASB, 2022).

As far as the research phase is concerned the following are dictated by the IASB according to IAS 38:

No intangible asset arising from research (or from the research phase of an internal project) shall be recognised. Expenditure on research (or on the research phase of an

internal project) shall be recognised as an expense when it is incurred.

During the research phase of an internal project, an entity cannot demonstrate that an intangible asset exists and will generate probable future economic benefits. Therefore, this expenditure is recognised as an expense when it is incurred.

In regard to the development phase the following are dictated by the International Accounting Standards Board (IASB, 2022):

An intangible asset arising from development (or from the development phase of an internal project) shall be recognized if, and only if, an entity can demonstrate all of the following:

- the technical feasibility of completing the intangible asset so that it will be available
  for use or sale.
- its intention to complete the intangible asset and use or sell it.
- its ability to use or sell the intangible asset.
- how the intangible asset will generate probable future economic benefits. Among
  other things, the entity can demonstrate the existence of a market for the output of
  the intangible asset or the intangible asset itself or, if it is to be used internally, the

usefulness of the intangible asset.

- the availability of adequate technical, financial and other resources to complete the development and to use or sell the intangible asset.
- its ability to measure reliably the expenditure attributable to the intangible asset
  during its development.

In the development phase of an internal project, an entity can, in some instances, identify an intangible asset and demonstrate that the asset will generate probable future economic benefits. This is because the development phase of a project is further advanced than the research phase.

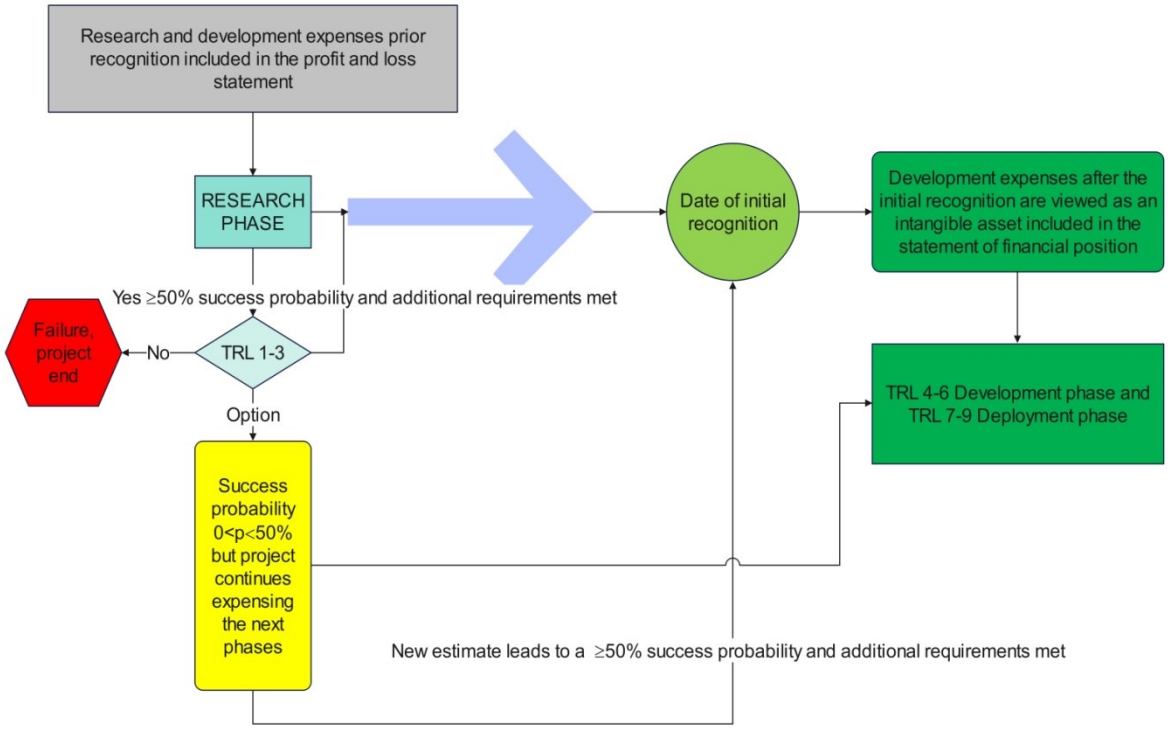
To demonstrate how an intangible asset will generate probable future economic benefits, an entity assesses the future economic benefits to be received from the asset using the principles in IAS 36 Impairment of Assets. If the asset will generate economic benefits only in combination with other assets, the entity applies the concept of cash-generating units described in IAS 36.

The availability of resources to complete, use and obtain the benefits from an intangible asset can be demonstrated by, for example, a business plan showing the technical, financial and other resources needed and the entity's ability to secure those resources. In some cases, an entity demonstrates the availability of external finance by obtaining a lender's indication of its willingness to fund the plan (Negkakis, 2015; Mirza et al., 2008).

The following diagram illustrates how the two phases evolve over time:

Figure 1

Diagram 1 R&D Phases and Relevant Decisions



Source: Author's work

An entity's costing systems can often measure reliably the cost of generating an intangible asset internally, such as salary and other expenditure incurred in securing copyrights or licenses or developing computer software.

The carried value of the internally generated intangible asset should be the cumulative development cost from the date that it initially met the recognition criteria as previously described. Additionally, the value of an internally generated intangible asset includes any direct cost required for the creation, production and preparation of the asset according to the function determined by the management (Mirza et al., 2008).

IAS 23 specifies criteria for the recognition of interest as an element of the cost of an internally generated intangible asset (Negkakis, 2015).

Internally generated brands, mastheads, publishing titles, customer lists and items similar in substance shall not be recognised as intangible assets.

Expenditure on internally generated brands, mastheads, publishing titles, customer lists and items similar in substance cannot be distinguished from the cost of developing the business as a whole. Therefore, such items are not recognised as intangible assets. Furthermore, the cost of an intangible asset that has been initially expensed cannot be recognised as part of the asset's capitalized cost ex-post.

The following are not components of the cost of an internally generated intangible asset:

- selling, administrative and other general overhead expenditure unless this expenditure can be directly attributed to preparing the asset for use;
- identified inefficiencies and initial operating losses incurred before the asset achieves planned performance; and
- expenditure on training staff to operate the asset.

Valuation cost recognition

A financial entity can choose either the cost or the revaluation method. However, the implementation of the revaluation method requires strict criteria, making it difficult to adopt (Negkakis, 2015;IASB, 2022).

When an intangible asset is valued using the revaluation method,, all the assets in the same category should be treated using the same method unless there is no active market for those assets.

The revaluation method cannot be used to revalue intangible assets that have been recognized using other amounts besides the cost. This method could be used if the asset would initially be recognized at cost and also in the case in which the asset is the result of a government grant recognized at an imputed value (Negkakis, 2015; Mirza et al., 2008).

The fluctuation of the fair values of the revalued intangible assets determines the number of revaluations. As such, the cumulative amortization at the revaluation date is defined according to the change in the value before amortization. Based on the standard, the amortizations are either adjusted according to the change of the asset's value prior to amortization or offset with the book value of the asset prior to amortization, and the net amount is revised in accordance with the revalued amount.

If no active market is available, thus making the revaluation impossible, then the cost method is used for the specific intangible asset.

Negkakis (2015) indicates that if the fair value of a revalued intangible asset can no longer be defined in relation to an active market, the asset is probably impaired and should be inspected according to IAS 36. The carried value of the asset should

be equal to the revalued amount as defined in an active market minus any subsequent accumulated amortization and impairment losses.

Impairment of intangible assets

When the fair value of an asset at a subsequent valuation date derives from an active market, then the revaluation model is applied from that date on. The increase in the carried value of an intangible asset due to revaluation should be credited directly to equity under the heading of revaluation surplus. In the case where a previous undervaluation of the same asset, which was included in the profit and loss statement, is reversed, the reverse should also be included in the profit and loss statement (Negkakis, 2015; Mirza et al., 2008).

Any decrease in the carried value of the intangible asset should be included in the profit and loss statement. When there is a prior revaluation surplus in equity then the decrease should be treated accordingly by debiting the heading of revaluation surplus directly.

If an intangible asset is sold or disposed of, the credit balance of the revaluation surplus should be carried to the profit and loss statement. In case some of the surplus is realized as the asset is used by the entity, the amount of the surplus realized is the difference between amortization based on the revalued carrying amount of the asset and amortization that would have been recognised based on the asset's historical cost. The transfer from revaluation surplus to retained earnings is not made through profit or loss (IASB, 2022:IAS 38.87).

The useful life of an intangible asset

Every entity should estimate the useful life of the intangible assets; this estimation directly influences the choice of accounting treatment method for the assets. Specifically, intangible assets with finite useful life are amortized; on the other hand, intangible assets with indefinite useful life are not amortized (Mirza et al., 2008).

Suppose the estimated useful life of the intangible asset is finite. In that case, the life span or the number of production or similar units should be estimated as components of the useful life. In the event that the estimated useful life is infinite, there is no end to the period in which the intangible asset is expected to produce net cash flows for the financial entity (Negkakis, 2015;IASB, 2022).

Intangible assets with finite useful life

The distribution of the amortizable amount of an intangible with finite useful life, which is determined after the deduction of its residual value, is systematic during its useful life. The amortization commences at the point in time when the intangible asset becomes ready for use, or it is in the appropriate operating condition and position according to the management. On the other hand, the amortization ceases at the former between the date of sale availability and retirement of the intangible asset (IASB, 2022).

In regard to the residual value of an intangible with finite useful life, it should be zero unless there is a third party commitment to buy the asset at the end of its useful life or there is an active market for it with the capability to determine the residual value through that market which would also present the possibility of a purchase at the end of its useful life. The revision of the residual value should be at least annual, at the end of the fiscal year and any alterations should be treated according to IAS 8. It is noted that any increase of the residual value can be larger than or equal to the book value, while the amortization should be zero until the subsequent decrease of the residual value below the book value (Negkakis, 2015).

The amortization of every fiscal year is carried on the profit and loss statement, unless there is a different requirement or indication provided by another standard. Also, sometimes the future financial benefits incorporated in an asset are absorbed in the production of other assets. Thus, the amortization could become part of the cost of another asset included in its book value as it happens with the amortization of the intangible assets that participate in the production process.

There are different methods of amortization such as straight line, declining balance and production unit. The most appropriate according to Negkakis (2015) should be chosen in line with the expected financial benefits rate of consumption. In any case the implementation of these methods should be consistent every fiscal year unless there is a change in the expected consumption rate of financial benefits.

It is noted that in situations where the expected consumption rate of financial benefits from the intangible cannot be reliably estimated the straight line method is adopted. The annual review of the used method is necessary. This is required because the expected useful life might differ from earlier estimations and so the amortization time period changes. Also an incident such as the recognition of impairment losses could affect the useful life prediction and necessitate the alteration of the amortization period. Also the schedule of anticipated financial benefit inflows will probably change (Negkakis, 2015).

Intangible assets with indefinite useful life

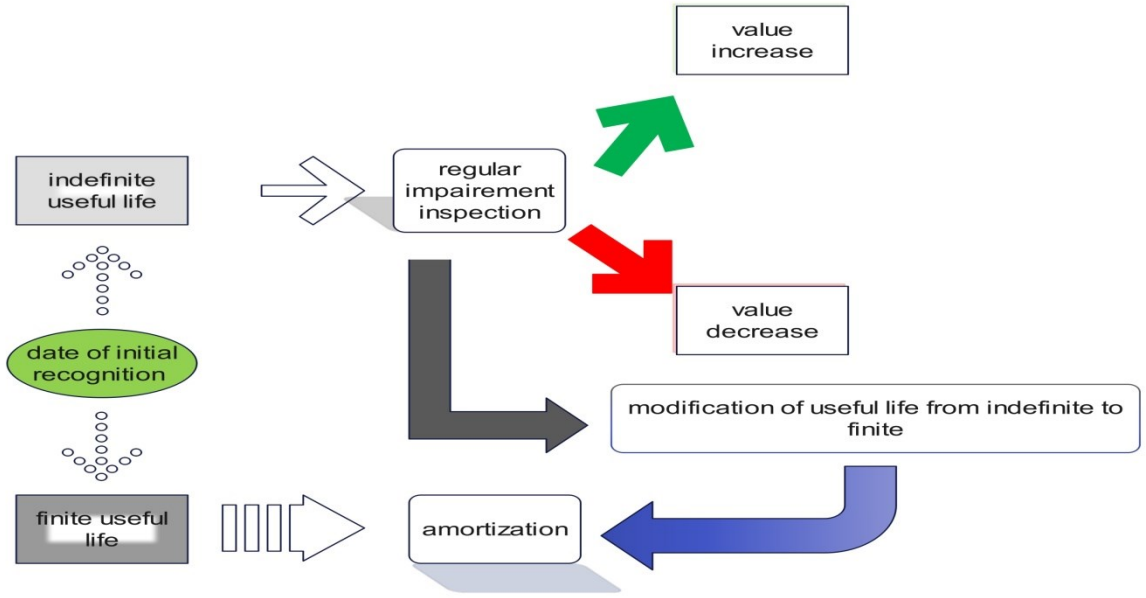
The intangible assets with indefinite useful life cannot be amortized. However, according to IAS 36, an inspection of the intangibles is required to determine any impairment to the recoverable amounts in comparison with the book value. The inspection should take place annually and whenever there is an indication of impairment.

The inspection of an intangible asset's impairment is done according to the IAS 36 (Negkakis, 2015).

The following diagram illustrates how the intangible asset's useful life is treated:

Figure 2

Treatment Depending on the Useful Life of the Intangible



Source: Author's work

Disposals and retirements

The erasure of an intangible asset takes place with its disposal or when no more financial gains are anticipated. The difference between the net amount of disposal and the book value is the bottom line, either profit or loss (Negkakis, 2015; Mirza et al., 2008; IASB, 2022).

Furthermore, the amortization of an intangible with finite useful life does not cease while the asset is not being used; unless it has been fully amortized or it has been classified for sale according to IFRS 5 (Negkakis, 2015).

Disclosures

Providing disclosures regarding the description of every fully amortized intangible asset that is still operational is encouraged. Furthermore, important intangible assets that are controlled by the entity but have not been recognised as assets because they did not fulfill the recognition criteria or were not purchased or generated before the implementation of IAS 38 should be disclosed (Mirza et al., 2008).

This is the end of the IAS 38 overview; an attempt was made to describe its provisions in a simple, yet as detailed as possible way. The standard's greater point of failure, as indicated by the relative literature, is the managerial probability estimation of future possible economic benefits deriving from the intangible to the entity. A task, which is not only difficult technically, but also counter intuitive to a manager in case the intangible asset is unlikely to produce future economic benefits. In the next section the IVS 210 regarding intangible assets will be presented in order to present what the valuation standard suggests regarding the valuation of intangible assets.

AN OVERVIEW OF IVS 210

The definition of intangible assets provided by the IVSC (2021) is "An intangible asset is a non-monetary asset that manifests itself by its economic properties. It does not have physical substance but grants rights and/or economic benefits to its owner." The definition is similar to the one observed in IAS 38, although there is a clear emphasis here to the economic properties of the asset as an indication of creation (Parker, 2016).

The intangibles are classified, by valuation regulators, in five distinct categories, the intangibles that interest this article belonging in the fifth category described as: "Technology-based: Technology-related intangible assets that arise from contractual or non-contractual rights to use patented technology, unpatented technology, databases, formulae, designs, software, processes or recipes." The hard science patents and software clearly belong in this category. As a result, the valuation method indicated as most suitable for this category or its elements will be the one of most interest.

The standard also provides a list of purposes concerning intangible asset valuations Among these purposes are financial reporting purposes, tax reporting purposes and litigation disputes. All of which have been mentioned as important to stakeholders (Parker, 2016).

Valuation approaches and methods

The three valuation approaches suggested by IVS 210 are the ones described in IVS 105, (IVSC, 2021). The requirements of IVS 105 need to be respected in addition to the requirements of IVS 210 when selecting a valuation approach.

The first approach mentioned is the market approach, where "the value of an intangible asset is determined by reference to market activity" (IVSC, 2021). This approach requires a robust market in order to ensure the genuineness of the

transactions and the reliability of the market prices. This method's weakness is that intangible assets are rarely identical. This is why valuers are compelled to meet both the following criteria if they intent to use the market approach:

Firstly, information is available on arm's length transactions involving identical or similar intangible assets on or near the valuation date, and secondly, sufficient information is available to allow the valuer to adjust for all significant differences between the subject intangible asset and those involved in the transactions.

Whenever significant qualitative, quantitative level adjustments seem indeterminable, adjustments are necessary to be made, the standard suggesting that perhaps another approach would be more suitable. At first glance, this approach seems to be identical with what IAS 38 is recommending for acquired intangible assets.

The next approach described in IVS 210 is the income approach. This approach involves apparently discounted cash flows, specifically "the value of an intangible asset is determined by reference to the present value of income, cash flows or cost savings attributable to the intangible asset over its economic life" (IVSC, 2021). Again the evaluator needs to consult the provisions of IVS 105 in order to decide if the income approach is appropriate for the subject intangible valuation. The income approach is the one mostly used on intangible asset valuations.

The subject intangible items of this paper would fall broadly under the category of technology. The practical difficulty of this approach is to distinguish the revenue portion attributed to the specific subject intangible asset. For example, a mobile phone usually incorporates thousands of patents so it is difficult to separate which part of the phone's cost is resulting from each patent or other intangible asset (Leroux and Quenedey, 2011). In order to navigate this issue the income approach has five different methods as follows: excess earnings method, relief-from-royalty method, premium profit method or with-and-without method, greenfield method, and distributor method.

The earnings method is defined as the present value of the cash flows attributable to the subject intangible asset after excluding the proportion of the cash flows that are attributable to other assets (IVSC, 2021). According to IVSC (2021), "this method is applicable to several periods of forecast cash flows, or a single period if the intangible is consumable within one period or by using the formula method"; "the capitalized excess earnings method or formula method is generally only appropriate if the intangible asset is operating in a steady state with stable growth/decay rates, constant profit margins and consistent contributory asset levels/charges" (IVSC, 2021: IVS 210 60.8-60.9). The earnings method is most commonly used over multiple periods since most intangible assets' economic lives span over more than one period.

Choosing an appropriate rate of return involves an estimation of risk in relation to macroeconomic factors, such as the Treasury bond yields, which are mostly considered risk free. Also, forecasting becomes increasingly difficult as the time horizon moves further away from the present (Vasiliou and Iriotis, 2009).

The last paragraph concerning the excess earnings method, according to IVSC (2021), indicates that "the excess earnings method should be applied only to a single intangible asset for any given stream of revenue and income (generally the primary or most important intangible asset). Evidently the method is focused on the asset with the most merit, presumably because it recognizes that without the core intangible the revenue stream would not exist. Again, there is a significant amount of subjective judgment involved in the valuation process, introducing an inherently arbitrary element in the valuation process.

The next income approach method is the relief from royalty method. By definition, the intangibles that involve royalties are usually works of art creators such as movies, songs but there are also instances where patents are being licensed. The central idea is that projections are developed based on the hypothetical royalty payments that are saved through ownership, the royalty payments are adjusted for tax and discounted to present value at the valuation date (IVSC, 2021: IVS 210 60.18). This method's implementation difficulty hinges on the availability of similar transactions. This is why naturally, intangibles such as movies, songs even literature, provide a large transaction database from where royalty rates could be extracted. In other cases though, where transactions are scarce, the royalty rate is based on a split of profits that would hypothetically be paid in an arm's length transaction by a willing licensee to a willing licensor for the rights to use the subject intangible asset (IVSC, 2021). The purpose of this article does not require elaborating more on this income method, not because it is inferior in any way or overlooked, but it is a subset of the next method.

The next method inside income approach is the premium profit method, also referred to as the "with and without" method, meaning with the asset versus without the asset. It is actually a comparison of two scenarios, one where the entity uses the subject intangible and one where the entity does not use it, on a ceteris paribus basis (IVSC, 2021: IVS 210 60.22).

This method is usually used in the valuation of non-competition agreements but may be appropriate in the valuation of other intangible assets in certain circumstances.

Again, this method variation involves a significant number of assumptions and estimations regarding the projections of revenue, expenses and discount rates. Also, the difference between the two scenarios may need to be probability-weighted. In the case of a non-competition agreement valuation, the individual or business bound by the agreement may choose not to compete even in the absence of an agreement. Lastly, the difference in value between the two scenarios should be the result of cash flow projections and not the selection of different discount rates (IVSC, 2021).

The Greenfield method assumes that the only asset in the entity's possession at the valuation date is the subject intangible. All other assets need to be produced, purchased or rented. This method is similar to the excess earnings method but instead of subtracting the contributory asset charges from the cash flow, the Greenfield method requires the acquisition of the contributory assets by any means possible (IVSC, 2021: IVS 210 60.29-60.30). This method is mostly used to estimate the value of "enabling" intangible assets such as franchise agreements and broadcast spectrum and so no further presentation is required since it does not seem to be appropriate for the intangible's types which are the subject of this paper.

The next income approach method is the distributor method. Specifically, the distributor method is an iteration of the multi-period excess earnings method sometimes used to value costumer- related intangible assets. According to IVSC (2021), the core element of the distributor method is that businesses that comprise of various functions are expected to generate profits associated with each function. Since distributors in general are usually tasked with the distribution of products to customers rather than development of intellectual property or manufacturing, information on profit margins earned by distributors is used to estimate the excess earnings attributable to customer-related intangible assets. "The distributor method is appropriate to value customer-related intangible assets when another intangible asset (for example, technology or a brand) is deemed to be the primary or most

significant intangible asset and is valued under a multi-period excess earnings method" (IVSC, 2021: IVS 210 60.34).

This method makes sense on a theoretical level. However, the profit margin of comparable distributors does not seem so easy to determine in practice. Then the next obstacle is the identification of contributory assets and their effect on forecast profits. How accurate an evaluator can be when using this method, clearly depends on the quality of available information and also the relevant experience of the evaluator. So it would seem, that the element of future economic benefits deriving from the subject intangible asset mentioned in IAS 38 is wrapped in the forecast revenue.

The next valuation approach is the cost approach, that prescribes that the value of the subject intangible is assessed based on the replacement cost of a similar asset or an asset that performs in a similar way in terms of service potential or utility (IVSC, 2021; Parker, 2016).

The cost approach's use is constrained by the paragraphs 60.2 and 60.3 of IVS 105 according to IVSC (2021). As a result of those constrains the cost approach's suitability is limited to the following intangible assets: (a) acquired third-party software, (b) internally-developed and internally-used, non-marketable software, and (c) assembled workforce (IVSC, 2021: IVS 210 60.35). Out of these three categories only the second one falls within the purview of this article. Still the cost approach can also be used in situations where no other method is suitable or practical to apply. It can also be used as a complementary approach to another approach (IVSC, 2021). Parker (2016) states that the cost approach is more suitable for "specialised" property.

This approach's methods are two, the replacement cost and the reproduction cost. The second one is not practical for intangible assets because the nature of the intangible assets is not suitable for reproduction and software cannot be valued based on the cost of lines of code.

Valuers need to take the following factors into consideration when applying the replacement cost method:

"(a) the direct and indirect costs of replacing the utility of the asset, including labor, materials and overhead,

(b) whether the subject intangible asset is subject to obsolescence. While intangible assets do not become functionally or physically obsolete, they can be subject to economic obsolescence,

(c) whether it is appropriate to include a profit mark-up on the included costs. An asset acquired from a third party would presumably reflect their costs associated with creating the asset as well as some form of profit to provide a return on investment. As such, under bases of value that assume a hypothetical transaction, it may be appropriate to include an assumed profit mark-up on costs. Costs developed based on estimates from third parties would be presumed to already reflect a profit mark-up, and (d) opportunity costs may also be included, which reflect costs associated with not having the subject intangible asset in place for some period of time during its creation" (IVSC, 2021: IVS 210 60.35).

This concludes the overview of valuation approaches and their corresponding methods.

The standard ends with the mention of some special considerations regarding intangible assets, namely, discount rates/rates of return for intangible assets, intangible asset economic lives and tax amortization benefit. The key takeaways for each of these special considerations will be presented for each one accordingly.

The discount rate selection is challenging and it requires a significant amount of professional judgment. An arbitrary element is introduced here. Also the risky nature of intangible assets should be taken into account by examining factors such as the asset's specialization, its lifespan, the capability to estimate related cash flow streams, associated risk with related use cases. Some of the discount rate benchmarks worth observing are the cost of equity or equity rates of return for market participants for the subject intangible asset. For the weighted average cost of capital (WACC) of participants for the subject intangible asset or of the company owning/using the subject intangible asset and in contexts involving a valuation of all assets of a business, the valuer should perform a weighted average return on assets (WARA) analysis to confirm reasonableness of selected discount rates (IVSC, 2021: IVS 210 90.4). Parker (2016) notes the difficulty of estimating an appropriate discount rate for a large period of time when income is not stable and there is fluctuation of the risk involved.

Regarding the economic lives of intangible assets the key takeaways are that the standard offers a distinction between finite and indefinite economic life, particularly when it comes to the use of the income approach valuation. This separation is also encountered in IAS 38 (IASB, 2022), although the valuation standard dictates that it is a different concept than the remaining useful life for accounting or tax purposes. Another key takeaway is that legal, technological, functional and economic factors must be considered individually and together in making an assessment of the economic life. "For example, a pharmaceutical technology protected by a patent may have a remaining legal life of five years before expiry of the patent, but a competitor drug with improved efficacy may be expected to reach the market in three years. This might cause the economic life of the patent to be assessed as only three years. In contrast, the expected economic life of the technology could extend beyond the life of the patent if the know how associated with the technology would have value in production of a generic drug beyond the expiration of the patent" (IVSC, 2021: IVS 210 100.2). In the case of software, the ability to replace slowly over time segments of the software such as with new versions of the software, which actually replace only a portion of the existing code, renews the remaining economic life.

The tax amortization benefit is indirectly relevant with the purpose of the paper, tax amortization implies that the asset is capitalized; otherwise, the expenses would be deducted from the income as they are incurred and recognized according to the provisions of relevant tax jurisdictions. The standard states that in the case where a tax amortization benefit exists and the valuation method permits it, it may be required to include that extra value in the intangible's value.

The treatment of intangible assets from an auditing standard perspective and other issues

The auditing landscape, while meticulously structured through various standards, occasionally presents areas of nuanced complexity. Among these, the International Auditing and Assurance Standards Board's (IAASB) ISA 620 stands out, primarily focusing on the "use of the work of an auditor's expert" rather than explicitly addressing intangible assets or a specific asset category. Despite this, the evolving nature of intangible assets, often rooted in groundbreaking research and innovation, necessitates a deeper exploration of their audit implications. This discourse aims to shed light on the unique challenges and considerations inherent in the audit of intangible assets. Additionally, the discourse highlights the standard's relevance to intangible assets but also navigates the broader implications for audit practice,

particularly in ensuring the accuracy and integrity of financial reporting in this complex domain.

There is no dedicated international standard on audit regarding intangible assets (IAASB, 2021). The framework put in place by the IAASB (2021) is a more generic set or guidelines that cover ethical, practical and operational issues concerning the implementation of audits. The general idea is that the international standards on audit provide guidance to auditors, so that the auditors will be able to determine if the specific accounting standards have been implemented correctly and the financial statements show a true and fair view of the entities' financial position. In other words, as far as intangible assets are concerned, the auditor is guided generally by the international standard on audit to determine if the provisions of IAS 38 have been respected.

Perhaps the only, indirectly relevant, international standard on audit is the ISA 620, where the "use of the work of an auditor's expert" is mentioned (IAASB, 2021). It is the case of "the valuation of complex financial instruments, land and buildings, plant and machinery, jewellery, works of art, antiques, intangible assets, assets acquired and liabilities assumed in business combinations and assets that may have been impaired" (IAASB, 2021).

In light of ISA 620's guidance on utilizing auditor's experts for complex valuations, the intricacies of auditing intangible assets, particularly those born from cutting-edge research and innovation, come to the forefront. These assets, often steeped in specialized knowledge beyond the auditor's expertise, necessitate a nuanced approach to valuation and verification. The involvement of experts, while indispensable for their insight and proficiency in these unique domains, introduces a layer of complexity to the audit process (Cheng et al., 2016; Kuo and Lee, 2017). This complexity stems not only from the specialized nature of the assets but also from the potential risks associated with the expert's deep engagement with the entity's confidential and sensitive information. Looking closer, into the implications of such expert involvement, it becomes apparent that ensuring objectivity and mitigating information leak risks are paramount, thereby setting the stage for a discussion on the standard's provisions for managing these challenges and the broader implications for audit cost and security.

The relevance of ISA 620 to the intangible assets is indirect in the sense that intangible assets in many cases are the result of innovation and research related activities from a wide range of disciplines and science fields beyond the auditor's skills and knowledge, thus requiring the assistance of field experts. However, the expert needs to be objective and thus not have any ties to the audited entity, which subsequently implies that the expert is an information leak risk, not only does the expert have the knowledge and skills to understand the research pertaining to the intangible, he or she might be able to reproduce or copy the research's results. As a precaution, the standard contains a provision regarding the appropriate agreement in writing between the expert and the auditor around matters such as access to sensitive or confidential entity information (IAASB, 2021). This will definitely add to the cost of the audit, especially from a legal counseling perspective plus additional friction, without providing any actual guarantee that a potential leak could be traced back to the auditor's expert; other factors need to be taken into consideration, such as multi-jurisdictional legal or regulatory requirements application, intangible asset generation phase, apparently the more advanced the intangible asset's creation is, the higher the risk. The standard is theoretically reasonable and practical in fields perhaps where the information leak risk is limited

such as real estate, although, when it comes to costly intangible asset development investments the disadvantage cannot be disregarded.

Invoking an expert has two major drawbacks. The first one is the extra audit cost caused by the additional friction. Cheng et al. (2016) found that development cost capitalisation results in increased audit costs in China due to the high risk and additional work required, especially from industry experts who are nonetheless expensive by definition. Kuo and Lee (2017) conducted a similar research across 21 countries and once again found evidence that development cost capitalisation increases audit costs due to the elevated possibility of earnings management. Additionally they found that the robustness of the legal framework pertaining to investor protection has an adverse effect on audit costs. However they do not identify if this legal framework includes intellectual property rights protection. The protection of intellectual property rights, in fact, holds equivalent importance for intangible assets as ownership rights do for tangible assets. Chen et al. (2017) specifically mention that better legal protection of intellectual rights encourages disclosures regarding intangible assets but with significant increase in cost. The obvious disadvantage of intangible assets is the relative easiness with which they can be duplicated or in some cases reverse engineered, causing significant loss of value for the inventors involved with development. This leads to the second drawback which is not explicitly mentioned by Kuo and Lee (2017). The confidentiality required in an audit of internally generated intangible assets can only be safeguarded by non disclosure agreements. Any auditor or his expert would be reluctant to sign such an agreement since it might interfere with their ability to express a truthful opinion. On the other hand the audited entity would be wary of the agreement's enforcement; in the event that the audited entity was based in a jurisdiction with loose intellectual property rights legal framework.

Tuttici et al. (2007) investigated the effect of the auditors' size and reputation in combination with the securities commission's enhanced monitoring. The securities commission monitored if the publicly traded entities in Australia capitalised development costs in a prudent manner. Their results seem to indicate that the auditors' quality and the securities commission's vigilance motivate management to use development capitalization more prudently than in cases where the auditor is not among the big four or the securities commission is lightly involved.

Methodology

In addressing the intricate aspects of internally generated intangible asset capitalization and its implications for stakeholder accountability, this article introduces a dual-methodological approach designed to dissect the nuances of financial reporting, valuation and auditing standards. This bifurcated strategy synergises both automated and manual analytical techniques to foster a comprehensive understanding of the texts that govern and guide the reporting, valuation and audit of R&D activities.

Initially, the paper delves into Automated Textual Analysis, leveraging the computational prowess of Principal Component Analysis (PCA) via Voyant tools (version 2.6.2; Sinclair & Rockwell, 2023). This sophisticated analysis scaffolds an objective similarity assessment within a corpus encompassing pivotal standards: IAS 38 (IASB, 2022), IVS 210 (IVSC, 2021), and ISA 620 (IAASB, 2021). By processing these texts, PCA elucidates patterns and associations that may not be immediately apparent, presenting a quantitative metric of textual congruence that serves as a foundation for further qualitative scrutiny. An Automated Textual Analysis employs a

statistical approach to compare texts, focusing on their quantifiable aspects rather than interpreting their intrinsic meanings, as outlined by Abdi and Williams (2010).

Following the delineation of professional standards in Section 3.2, the initial phase embarks on an exhaustive content analysis, complemented by the precedent automated similarity analysis via Voyant tools (version 2.6.2; Sinclair & Rockwell, 2023). Anchored in the methodological frameworks proposed by Neuendorf (2017) and Miles et al. (2014), this multifaceted approach undertakes a meticulous scrutiny of each standard. The aim is to navigate through the textual corpus, pinpointing critical variables that resonate with the focal points of the research, followed by statistical analysis using similarity and dissimilarity measures. This process transcends a basic surface-level examination, venturing into the interpretation of subtle nuances and underlying connotations present within the standards, as well as assessing their interconnections. The in-depth analysis, enriched by the dual methodologies, aims to yield profound insights into the realms of R&D accountability and the safeguarding of stakeholder interests.

According to Abdi and Williams (2010), Principal Component Analysis, commonly known as PCA, is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The process of creating these dimensions in PCA is a multi-step procedure that begins with the standardization of the feature set (Aggarwal, 2018; Bishop, 2006; Greenacre, 2007; Jollife, 2002). In practical terms, this means adjusting the original variables, which could be word frequencies in various documents, to have a standardized mean of zero and a standard deviation of one. This normalization is critical as it places all variables on the same scale, allowing for a fair comparison.

A term-document matrix looks like this, each row corresponding to a term and each column corresponds to a document (Abdi and Williams, 2010;Aggarwal, 2018; Bishop, 2006; Greenacre, 2007; Jollife, 2002).

(1) Term-Document matrix: $\begin{pmatrix} 243 \\ 132 \\ 413 \\ 321 \end{pmatrix}$

In this matrix the first row represents the frequency of term 1 across documents A, B, and C while the second row represents the frequency of term 2 across these documents, and so on. As described by Abdi and Williams (2010) and relevant literature (Aggarwal, 2018; Bishop, 2006; Greenacre, 2007; Jollife, 2002) the first step to PCA would be to standardize the term-document matrix using the formula to calculate standardized z values:

(2) $z=\frac{(x-\bar{x})}{std.dev}$

After standardization the hypothetical matrix will look like this:

(3) standardized matrix: $\begin{pmatrix} -0.2 & 0.8 & 0.2 \\ -0.5 & 0.5 & 0.5 \\ 1.2 & -1.2 & 0.5 \\ 0.2 & 0.2 & -1.2 \end{pmatrix}$

Following the standardization, PCA involves the computation of a covariance matrix derived from the standardized features (Abdi and Williams, 2010; Aggarwal,

2018; Bishop, 2006; Greenacre, 2007; Jolliffe, 2002). The covariance matrix is a key component as it contains information about the extent to which the dimensions (or documents) vary from the mean with respect to each other. The formula for the covariance between two different terms i and j is:

(4) Covariance calculation formula: $Cov(i,j) = \frac{1}{N-1}\sum_{k=1}^{N}(x_{ik} - \bar{x_i})\left(x_{jk} - \bar{x_j}\right)$

The calculation would result in a covariance matrix, for example:

(5) 3*3 Covariance matrix: $\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix}=\lambda\begin{pmatrix} x \\ y \\ z \end{pmatrix}$

The subsequent stage involves eigen decomposition of this covariance matrix, which is a technical process to ascertain the eigenvalues and eigenvectors. The eigenvalues denote the magnitude, whereas the eigenvectors denote the direction of the axes along which the data is most spread out; in essence, they form the backbone of the dataset, revealing where the most significant variation lies (Jolliffe, 2002).
Given a covariance matrix Σ, an eigenvector $\vec{u}$ and its corresponding eigenvalue λ satisfy the equation:

(6) $\sum \vec{u} = \lambda\vec{u}$

To solve for eigenvalues, the equation is rearranged like this:

(7) $(\Sigma - \lambda I)\vec{u} = 0$

Where, I is the identity matrix. For this equation to have a non-zero solution, the determinant must be zero:

(8) Det$(\Sigma - \lambda I) = 0$

After the calculation of the eigenvalues, they can be substituted back into (7) to find the corresponding eigenvectors.

Once the eigenvalues are determined, they are sorted in descending order. The corresponding eigenvectors are arranged in the same way. This ordering is paramount as it prioritizes the components that hold the most significant information about the distribution of the data (Greenacre, 2007; Jolliffe, 2002).

The eigenvalues indicate the amount of variance captured by each principal component, so higher eigenvalues correspond to more "important" dimensions.

The eigenvectors give the direction of these dimensions in the original feature space. In text analysis, each element in an eigenvector corresponds to a term in the original feature set (terms in the corpus). The value of each element signifies the weight of that term in the principal component. Thus, terms with higher weights in the same component are more "similar" in the variability they capture across documents (Aggarwal, 2018; Bishop, 2006; Jolliffe, 2002).

The step of dimensionality reduction then comes into play, where the first k eigenvectors associated with the largest eigenvalues are chosen. These constitute

the new feature subspace, a lower-dimensional space into which the high-dimensional data can be mapped without substantial loss of information.

The final act of the PCA process is the projection phase. In this phase, the original, possibly correlated features are transformed onto this lower-dimensional subspace. The PCA output, resulting from this projection, aims to capture the most significant aspects of the original dataset in a reduced dimensional space, simplifying complexity while maintaining the essence of the information. This transformation is fundamental in pattern recognition and data compression, as it allows for the simplification of the dataset while maintaining the structural integrity of the data (Aggarwal, 2018; Bishop, 2006; Jolliffe, 2002).

This process, as delineated by notable scholars such as Abdi and Williams (2010), Aggarwal (2018), Bishop (2006), Jollife (2002), and Greenacre (2007), is efficiently automated using Voyant Tools (version 2.6.2; Sinclair & Rockwell, 2023), culminating in the generation of a two-dimensional scatter plot. This plot serves as a visual synthesis of the PCA outcomes, illustrating the principal components in a manner that highlights the variance and relationships within the data set. The scatter plot, a critical component of this analysis, is elaborated upon in a later section of this document, providing a visual representation of the data's underlying structure.

The PCA output is visually represented in a two-dimensional scatter plot, providing an intuitive grasp of the textual congruence among IAS 38, IVS 210 and ISA 620. This quantification lays the groundwork for deeper qualitative examination, directly tying back to the article's focus on R&D accountability and stakeholder protection.

The similarity analysis, crucial to this research, will unfold in two distinct yet interconnected methods. This bifurcated approach is essential for a meticulous dissection of the professional standards, ensuring a thorough and nuanced understanding of their provisions and implications.

It's crucial to note that unlike the PCA conducted using Voyant Tools (version 2.6.2; Sinclair & Rockwell, 2023), the second similarity analysis method transcends mere textual structure to consider the context and interpretative nuances of the standards' documentation. Content analysis, by its nature, involves a subjective interpretation of the text, aiming to capture the underlying meaning and implications, whereas PCA, in its automated form, primarily quantifies text based on the frequency and distribution of terms, offering a more structural than semantic comparison (Abdi and Williams, 2010; Aggarwal, 2018; Bishop, 2006; Greenacre, 2007; Jolliffe, 2002).

Following the content analysis the analysis themes have been formed and are presented:

a) Recognition and measurement.
b) Disclosure and reporting.
c) Valuation of intangible assets
d) Audit considerations

The initial analysis theme centres on the concept of recognition and measurement, pivotal to accounting and valuation standards. It establishes the conditions for the recognition of intangible assets and dictates their initial and subsequent measurement. IAS 38 emerges as the prevailing standard within this theme, offering explicit criteria for the recognition and measurement of intangible assets. Thorough analysis is required to understand the practical implications for accounting. The comparison of these criteria with those suggested in IVS 210 and ISA 620 aligns accounting recognition with valuation standards and auditing guidelines, ensuring consistency in financial reporting.

The second theme pertains to disclosure and reporting. Transparency in reporting is critical for stakeholders to comprehend the valuation basis of intangible assets and the assumptions influencing their value over time. Originating from IAS 38, this theme calls for detailed disclosure about valuation methods, useful life, and R&D expenditures, crucial for users of financial statements to evaluate the economic benefits of intangible assets. Examining how IVS 210 and ISA 620 address these disclosures reveals the extent of rigour and detail expected in valuation and auditing practices.

Addressing the valuation of intangible assets, the selection of appropriate valuation techniques and the application of fair value are significant in reflecting the true worth of intangible assets within financial statements. The major query financial statements aim to resolve is the accuracy and fairness of the presented values. Exploring IAS 38 is crucial, especially when used together with IVS 210. IVS 210 is important because it offers detailed instructions on how to apply acceptable methods for valuing intangible assets. This analysis is also focused on understanding the risks associated with the unpredictable and changing future advantages of intangible assets, which play a significant role in determining their value.

The final theme focuses on audit considerations. While no dedicated audit standard for intangibles exists, ISA 620 is the closest standard indirectly associated with intangible assets. It provides guidance on the use of valuation experts and the assessment of risks related to the valuation of intangible assets, essential elements of the audit process. Reflecting on how these considerations are manifested in IAS 38 and IVS 210 assists in evaluating whether financial statements present a true and fair view of the intangible assets' value. Furthermore, this theme encompasses the evaluation of management's estimates, a critical aspect of auditing intangible assets due to their subjective and complex nature.

Each theme has been meticulously chosen to reflect a crucial aspect of intangible asset accounting and valuation, ensuring a comprehensive analysis across the domains of recognition, measurement, disclosure, valuation, and auditing perspectives.

For every analysis theme, specific elements that represent variables have been formed after content analysis similar to the methodology presented by Deaconu and Buiga (2010). These analysis elements, which are used as binary variables within each theme, serve as pivotal points of scrutiny.

Under the theme of Recognition and Measurement, the variables include 'Recognition Criteria', 'Initial Measurement', 'Subsequent Measurement', and 'R&D Costs'. These elements are critical in establishing the conditions that intangible assets must meet to be recognized in the financial statements and the methodology applied in their valuation at inception and in subsequent periods. 'R&D Costs' specifically addresses the accounting treatment of research and development expenditures, which are often significant for intangible assets.

For Disclosure and Reporting, the variables are 'Valuation Method Disclosure', 'Useful Life Disclosure', and 'R&D Expenditure Disclosure'. These elements ensure that the financial statements provide a clear and complete picture of how intangible assets are valued and amortized over time, along with the expenses incurred in their development. The disclosures are instrumental for users of financial statements to assess the sustainability and the long-term profitability of the assets.

In the Valuation of Intangible Assets theme, the analysis is focused on 'Permitted Valuation Techniques', 'Use of Fair Value', and 'Guidance on Uncertainty'. These variables are central to understanding the methods and approaches permissible for valuing intangible assets, the role that fair value plays in this process, and how

uncertainty is accounted for, which can significantly impact the valuation of such assets.

The final theme, Audit Considerations, includes variables such as 'Risk Assessment', 'Use of Valuation Experts', and 'Evaluation of Management's Estimates'. These elements are key to the audit process, where the reliability and accuracy of the intangible asset valuations are verified. 'Risk Assessment' involves identifying and evaluating the risks associated with valuing intangible assets. 'Use of Valuation Experts' considers the necessity and impact of specialist input in the audit process, and 'Evaluation of Management's Estimates' scrutinizes the assumptions and judgments made by management in the valuation of intangible assets.

Each analysis element within the respective themes is intricately linked to the overarching standards—IAS 38, IVS 210 or ISA 620 and plays a vital role in the rigorous framework for accounting, reporting, valuation, and auditing of intangible assets. These elements collectively form the basis for addressing the second research question: Are the provisions of the standards sufficient to ensure R&D accountability and shareholder protection? By dissecting the components of recognition criteria, disclosure norms, valuation techniques, and audit processes, the analysis aims to determine the adequacy of these standards in promoting transparency and reliability in the reporting of R&D activities. The scrutiny of each variable contributes to a comprehensive understanding of whether the standards effectively safeguard shareholder interests by mandating accountability in the treatment and presentation of R&D investments. Thus, the examination of these elements is not just a study of compliance, but a critical appraisal of the standards' capacity to uphold financial integrity and protect shareholders in the dynamic and often opaque realm of intangible asset valuation.

In the progression of the manual content analysis, the second critical phase begins, the similarity analysis, which draws inspiration from the methodology proposed by Deaconu and Buiga (2010). At this juncture, the binary variables delineated in the content analysis undergo a meticulous statistical examination. The variables are presented in Table 1 below. Echoing Deaconu and Buiga's (2010) systematic approach, the process juxtaposes the attributes of the standards using a suite of statistical measures tailored to the binary nature of the data.

Table 1 presents the analysis themes and their relevant elements, variables. The table organizes information across columns and rows: the columns represent the standards IAS 38, IVS 210, and ISA 620, indicating their applicability to various analysis elements. The rows are divided by the analysis themes, each listing specific binary variables evaluated across the standards.

Values derived from an in-depth content analysis for each thematic element, are presented, which will be encoded as binary nominal variables in SPSS (IBM Corp., 2017) to perform similarity and dissimilarity assessments. For each variable 'present' is coded as value 1 and 'absent' as value 0.

Key to this phase is the judicious selection of similarity measures. This choice is predicated on the characteristics of the data gleaned from the content analysis and incorporates an array of statistical instruments. These include non-parametric correlations apt for binary variables such as the Simple Matching Coefficient, Dice, Rogers and Tanimoto coefficient, Sokal and Sneath I coefficient, Jaccard coefficient and the Euclidean Distance Coefficient, which is a dissimilarity measure (Han et al., 2012; Tan et al., 2014). This eclectic mix of tools reflects the thorough approach embodied in Deaconu and Buiga's (2010) work, ensuring a comprehensive and multi-faceted examination of the standards.

Table 1
Variable Presentation per Analysis Theme and Standard

Analysis Theme	Analysis Element of the Theme	IAS 38	IVS 210	ISA 620
Recognition and Measurement	Recognition criteria	Present	Present	Absent
	Initial measurement	Present	Absent	Absent
	Subsequent measurement	Present	Absent	Absent
	R&D costs	Present	Absent	Absent
Disclosure and Reporting	Valuation method disclosure	Present	Present	Absent
	Useful life disclosure	Present	Present	Absent
	R&D expenditure disclosure	Present	Absent	Absent
Valuation of Intangible Assets	Permitted valuation techniques	Present	Present	Present
	Use of fair value	Present	Present	Absent
	Guidance on uncertainty	Present	Present	Present
Audit Considerations	Risk assessment	Present	Present	Present
	Use of valuation experts	*Present	*Present	Present
	Evaluation of management's estimates	Present	Present	*Present

***Present means the specific information is typically expected to be covered by the standard, but a direct quote was not provided from the content analysis.**

Source: Author's work

The similarity measures are calculated as follows: The simple matching coefficient is calculated by taking the number of matching attributes (both present and absent) and dividing by the total number of attributes (Tan et al., 2014).

$$(9) SMC = \frac{Numberofmatchingattributes(bothpresentaswellasabsent)}{Totalnumberofattributes}$$

The range of values are from 0 to 1, where a value of 1 indicates perfect similarity (all attributes match), while a value of 0 indicates no similarity (no attributes match).

The Dice Coefficient is calculated as two times the count of common elements between both sets over the sum of elements in set A and B. In this case the sets are the standards' documents, ISA38, IVS 210 and ISA 620, interchangeably in sets of two. The Dice coefficient gives more weight to the number of shared attributes between the two sets. This can be particularly useful when assessing the similarity of two samples where the presence of common characteristics is more significant than their differences (Tan et al., 2014). Again the values range from 0 to 1, where a value

of 1 indicates perfect similarity (all attributes match), while a value of 0 indicates no similarity (no attributes match).

(10) $Dice = \frac{2*(Numberofcommonattributes)}{Totalattributes\in objectA+Totalattributes\in objectB}$

The Rogers and Tanimoto coefficient is calculated by taking the sum of matching present and absent attributes and dividing by the sum of this number plus twice the sum of non-matching attributes, it is similar to the simple matching coefficient but puts more emphasis on the disagreements (Han et al., 2012;Tan et al., 2014). Again the values range from 0 to 1, where a value of 1 indicates perfect similarity (all attributes match), while a value of 0 indicates no similarity (no attributes match).

(11) $RogersTanimoto = \frac{Numberofmatches}{Numberofmatches+2*(Numberofmismatches)}$

The Sokal and Sneath 1 coefficient is another variant of similarity measure that adjusts for agreements and disagreements, calculated similarly to Rogers and Tanimoto but with different weights (Tan et al., 2014).

(12)$Sokal-Sneath1 = \frac{2*(numberofmatchesofpresence)}{2*(Numberofmatchesofpresence)+(Numberofmismatchesofpresencevsabsence)}$

Again the values range from 0 to 1, where a value of 1 indicates perfect similarity (all attributes match), while a value of 0 indicates no similarity (no attributes match). The last similarity measure is the Jaccardcoefficient, it is calculated as the size of the intersection of two sets divided by the size of the union of the sets, once again its values range from 0 to 1. A value of 1 means the sets are identical; a value of 0 means they share no elements and most notably, it does not consider the joint absence of attributes (Han et al., 2012;Tan et al., 2014).

(13) $Jaccard = \frac{Numberofcommonatrributes}{Numberofattributespresent\in A+Numberofattributespresent\in B-Numberofcommonattributes}$

The Euclidean distance coefficient is a dissimilarity measure which is based on the 'straight line' distance between two points in multidimensional space, calculated using the Pythagorean theorem as indicated by various publications (Bishop, 2006; Han et al., 2012; Hastie et al., 2008; Tan et al., 2014). The range of values starts from 0 and can go to infinity, where a value of 0 indicates no distance between points (perfect similarity), while higher values indicate greater dissimilarity. Unlike the other coefficients, which were similarity measures, for Euclidean distance, lower values signify similarity. For two points p and q with n dimensions, the relevant formula is

(14) $EuclideanDistance = \sqrt{\sum_{i=1}^{n}(p_i - q_i)^2}$

In all the formulas from (9) to (14) "number of matches" refers to the count of attributes where both objects have a presence 1 or absence 0 of a particular attribute. "Number of mismatches" refers to the count of attributes where the presence 1 or absence 0 in one object does not match the presence 1 or absence 0 in the other object.

Leveraging the analytical prowess of SPSS (IBM Corp., 2017), the similarity scores that form the backbone of the analysis are calculated. SPSS serves not just as a calculation resource but as a critical interpretive ally, aiding in the elucidation of the complex relationships and distinctions between the standards.

The culmination of this phase is the analysis and synthesis of the quantitative findings into an intelligible narrative. This narrative is instrumental in unravelling the nuances of R&D accountability and the safeguarding of stakeholder interests within

the ambit of professional standards. By harmonizing quantitative rigour with qualitative insight, this phase endeavours to unravel the layered complexity of the standards, offering an exhaustive and insightful exposition.

Results

The pursuit of rigorous R&D accountability and shareholder (SH) protection within financial reporting is a complex endeavour, demanding a multifaceted analysis of international standards. To address the research question regarding the sufficiency of standard provisions in this matter, this paper embarks on a methodical investigation using a dual-analytical approach. Initially, Voyant tools (version 2.6.2; Sinclair & Rockwell, 2023) will facilitate a Principal Component Analysis (PCA), dissecting the lexical density and thematic prominence within the IAS 38, IVS 210 and ISA 620 standards. This automated analysis provides a baseline understanding of the frequency and distribution of pertinent terms, setting the stage for a deeper, theme-based scrutiny.

Complementing the PCA, a meticulous content analysis, akin to the methodology espoused by Deaconu and Buiga (2010), identified key binary variables within predefined themes—Recognition and Measurement, Disclosure and Reporting, Valuation of Intangible Assets, and Audit Considerations. These variables, emblematic of the intricate requirements and disclosures embedded in the standards, were then subjected to a similarity analysis using SPSS (IBM Corp., 2017). This approach allowed for a quantitative comparison across the standards, evaluating the convergence and divergence of their provisions as they pertain to intangible assets' recognition, initial and subsequent measurement, and the intricacies of R&D costs.

Similarity analysis using automated text processing

The following scatter plot, referred to as Figure 1, offers an insightful depiction of the similarity relationships among the IAS 38, IVS 210 and ISA 620 standards. Each point on the scatter plot represents a document from the corpus, namely IAS 38, IVS 210 and ISA 620, which have been uploaded to Voyant tools (version 2.6.2; Sinclair & Rockwell, 2023) as pdf document files. The spatial arrangement of these points reveals how similar these documents are in terms of their word usage. This visual representation, derived from the frequency matrices of the 53 most prevalent terms in the documents, serves as a preliminary similarity analysis. While the intricate calculations underpinning the principal component analysis (PCA) are automated and thus not detailed here, the significance of the axes is worth noting. The horizontal axis, or Dimension 1, accounts for 73.43% of the total variance, indicating its substantial role in differentiating the documents. The vertical axis, or Dimension 2, explains a lesser but still notable 26.57% of the variance.

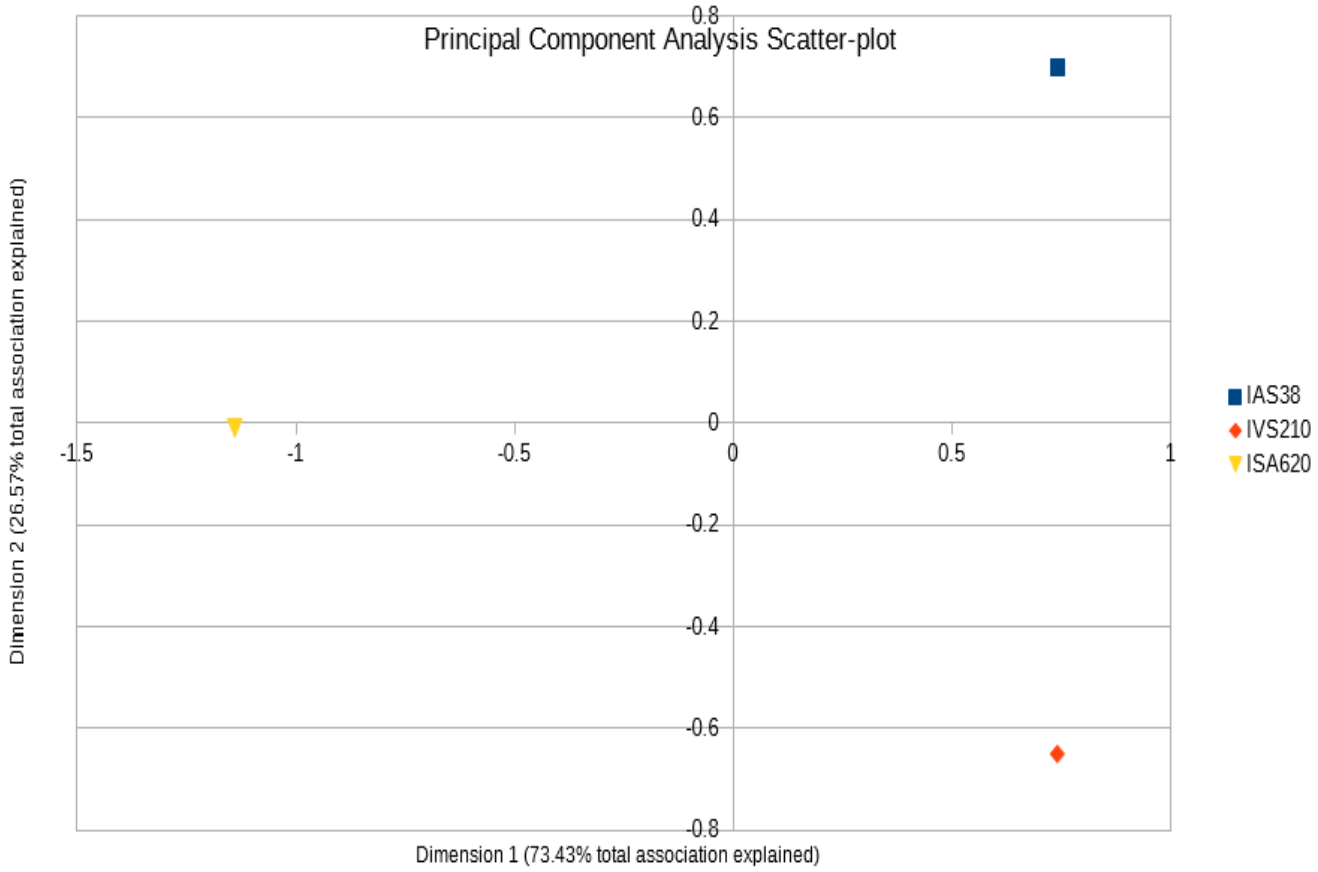
The PCA scatter plot, generated by Voyant tools (version 2.6.2; Sinclair & Rockwell, 2023), shows that ISA 620 is positioned distinctly apart from IAS 38 and IVS 210, suggesting a relative dissimilarity with these standards. Conversely, IAS 38 and IVS 210 appear in closer proximity along the more influential Dimension 1, suggesting greater similarity between them based on the analysed terms. Despite this, the distance between IAS 38 and IVS 210 along Dimension 2 should not be overlooked, as it indicates there are still significant differences to consider.

The analysis presented in Figure 3 underpins the distance of ISA 620 from the other two standards, namely IAS 38 and IVS 210. The rationale is that the initial PCA has highlighted fundamental dissimilarities with the other two standards, which may overshadow finer comparative nuances. Meanwhile, the relative closeness of IAS 38

and IVS 210 along the principal axis of variation warrants a deeper investigation to uncover the subtleties and specifics of their convergence and divergence.

This refinement of the analysis sets the stage for a focused evaluation of the IAS 38 and IVS 210 standards, examining their thematic overlaps and divergences to provide a robust understanding of their implications for R&D accountability and shareholder protection.

Figure 3
PCA Scatter Plot Similarity Analysis



Source: Author's work

Dimension 2, orthogonal to Dimension 1, captures the secondary pattern of variance at 26.57%. The y-coordinates suggest a divergence between IAS 38 and IVS 210 along this dimension, as indicated by their opposite signs. IAS 38's positive y-value contrasts with IVS 210's negative y-value, implying that they differ in the secondary patterns of word usage captured by this component.

ISA 620, positioned at a y-value of zero, does not exhibit a significant positive or negative correlation with Dimension 2, suggesting its neutrality or lack of significant contribution to the patterns captured by this secondary dimension.

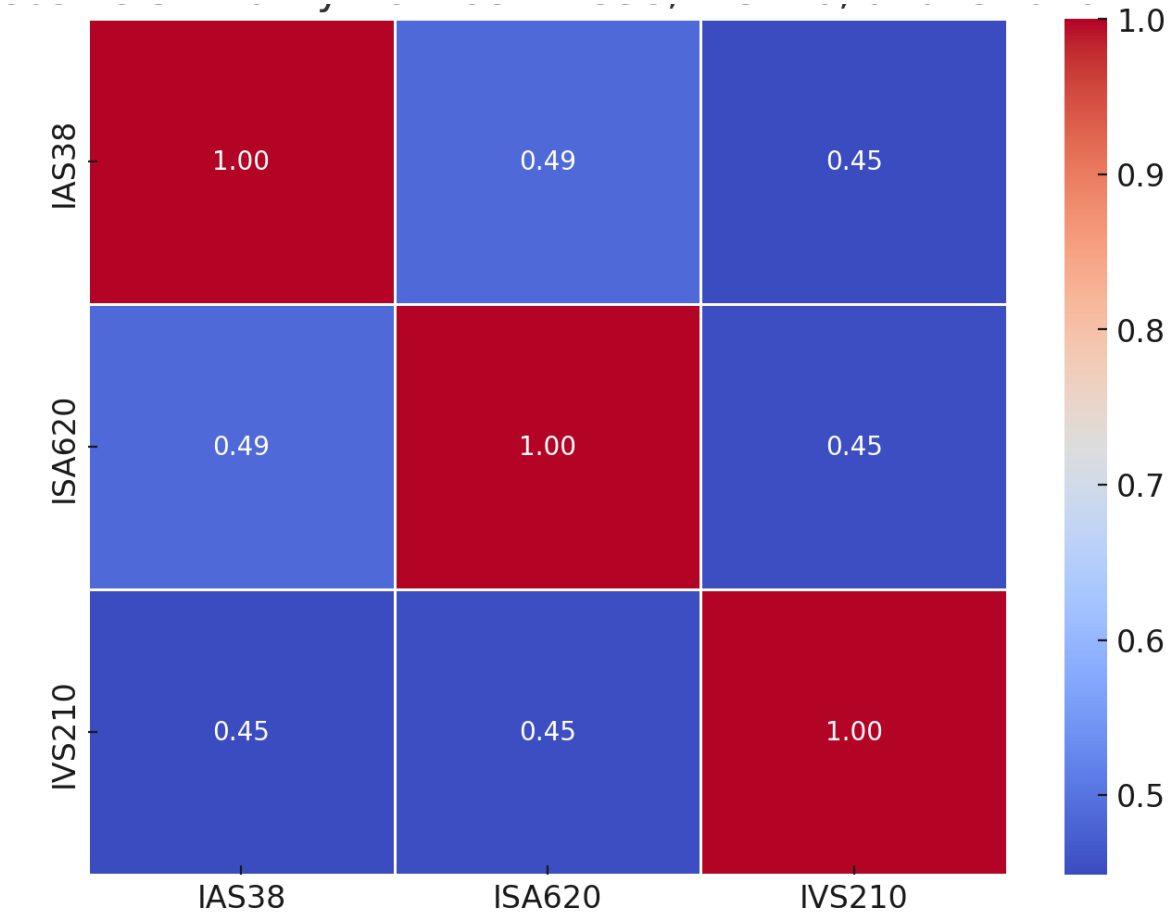
The scatter plot's scaling is relative, and the actual coordinates' values are influenced by the scaling and transformation process inherent in PCA. There are no fixed minimum or maximum values for these coordinates; rather, the spread of the original data determines their range, the standards' documents, across the calculated dimensions.

The application of machine learning techniques in textual analysis has significantly advanced the precision and efficiency of similarity assessments. Scikit-learn's TF-IDF (Term Frequency-Inverse Document Frequency) vectorization transforms textual data

into numerical form, enabling a structured comparison of financial reporting standards. This technique evaluates the importance of words within a document relative to a corpus, ensuring that commonly occurring words do not dominate the analysis while emphasizing key terminologies specific to each standard (Pedregosa et al., 2011;Han et al., 2012). By applying TF-IDF, the study effectively highlights thematic prominence and lexical density across IAS 38, IVS 210, and ISA 620. To quantify the textual alignment among IAS 38, IVS 210, and ISA 620, a cosine similarity analysis was conducted using TF-IDF vectorization and Scikit-learn's machine learning capabilities (Pedregosa et al., 2011). The cosine similarity metric measures the degree of overlap between textual data by evaluating the angle between document vectors. This method is particularly useful in assessing thematic and lexical commonalities across regulatory standards. By transforming each standard into a vectorized numerical representation, the pairwise similarity scores provide an objective measure of textual proximity.

The results of this analysis are presented in the heatmap visualization in Figure 2, where a higher cosine similarity score (closer to 1) indicates a greater degree of textual similarity, while a lower score (closer to 0) suggests significant differences in terminology and thematic focus.

Figure 2 Cosine Similarity Between IAS38, IVS210, and ISA620



Source: Author's work

The results of the similarity analysis reveal notable patterns in the textual alignment between IAS 38, IVS 210, and ISA 620. The similarity score between IAS 38 and IVS 210 indicates a moderate level of textual alignment, suggesting that while both standards address aspects of intangible asset valuation, IVS 210 remains primarily valuation-focused, whereas IAS 38 emphasizes accounting treatment and financial reporting. This indicates an overlapping conceptual foundation but a divergence in technical applications. Similarly, the comparison between IAS 38 and ISA 620 reflects a slightly higher similarity, likely attributed to their shared concern with the review and verification of intangible asset valuation. However, ISA 620 differs significantly as it concentrates on the role of auditors and expert opinions rather than defining specific valuation methodologies. This highlights the distinct function of ISA 620 in validating the credibility of valuation processes rather than prescribing valuation standards.

The lowest similarity score observed between IVS 210 and ISA 620 underscores the fundamental difference between valuation and audit assurance. While IVS 210 provides guidelines for how intangible assets should be valued, ISA 620 focuses on assessing whether those valuations are reliable, emphasizing audit validation rather than valuation principles. These findings indicate that IAS 38 and IVS 210 share more conceptual commonalities in terms of valuation and disclosure, whereas ISA 620 remains distinctly separate due to its audit-specific focus.

Elucidating Standards' Similarity: A Manual Content Analysis Approach processed with/in SPSS

Table 2 contain the results of the SPSS (IBM Corp., 2017) similarity and dissimilarity measures for the binary variables per analysis theme in standard pairs.

Table 2
Comparison Analysis Results on Recognition and Measurement Theme

Binary Variables	**Analysis theme: Recognition and Measurement**		
Measures	*IAS 38/IVS 210*	*IAS 38/ISA 620*	*IVS 210/ISA 620*
Simple matching coefficient*	0.25	0	0.75
Dice*	0.4	0	0
Rogers and Tanimoto coefficient*	0.143	0	0.6
Sokal and Sneath I coefficient*	0.4	0	0.857
Jaccard coefficient*	0.25	0	0
Euclidean distance coefficient**	1.732	2	1
Notes: *Similarity measure; *Dissimilarity measure			

Source: Author's work

In the detailed similarity analysis of the 'Recognition and Measurement' theme presented in Table 2, the binary variable measures were calculated to discern the extent of alignment between IAS 38/IVS 210, IAS 38/ISA 620, and IVS 210/ISA 620. This theme, which includes pivotal elements such as recognition criteria, initial and

subsequent measurement, and R&D costs, forms the foundation of accounting for intangible assets.

When considering measures that primarily focus on the presence of attributes, such as the Jaccard coefficient, the analysis revealed a moderate similarity of 0.25 between IAS 38 and IVS 210, and no similarity between IAS 38, and ISA 620. This indicates a substantial disparity between IAS 38, IVS 210 and ISA 620 in the acknowledgment and quantification of R&D costs, suggesting divergent methodological approaches in the standards.

On the other hand, measures that account for both the presence and absence of attributes, such as the Simple matching coefficient and the Rogers and Tanimoto coefficient, demonstrated a higher degree of similarity between IVS 210 and ISA 620, with values of 0.75 and 0.6 respectively. This reveals a nuanced compatibility in the absence of certain criteria as well as their presence, suggesting a broader congruence in their overall frameworks for recognition and measurement.

The Dice and Sokal and Sneath I coefficients, which balance the importance of present and absent values, showed a more pronounced similarity between IAS 38 and IVS 210 with values of 0.4, indicating a shared perspective in the treatment of R&D. However, these coefficients registered no similarity between IAS 38 and ISA 620, underscoring the stark contrasts in their respective standards.

The Euclidean distance coefficient, a dissimilarity measure sensitive to the absence of shared attributes, corroborated these insights by revealing greater distances between IAS 38 and ISA 620 at 2, and a lesser distance between IVS 210 and ISA 620 at 1. This aligns with the earlier observations of IVS 210 and ISA 620 sharing more in common, potentially due to similar omissions in the standards, than either does with IAS 38.

These measures collectively highlight the intricate dynamics of standard provisions. They underscore the importance of considering both the presence and absence of criteria in the complex landscape of intangible asset accounting, thereby offering a comprehensive view of the standards' alignment and divergence in ensuring R&D accountability and stakeholder protection.

Table 3
Comparison Analysis Results on Disclosure and Reporting Theme

Binary Variables	**Analysis theme: Disclosure and Reporting**		
Measures	*IAS 38/IVS 210*	*IAS 38/ISA 620*	*IVS 210/ISA 620*
Simple matching coefficient*	0.667	0	0.333
Dice*	0.8	0	0
Rogers and Tanimoto coefficient*	0.5	0	0.2
Sokal and Sneath I coefficient*	0.8	0	0.5
Jaccard coefficient*	0.667	0	0
Euclidean distance coefficient**	1	1.732	1.414
Notes: *Similarity measure; **Dissimilarity measure			

Source: Author's work

As indicated in Table 3, in the thematic exploration of 'Disclosure and Reporting' within financial standards, the binary variables highlight how IAS 38 and IVS 210 often align in their disclosure requirements, as evidenced by a Simple matching coefficient of 0.667. This suggests a substantial overlap in the presence of disclosure elements between these two standards, indicating a shared commitment to transparency in valuation methods, useful life estimations, and R&D expenditure reporting.

The Dice coefficient amplifies this observation, with a high score of 0.8, underscoring that not only do these standards have similar disclosure requirements, but also that these requirements constitute a significant portion of their reporting frameworks. This is indicative of a concerted effort by the standards to ensure that valuation methodologies and the expected longevity of assets are clearly communicated.

However, when comparing IAS 38 with ISA 620, the absence of a similarity score across all measures, and the high value of the Euclidean distance coefficient of 1.732, points to a stark contrast between IAS 38 and ISA 620. This divergence suggests that ISA 620's disclosure requirements are either not as extensive or are approached in a fundamentally different manner compared to IAS 38, which may lead to variations in stakeholder interpretation and understanding. Similarly, IVS 210 and ISA 620 show a modest Simple matching coefficient of 0.333 and a Rogers and Tanimoto coefficient of 0.2, indicating some commonalities in their absence of disclosures, yet these figures also reflect notable differences in the standards. The modest score in the Sokal and Sneath I coefficient at 0.5 reaffirms this notion, suggesting that while there are some convergences, there is also a discernible disparity in the reporting obligations under these standards.Interestingly, the Jaccard coefficient for the comparisons involving ISA 620 consistently registers zero, reinforcing the notion that when it comes to the presence of specific disclosure items, ISA 620 diverges significantly from the other two standards. The Euclidean distance coefficient, which serves as a dissimilarity measure, provides a numerical representation of the gaps between the standards, with higher distances indicating greater divergence. A distance of 1 between IAS 38 and IVS 210 is the smallest among the comparisons, denoting closer proximity and a smaller gap in disclosure practices, whereas the distance of 1.732 between IAS 38 and ISA 620 is indicative of a more pronounced disparity, which is mirrored by the distance of 1.414 between IVS 210 and ISA 620.

These findings, encapsulated within the 'Disclosure and Reporting' theme, reveal a complex web of disclosure requirements, where IAS 38 and IVS 210 share a closer affinity, and ISA 620 stands apart. It is important to contextualize the role of ISA 620. While IAS 38 and IVS 210 are standards dedicated explicitly to the treatment of intangible assets, ISA 620 is associated with intangibles indirectly through its guidance on using experts in audits. As such, the mentions of intangible assets within ISA 620 are incidental and not the primary focus, which explains the limited disclosure requirements related to intangible assets when compared to IAS 38 and IVS 210. This nuanced context underscores why ISA 620 exhibits a significantly different profile in the similarity analysis, reflecting its distinct purpose and scope within the financial reporting and auditing landscape. This delineation is vital for understanding the nuances of stakeholder protection and the sufficiency of R&D accountability as prescribed by these standards.

Table 4
Comparison Analysis Results on Valuation of Intangible Assets Theme

Binary Variables	**Analysis theme: Valuation of Intangible Assets**		
Measures	*IAS 38/IVS 210*	*IAS 38/ISA 620*	*IVS 210/ISA 620*
Simple matching coefficient*	1	0.667	0.667
Dice*	1	0.8	0.8
Rogers and Tanimoto coefficient*	1	0.5	0.5
Sokal and Sneath I coefficient*	1	0.8	0.8
Jaccard coefficient*	1	0.667	0.667
Euclidean distance coefficient**	0	1	1
Notes: *Similarity measure; **Dissimilarity measure			

Source: Author's work

For the 'Valuation of Intangible Assets' theme, as indicated in Table 4, measures like the simple matching and Jaccard coefficients, which focus primarily on the presence of attributes, suggest a strong similarity between IAS 38 and IVS 210, with a perfect match indicated by a coefficient of 1. These measures show that where valuation techniques, the use of fair value, and guidance on uncertainty are explicitly mentioned (present), IAS 38 and IVS 210 are in complete agreement.

The Dice and Sokal and Sneath I coefficients, which also consider the absence of attributes, reinforce this alignment, indicating a robust congruence in both what is included and excluded within the standards. This suggests that not only do IAS 38 and IVS 210 share common valuation elements, but they also concur on what is not considered or excluded from their provisions.

The Rogers and Tanimoto coefficient, which gives equal weight to matches on both present and absent attributes, still presents a perfect score of 1 for IAS 38 and IVS 210. This implies that both the presence and absence of valuation elements are harmoniously mirrored across these two standards.

The Euclidean distance coefficient, being a dissimilarity measure, corroborates the similarity findings by indicating no distance between IAS 38 and IVS 210. This indicates a perfect alignment and no divergence in valuation practices as prescribed by these standards.

When considering ISA 620, the moderate values across similarity measures indicate that, while ISA 620 does pertain to valuation through its guidance on the use of experts, it does not match the specificity and focus of IAS 38 and IVS 210 on the valuation of intangible assets. The Euclidean distance coefficients of 1 for comparisons involving ISA 620 align with this interpretation, suggesting a clear but not extreme departure from the other two standards.

In summary, the analysis underscores a nuanced difference: IAS 38 and IVS 210 are tightly coupled in their approach to the valuation of intangible assets, sharing a common framework for both the inclusion and exclusion of valuation elements. ISA 620, while still relevant to the valuation process, operates from a different vantage point, focusing on the auditing aspect and the use of expert valuations, which is reflected in its moderate similarity scores and corresponding dissimilarity distance.

Table 5
Comparison Analysis Results on Audit Considerations Theme

Binary Variables	**Analysis theme: Audit Considerations**		
Measures	*IAS 38/IVS 210*	*IAS 38/ISA 620*	*IVS 210/ISA 620*
Simple matching coefficient*	1	1	1
Dice*	1	1	1
Rogers and Tanimoto coefficient*	1	1	1
Sokal and Sneath I coefficient*	1	1	1
Jaccard coefficient*	1	1	1
Euclidean distance coefficient**	0	0	0
Notes: *Similarity measure; **Dissimilarity measure			

Source: Author's work

The 'Audit Considerations' theme, shown in Table 5, presents a strikingly uniform set of results across all measures and pairings of the standards. With each similarity coefficient measuring at 1 and the dissimilarity (Euclidean distance) coefficient at 0, this suggests an absolute congruence between IAS 38, IVS 210, and ISA 620 in terms of the elements under this theme: risk assessment, the use of valuation experts, and the evaluation of management's estimates.

Given that these measures, whether emphasizing the presence of attributes or a combination of both presence and absence, yield a perfect score, we can infer that these three standards share a completely aligned approach in their audit considerations. This alignment is quite comprehensive, as it does not vary across different types of measures those sensitive only to the presence of attributes and those sensitive to both presence and absence alike.

In interpreting these results, it's essential to note that while IAS 38 and IVS 210 directly address intangible assets, ISA 620 is associated with these assets indirectly through the audit process. Despite ISA 620's broader focus on auditing beyond just intangible assets, the findings indicate that when it comes to audit considerations relevant to intangible assets, ISA 620 fully aligns with the specific provisions of IAS 38 and IVS 210. This might be due to the nature of audit standards, which tend to be more universal and applicable across different areas of financial reporting, including intangible assets.

Thus, these results do not imply that ISA 620 is as detailed or prescriptive about intangible assets as IAS 38 and IVS 210 are; rather, it suggests that where ISA 620 does touch upon intangibles, it does so in a manner consistent with the frameworks established by the other two standards. This consistency is crucial for ensuring the reliability and thoroughness of audits in the context of intangible assets and underscores the interconnectedness of standards when it comes to audit practices.

Table 6
Comparison Analysis Results on Overall Similarity

Binary Variables	**Analysis theme: Overall similarity**		
Measures	*IAS 38/IVS 210*	*IAS 38/ISA 620*	*IVS 210/ISA 620*
Simple matching coefficient*	0.692	0.385	0.692
Dice*	0.818	0.556	0.714
Rogers and Tanimoto coefficient*	0.529	0.238	0.529
Sokal and Sneath I coefficient*	0.818	0.556	0.818
Jaccard coefficient*	0.692	0.385	0.556
Euclidean distance coefficient**	2	2.828	2
Notes: *Similarity measure; **Dissimilarity measure			

Source: Author's work

The overall similarity analysis, encapsulating all the themes pertinent to intangible assets, yields a nuanced picture of the relationships between the standards IAS 38, IVS 210 and ISA 620. The Simple Matching Coefficient, which equally considers matches of both presence and absence of attributes, indicates a moderate similarity between IAS 38/IVS 210 and IVS 210/ISA 620, with scores of 0.692, and a less pronounced similarity between IAS 38/ISA 620, at 0.385.

The Dice coefficient and the Sokal and Sneath I coefficient, which give more weight to the presence of attributes, suggest a higher degree of similarity between IAS 38/IVS 210 and IVS 210/ISA 620, with values over 0.7, indicative of a strong overlap in the characteristics considered in these standards. The Jaccard coefficient, known for emphasizing the presence of attributes without giving weight to joint absences, presents a similar trend but with slightly lower similarity scores.

The Rogers and Tanimoto coefficient, with its balanced emphasis on both present and absent values, shows a relatively lower similarity across all pairings, most notably between IAS 38/ISA 620, where it drops to 0.238, underscoring the differences in their treatment of intangible assets.

The Euclidean distance coefficient, as a measure of dissimilarity, reinforces these findings with higher scores indicating greater divergence, particularly between IAS 38/ISA 620, which scores the highest at 2.828, suggesting the most pronounced differences between these standards.

It is important to consider that IAS 38 and IVS 210 are directly focused on intangible assets, while ISA 620's connection to intangibles is more tangential, reflected in the limited mentions of intangible assets within it. Therefore, the results for ISA 620, particularly in its comparison with IAS 38, must be interpreted with an understanding of its broader auditing scope, which may not delve into the specifics of intangible assets as deeply as the other two standards.

Overall, these similarity measures, with their varying focus on the presence and absence of attributes, provide a composite view of the congruity and divergence among the standards. They underscore the robust alignment between IAS 38 and IVS 210, while also highlighting the relative distance of ISA 620 due to its different purview and indirect association with intangible assets.

Discussion

The results of this paper synthesize the outcomes from both the automated principal component similarity analysis using Voyant tools (version 2.6.2; Sinclair & Rockwell, 2023) and the manual content analysis combined with SPSS (IBM Corp., 2017) statistical processing. Though distinct in approach and depth, these methodologies converge on key insights regarding the alignment and divergence of the standards IAS 38, IVS 210, and ISA 620.

The automated text processing facilitated by Voyant tools (version 2.6.2; Sinclair & Rockwell, 2023) revealed fundamental differences between ISA 620 and IAS 38 as well as IVS 210, particularly highlighting the dissimilarity in textual structure and term usage. This initial analysis served as a stepping stone for a more granular investigation using SPSS (IBM Corp., 2017), which allowed for the nuanced exploration of themes through binary variables derived from content analysis.

In contrast to the broad-stroke differentiation provided by PCA, the SPSS (IBM Corp., 2017) analysis offered a detailed examination of themes such as Recognition and Measurement, Disclosure and Reporting, Valuation of Intangible Assets, and Audit Considerations. This deep dive elucidated the specifics of the standards' provisions, uncovering the extent to which they address R&D accountability and shareholder protection. The SPSS (IBM Corp., 2017) measures indicated a strong thematic alignment between IAS 38 and IVS 210, especially within the realms of valuation and audit considerations, which are critical to the integrity and transparency of financial reporting for intangible assets.

However, the analysis also underscored ISA 620's distinct position. While it is not primarily focused on intangibles, its connection to them through audit considerations is consistent with the frameworks established by IAS 38 and IVS 210, ensuring a holistic approach to intangible asset governance across the standards.

Conclusion

The conclusions drawn from these analyses are multifaceted. Firstly, they affirm the robustness of IAS 38 and IVS 210 in their convergent treatment of intangible assets, suggesting that stakeholders can rely on a coherent framework for R&D accountability.

Secondly, the consistency of ISA 620 with the other standards in audit-related aspects reinforces the reliability of audits concerning intangible assets, despite its broader scope.

It is important to recognize that while automated tools like Voyant(version 2.6.2; Sinclair & Rockwell, 2023) provide a valuable macro view of document similarity, they lack the contextual sensitivity that manual content analysis affords. Therefore, the combination of both methods yields a more comprehensive understanding of the standards' provisions.

The analysis conducted in this paper exposes inherent vulnerabilities within IAS 38, IVS 210, and ISA 620, particularly concerning the uncertainty embedded in managerial judgement and expert evaluations. The provision in IAS 38 that allows for the capitalization of development costs based on a probability threshold opens the door to earnings manipulation, given that managerial incentives can skew the estimations of economic benefits (Dinh et al., 2015a). This subjectivity does not adequately safeguard against over or underestimation, which can be driven by motivations ranging from bonus optimization to tax advantages.

Similarly, IVS 210's (IVSC, 2021) reliance on discount rates for valuing intangible assets introduces an arbitrary element that may not reflect true risk, again inserting a layer of judgement into the valuation process. The standards, while offering a

framework, do not provide a fail-safe mechanism to counter the potential arbitrariness of these estimations.

The challenges extend into the auditing domain, as illustrated by ISA 620. The requirement to seek expert opinions introduces additional costs and raises concerns over the confidentiality of proprietary information (Basu&Waymire, 2008; Ciftci& Zhou, 2016; Hunter et al., 2012). This is particularly relevant when considering the valuation and audit of advanced technologies, such as AI systems. The unique characteristics of such technologies, including their development costs, the expertise needed for their evaluation, and the difficulty in forecasting their generated cash flows, pose significant challenges (Warren & Casey, 2023, 'The Dichotomy of AI: MIT Professor Sandy Pentland Examines Whether It Poses a Threat or Opportunity to Humanity').

These observations are not merely theoretical; they have practical implications. For instance, considering an AI technology's development costs, raises questions about capitalisation and the practicality of finding an expert capable of auditing its complex capabilities without infringing on proprietary rights. Moreover, determining an appropriate discount rate for the projected cash flows generated by AI, and accounting for regulatory risks, presents complex dilemmas that the current standards do not explicitly address.

Therefore, the current standards, despite their intent to enhance accountability and protect stakeholders, fall short when confronted with the complexity and rapid advancement of intangible assets, particularly in the technology sector. Stakeholders are left to navigate a landscape where the standards provide insufficient guidance on practical applications, leaving a gap that could be exploited to the detriment of financial transparency and integrity.

The conclusion of this article, therefore, points to a need for the evolution of these standards. It calls for a framework that can more accurately reflect the risk, value, and uncertainty of intangible assets, especially cutting-edge technologies. Future iterations of these standards should consider incorporating more objective, quantifiable metrics and enhanced guidance to mitigate the subjectivity of managerial judgement and expert evaluations. The goal should be to construct a robust, adaptable framework that can keep pace with innovation and more effectively shield stakeholders from the risks inherent in the valuation and reporting of intangible assets.

Moving forward, these findings imply the necessity for continued harmonization of standards, particularly as the business environment evolves and the importance of intangibles escalates. Future revisions of standards should consider these alignment insights to further strengthen the framework for intangible assets and enhance stakeholder trust.

In conclusion, this paper establishes a clear picture of the current landscape of financial standards as they pertain to intangible assets. It paves the way for ongoing discourse on the efficacy of these standards in safeguarding shareholder interests and the transparent reporting of R&D activities, thus contributing to the broader goal of financial integrity in the global economy.

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About the authors

Andreas Georgiou is a PhD student at the Babes-Bolyai University, Faculty of economics and business administration. He is an economist and accountant mainly active in the submission and implementation of projects funded by EU. Structural funds and other funding tools. His research interests include the evaluation of internally generated intangible assets, specifically hard science patents and software. Also, he is interested in the potential usage of blockchain technology in accounting reporting through the use of distributed ledgers and decentralized validators and real world asset tokenization. Author can be contacted at **andreas.georgiou@econ.ubbcluj.ro**