

Critical Factors for Accounting Estimation of Investment in Artificial Intelligence: an Imperative for Accounting Standards Setters in the Fourth Industrial Revolution Era

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Abstract: The major assets of the 21st century organisations have moved from the company premises to the cloud where the telescopic rules of accounting could not locate them. This study addressed the inadequacies of existing Accounting Principles and Standards in estimating Artificial Intelligence (AI) assets in the era of the fourth industrial revolution. Constant fusion of multiple technologies had substantially altered the nature of organizational non-current assets from tangible (physical) to intangible (non-physical). Assets considered as intangible by existing studies and accounting standards are largely goodwill, patents, trademarks, copyright, customer list etc while AI remains foreign to accounting valuation. The study employed desk-review to identify factors essential for policy review to accommodate further development in AI-accounting domain. The study found Intellectual property, increased investment AI assets, multi-functional savings, privacy infringement, ransoms and law suit among others as crucial for estimating AI assets in the 21st century. Estimating and reporting AI assets still domicile in an uninformative accounting environment. Therefore accounting practitioners, professional bodies, standard-setters, academics and researchers need to recognise and leverage its potential impacts on accounting education and organisational practices. The study concluded that AI assets should be capitalized using simple algorithm to promote the fairness of the financial reports.

Keywords: Algorithm; Intelligent Machines; Intangible Valuation; Financial Reporting

JEL Classification: M41; O32; D04

1. Introduction

“Machines are much better than auditors at processing huge amounts of data,” “With AI and machines, you won’t need to sample — the machine can check all the transactions, which human auditors couldn’t. That’s where the power of the machine is.” – Katsnelson, CPA.Com. (2018).

Accounting as a profession emerged primarily as a result of the need to keep record of business transactions which provide evidence for the transacting parties. Historically, accounting practices are responsive to dynamic changes and necessary transformations making it most suitable in meeting the needs of users. As businesses grew in size and complexity, record keeping, production of financial statements and communication of same became rule-based. The standardization was purposely to ensure consistency in the system of recording, promoting transparency and comparability of financial information across similar businesses. Akinyemi, Okoye & Izendonmi (2015) and Salawu & Moloi (2018) noted the pace at which accounting practices responded to progressive and revolutionary

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innovations from pre-paper era which featured the use of physical materials such as bones of animals, clay, and papyrus, among others for capturing, recording and communicating the results of business transactions. An impressive progress was marked by the invention of paper around 100 BC with the introduction of journal, ledger, and cashbook by Luca Pacioli and managed by business merchants and scribes (Zhangmingwu, 2011; Ovunda, 2015). The invention of computers in the 19th century and subsequent usage of application software transformed accounting practices across business organizations globally with improved reporting and communication of business annual performance (Salawu, 2013; Taiwo & Edwin, 2016; Hanafizadeh, Ghandchi & Asgarimehr, 2017; Financial Reporting Lab, 2019).

Until the 20th century, the assets of businesses have been mostly physical in nature. However, as conjectured by earlier research, the exponential capacity of technological innovation has transformed the nature of the assets of companies from tangibles to intangible (O'Leary & Turban (1987). This has become more pronounced with the recent trends in technological disruption, especially, the use of Artificial Intelligence (AI) to solving complex problems in engineering, science, medicine, business, communications, law, security, video games, hospitals, education, transportation, architecture, climate prediction, aviation, etc. The traditional processes which characterized the 19th and 20th century's organizations had been altered via expert system and by creating intelligent machines and software that mimic human beings in work and reaction (Lecot, 1988; O'Leary, 2015; Shabbir & Anwer, 2015; Kamble & Shah, 2018). This trend as noted by Salawu and Moloi (2018) ushers in the fourth industrial revolution with technological switch from unintelligent Information Technology (IT) to Intelligent Information Technology commonly tagged Artificial Intelligence (AI). Today's valuable assets tend to be more invisible in nature. This explains the reasons for global emphasis on cloud, big data, internet of things, etc.

The disruptive and substantial change in the nature of companies' assets from tangible (physical) to intangible (non-physical) therefore poses a challenge to the established rules and existing accounting standards in the treatment of intangible assets. This is because of the constant fusion of multiple technologies. AI for instance relies on software and is driven by algorithm; it operates efficiently with big data as well as innovatively combines both the human and machine functions for collecting business data, processes and produces business solution as well as communicating business performance instantly to 21st century companies and stakeholders. This advanced innovative system has become notable, irresistible and revolutionary that accounting profession cannot but briskly embrace and integrate. However, the required integration of AI cannot be easily and successfully achieved without due consideration of unique factors originated by AI upsurge.

There is dearth of literature on the factors to consider for estimating artificial intelligence for inclusion in the financial statements of companies. The intangible assets considered by existing accounting standards are largely goodwill, patents, trademarks, trade names, copyright, customer list etc while AI remains foreign to accounting valuation. Most of the existing studies had focused on the impact of IT on the economic performance of organizations (Mahmood & Mann 1993; Lu, Tsai & Yen, 2010; Taiwo & Edwin, 2016); valuation of goodwill (Jahmani, Dowling & Torres, 2010; Abeysekera, Šapkauskienė & Leitonienė, 2014); Intangibles and machine learning (Karimi, Zare'ie & SalwmiNajafabadi, 2013; Tsai, Hung & Yen, 2016). As investment in AI by famous organisations such as Google, Facebook, Intel corporations, Amazon, Apple, IBM, Salesforce, Microsoft, Liveperson, INVIDIA, Axon enterprise, Uber is becoming increasingly heavy, it is equally becoming almost unavoidable for other companies across the major sectors of the global economy including

capital market, manufacturing, finance, education, communications, banking, etc., to invest in AI. It is therefore highly imperative to identify relevant critical factors associated with AI that would guide the practitioners as well as the standards setters in determining appropriate measurements for huge investment in AI. Hence this study.

This study would serve as a guide for identifying the elements of assets and liabilities necessary for the valuation of the component of AI investments by 21st century companies. Professional Accountants, AI compliant auditors, financial analysts, existing and potential investors, the management, tax authority and other government agencies, standard setters as well as other policy makers would find the result of this study as a useful input into policy formulation on AI investment and for accounting recognition in the interest of companies' wide stakeholders. The study is therefore an attempt to contribute to current search for reliable accounting measurement for the increasingly huge investment of AI components by business organisation which is germane to determining the profitability/performance of companies in any financial year. Specifically, it attempts to identify the key factors to be considered by Accounting Standard Setters for valuation of AI assets by companies.

2. Literature Review

2.1. Observable Convergence between Machine (AI) and Human

Basu and Waymire (2008) defined accounting intangible, a subset of economic intangibles as the legally recognized right to exclusively exploit an idea for a defined time period to generate cash inflows. While according to Romer (1990), economic intangibles such as ideas and knowledge (Lucas, 2002) tend to be non-rival; Basu and Waymire (2008) argued that they create value by better use of complementary tangible and intangible assets. Therefore, intangibles do not unilaterally create values without direct or indirect interaction with other tangible and or intangible assets. Necessarily, the role of human, though at a continuously reduced rate is incredibly primal for value creation of AI in any company. Rock (2018) provided evidence on the complementary role of engineers to the intangible knowledge assets of companies in implementing technology and consequently gaining monopsony power. These synergistic complementarities (knowledge and innovation) of intangibles with the tangible assets were arguably responsible for the higher valuations of business organizations in high-income countries (Babu & Waymire, 2008). Rock (2018) demonstrated rapid market value gained by AI-intensive companies in comparison with companies with relatively larger quantity of labour. This according to Rock (2018) could be attained by using job design and partial allocation of firm-specific tasks to employee based on that simple model.

While it is still true that the ultimate control of organisations lies with human being as the initiator and manager, AI is fast assuming a holistic role in which case, machines are found to be more productive and cost-saving than human in virtually all fields of endeavour. As such, the traditional roles of workers in most organizational are to be taken over by robots which according to Graves (2017) can hear, see, walk, speak, read and remember but cannot think like human as yet. With big data, AI offers valuable insight for strategic business decisions through dynamic analytical power. Results provided by AI are more reliable in most instances especially, in programmable activities and in related decisions because, machine would not lie or manipulate results unlike man.

2.2. Potentials in Organisational Investment on Artificial Intelligence

The emergence of artificial intelligence is concomitant with the existing operationalization of information and communication technology within organization. Artificial intelligence according to Shabbir and Anwer (2015) is the property of machines, computer programs and systems to independently perform the intellectual and creative functions of a person, such as solving problems, drawing conclusions and making decisions. However, Wilson and Daugherty (2018) argue that AI would rather complement and augment human capabilities instead of replacing them as concluded by many. This view is based on the premise that human would be central to the successful deployment and sustainability of AI technologies. According to Wilson and Daugherty (2018), such collaborative relationship would ensure reimagining business process; embrace experimentation, enhance responsible data collection, facilitating work redesign to incorporate AI as well as cultivate related employee skills. Although AI would be expected to perform the routine with the advantages of handling large data efficiently and producing results at a rate faster than human, the work of interpreting unprogrammed or unexpected output, training the machine and improving on the functionality of AI would be the responsibility of skill workers.

Companies leverage on AI to improve their products and services either digitally or physically; optimize internal decision-making processes for enabling adaptation in a fluid market environment as exemplified by Amazon; optimizing external business processes for personalized customer interactions with the use of chatbots and intelligent assistants; and bridge the talent gap to achieve cost effectiveness and increased productivity (Davenport, 2018). However, such would require the integration of the existing business infrastructure with AI open source frameworks and tool kits such as cloud services, data reengineering and DevOps as observed by Davenport (2018). The increase in the magnitude of investments in AI by the leading global companies lends credence to the necessity of recognizing artificial intelligence as major assets by 21st century companies.

2.3. Limitations of the Existing Standards and Guidelines in Addressing Investment in Artificial Intelligence

There are no specific guidelines issued by the IFRS for the valuation of the ever growing investment of companies in artificial intelligence as well as other associated intangibles. Recent research had found that a substantial percentage of an organization's value is embedded in its intangibles, either internally generated or acquired (Artsberg & Mehtiyeva, 2010; Abeysekera et al., 2014; Cosmulese, Grosu & Hlaciuc, 2017; Sveiby, 2018). In the fourth Industrial revolution era, the significance of intangible assets had been brought to the fore by the compelling huge investment in AI and other disruptive technologies.

International Accounting Standard 38 had particularly focused on the valuation of intangible assets by companies. However, the standard imposes serious limitation to innovatively generated intangibles within business organisations. Going by the definition of intangible by the IAS 38, the standard has failed to give recognition to unique business secrets and innovative ideas which are not traded in the open market which however serve as the distinguishing success marks for AI driven-companies such as Microsoft, Apple, Facebook, Google, Sony-Ericson, etc. (International Accounting Standard, IAS 38; Artsberg & Mehtiyeva, 2010).

3. Methodology

Online desk research method was adopted for this study in order to gain access to relevant scholarly publications including journal articles, library resources, and company financials, accounting professional publications, relevant Accounting Standards and other online resources in the field of accounting and other fields on investment in AI. The rationale is to identify and provide objective details of the key factors that must be considered by accounting standard setters, accounting professional bodies, accounting firms, academic researchers and other key accounting practitioners in determining the acceptable valuation method for recognizing and reporting investments in artificial intelligence for the purpose of reliability, transparency, accountability and consistency in financial reporting. As a result of the fact that many organisations are still new to the operations and the potentials of artificial intelligence coupled with the challenge of inadequacies that characterize the existing valuation methods of intangible assets, the researchers explored literature to appraise the limitation of the current accounting guidelines and standard for valuing investments of intangible assets which were insufficient for addressing AI assets which constitute the bulk of the overall assets of the technologically-driven companies. With specific reference to Facebook and IBM Watson, the researchers made further efforts to identify the critical features of costs associated with investment in AI assets, some of which are either avoidable or unavoidable.

4. Ai-Driven Operations And 21st Century Companies

4.1. Practical Cases of AI-Driven companies

IBM Watson: IBM Watson was said to have laid off about 80% of its key technical employees who used to work hands-on with the clients from engineering, sales and project management as a result of massive reliance on AI by the company (Strickland, 2018). Its associated new costs for consideration would include cost of hiring new experts as in the case of Apple that had hired 40 to 50 physicians who are meant to guide strategy and decisions as the company moves into healthcare (Paavola, 2018). Other essential costs would include actual or provision for cybersecurity as in the case of Michigan Medical Practice – Brookside ENT and Hearing Center cyber-attack with the required ransom of \$6,500; UCLA Health with \$7.5M as settlement for data breach class-action case; UConn Health patient data breach which exposed the victim to bank fraud (Drees, 2019).

Facebook: The company has made significant investments in innovative technology which cuts across its research and development, sales and operations, marketing, intellectual property among others. Its unique design and creation of mobile devices and applications for social interaction products include Instagram, Messenger, WhatsApp and Oculus. In relation to sales and operations, huge investment made by Facebook include the cost of attracting, retaining and providing support to marketers from pre-purchase campaign to post-campaign analytics, improving the marketers and the developers as well as investment on lease data centers. The intangible investment includes the intellectual property in form of patents, trademarks, copyrights, trade secrets, license agreements, confidentiality procedures, contractual rights, etc. which are valued on the basis of the expected lives of the various products (Facebook, 2015). For Facebook, accounting evaluation of investment in AI need to consider the associated investments in the various intangibles identified by the company.

Artificial Intelligence as an Enabler: As exemplified in the above practical cases, investment in AI would invariably require large capital expenditure because of the risk and returns associated with it.

Only minimal human intervention would be required for companies to achieve their goals. Each of the above practical cases clearly revealed the necessity of human-machine interaction in the operation of AI notwithstanding, *AI deployment would enable business organisations achieve the following:*

- **Value creation via Risk Reduction:** Possibility of expertise attainment and sustainability is another risk reduction achievable by AI. This could take the form of increased consistency in problem solving approaches or capability by the system (AI) as suggested by Willingham and Ribar (1988). Risk documentation and continuous evaluation of the system potentially reduces the chance of future risks;
- **Economics of Production and Innovation:** AI innovation could diffuse to other users and for other uses within the same organisation, outside the organisation to which the benefits diffuse to at little or no cost as argued by O'Leary (2015) on the preposition of Rosegger (1980);
- **Complementary work process integration:** AI not only promotes the achievement of the main objectives of an institution in term of products and services rendered, it also enhances the functionality of all other key functional units including accounting, auditing and finance in an organisation.

4.2. Critical Factors Emanating from AI Operations

The following factors are peculiar with AI deployment and their associated costs need to be carefully and objectively considered for reliable estimation of AI assets to be included in companies' financial reports:

- i. Intellectual Property (IP):** This is a non-rival property that distinguishes the idea generated by one company from the other. The use of AI would induce and promote the production of monopolistic products which would invariably drive competition and the eventual cost reduction. There is need to review and extend the accounting treatment of IP laws to embrace the evolving nature of the new technologies, thus minimizing application complexities;
- ii. Brand:** One of the uniqueness of the AI era is the brand with which the product or services rendered by a company is differentiated from those produced or offered by similar companies. This would also account for coverage in terms of geographical impact, the market share which determines market leadership; quality of product or services etc which combine to determine the revenue of a company;
- iii. Research and Development:** Accounting standards setters need to consider the development of algorithms and the associated human capital as another aspect of research and development cost to be capitalized in this era;
- iv. Sales and operations investment:** Smart client outreach, demand generation, data sourcing and operations intelligence via analytics and machine learning are prominent and emerging trend for portfolio management. Accounting standard setters need to pay attention to the embedded costs of data capturing for reliable investment estimation (Halpin & Dannemiller, 2019);
- v. Synergistic Assets/Income:** This could arise from cost-savings from shared assets in form of % of royalty received from a similar company for benefitting from the cloud resource(s) of another company in the same industry. For example, the arrangement between two telecommunication companies for sharing the use of an existing antenna on a location where no other antenna could be erected to reduce radioactivity for health and safety purpose;

vi. Multi-functional savings: Robots would differ in the level or degree of different functions that could be compressed into it. For a robot that takes the job of 80% of top executive, it has saved more cost than the robot that could only take up the job of line managers or factory workers;

vii. Patents, trademarks, copyrights, trade secrets, license agreements, confidentiality procedures and contractual rights need to be defined for AI deployment;

viii. Cybersecurity: The problem of cybersecurity would be on the increase and this could result in either contingent asset or contingent liability, depending on who is the perpetrator and who is the victim;

ix. Privacy infringement: This would also take on the nature of cybersecurity for the purpose of recognition by companies in their financial statements;

x. Ransoms: This era features ransomware as another cost of doing business which becomes unavoidable cost for recovery when the business activities come to a halt. The experience of the city of Baltimore with an estimated cost of \$18.2 million while the cybercriminal demanded \$76,000 in Bitcoin (Rayome, 2019);

xi. Law suit: There would be increased cases of law suit which would be controllable or avoidable by some companies while for some, it would not. With the huge and increased investments in robotic machines, the management of risk profile would be the responsibility of each company to handle. Specific scenario need to be provided for and possible solution proffered.

4.2. Remedial Clause to Addressing the Limitation of Existing Accounting Standards in Artificial Intelligence Era

Estimating and reporting AI assets still domicile in an uninformative accounting environment. The components of AI includes machine learning, neural network and deep learning which combine to provide data feedback, optimize models, configure management, make continuous delivery of expected result and monitor performance among others. Largely, these components are unlike physical assets. The reality of the revolutionary change in the nature of assets required by the 21st century organisations requires that the limitations imposed by IAS 38 in the treatment of the intangibles which forms a bulk of the new generation companies, be addressed.

In the light of the digital economy of today which is largely based on intangibles, some of the criteria set by IAS 38 for research and development, internally generated brands and goodwill cannot readily offer fair treatment for AI assets estimation. The application of prudence and substance over form come to play here in recognising such investment. In like manner, marketing and administrative cost would be expensed under the current regime of accounting standard, most of such costs now vary in magnitude and could constitute huge investment in AI-driven companies. The nature of the assets have significantly changed while some are obsolete or near obsolescence. Certain costs such as administrative costs would however be expected to decrease in AI-powered companies than in labour-driven companies. In the absence of accounting template for capitalizing the huge AI assets by today's world class organisations such as Apple, Google, Amazon, investments in AI and other related intangibles could be immediately reported by way of enhanced public disclosure of the assets instead of merely expensing huge capital outlay as suggested by GAAP (Lev, 2004). Due recognition and disclosure of AI assets and other associated intangibles would guide the management of R & D spending decision as well as providing possible basis for future company comparison.

5. Conclusion and Recommendations

Increased investment in AI has become part of the 21st century reality. From the current review, it is clear that while companies across major sectors of the economy now embrace AI to leverage on its numerous benefits, the provisions of accounting standards in its current state do not sufficiently address the demand of the fourth industrial revolutions disruptive assets. Having identified various key features that must be considered in assessing AI assets for developing acceptable valuation method (s) necessary to account for huge investment in AI-driven companies which include the expected life, budget, magnitude, capital outlay, the nature, etc. investments in AI and other related technological assets, should be capitalized for the purpose of promoting the fairness of the financial reports. Accounting modellings are technology-friendly, the entire classes of companies' intangibles could be synchronized by a simple algorithm and processed by AI. It is therefore imperative for accounting standard setters, professional accounting bodies, academics and practitioners to align their focus on the important issue of reviewing existing accounting guidelines and standards in response to the dynamic nature and demand of businesses in AI era with special focus on the critical factors identified in this study for objective evaluation of investment in AI assets and towards the fairness of financial statements.

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